2016 Fermi National Accelerator Laboratory Site Sustainability Plan

Fermilab

U.S. DEPARTMENT OF ENERGY | Office of Science

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ACRONYMS USED

AFV	Alternative Fuel Vehicle
BTU	British thermal Units
C&D	Construction and Demolition
CEDR	Consolidated Energy Data Report
CEM	Certified Energy Manager
CERN	European Organization for Nuclear Research
CMS	Compact Muon Solenoid
CO_2e	Carbon dioxide equivalent
DOE	Department of Energy
DUNE	Deep Underground Neutrino Experiment
ECM	Energy Conservation Measure
eGRID	Emissions & Generation Resource Integrated Database
EISA	Energy Independence and Security Act
ELM	Ecological Land Management
EPACT2005	Energy Policy Act of 2005
EPEAT	Electronic Product Environmental Assessment Tool
ESCo	Energy Savings Company
ESPC	Energy Savings Performance Contract
FAST	Federal Automotive Statistical Tool
FCMP	Fermilab Campus Master Plan
FESHM	Fermilab Environment, Safety and Health Manual
FESS	Facilities Engineering Services Section
FIMS	Facility Information Management System
FSO	Fermi Site Office
FY	Fiscal Year
GCC	Grid Computing Center
GHG	Greenhouse gas
GP	Guiding Principles
GSA	General Services Administration
GSF	Gross square feet
HEMSF	High Energy Mission Specific Facility
HPC	High Performance Computing
HPSB	High Performance Sustainable building
IARC	Illinois Accelerator Research Center
ICW	Industrial Cooling Water
ILA	Industrial, Landscaping and Agricultural (water)
Kw	Kilowatt
LBNF	Long Baseline Neutrino Facility
LEED-NC	Leadership in Energy and Environmental Design – New Construction
LHC	Large Hadron Collider
MWH	Megawatt-hour
MINOS	Main Injector Neutrino Oscillation Search
MINERvA	Main Injector Experiment for v-A
MT	Metric ton
$MTCO_2e$	Metric ton carbon dioxide equivalent
NOvA	NuMI Off-Axis Electron-neutrino Appearance Experiment
NuMI	Neutrinos at the Main Injector
OSF	Other Sites and Facilities
OTE	Office, Technology and Education
PC	Personal Computer
PIP	Proton Improvement Plan
PM	Portfolio Manager
PUE	Power Usage Effectiveness
REC	Renewable Energy Certificate
ROC	Remote Operations Center
RF	Radio Frequency
SA	Sustainable Acquisition
SBN	Short Baseline Neutrino
SF_6	Sulfur Hexafluoride
SPO	Sustainability Performance Office
SPOFOA	Sustainability Performance Office Funding Opportunity Announcement
SSP	Site Sustainability Plan
SSPP	Strategic Sustainability Performance Plan
T&D	Transmission and Distribution
UESC	Utility Energy Service Contract
UIP	Utility Improvement Project
UPS	Uninterruptable Power Supply
VAM	Vehicle Allocation Methodology
WUI	Water Use Intensity

I. Executive Summary

Vision Statement

Fermilab has an established track record of integrating environmental stewardship and sustainability with the operation of the facility. This Site Sustainability Plan (SSP) describes progress on 32 Department of Energy (DOE) sustainability related goals. 2015 was a transition year for sustainability goals in response to the release of Executive Order 13693, *Planning for Federal Sustainability in the Next Decade.* The goal summary table below provides a snapshot on status and progress of Fermilab's efforts towards meeting the goals. Goals that are new or in transition are described minimally as Fermilab develops a path forward to address them.

Fermilab is home to more than 2,000 acres of restored ecosystems and conservation of the site's natural areas is institutionalized in the Fermilab Ecological Land Management (ELM) Plan. Fermilab's land and water management practices minimize contamination of the environment, ensure the efficient use of resources to complete the science mission, and conserve biodiversity. The surrounding communities recognize Fermilab as a good neighbor, in part for this attitude towards a common environment. As a facility that is accessible to the public, Fermilab's neighbors are afforded the opportunity to share the natural environment as well as other amenities such as cultural events, lectures and learning opportunities. Additionally, over 17,000 school-age students participate in activities at Fermilab each year providing yet another opportunity to share Fermilab's commitment to sustainability and stewardship of the facility.

Planning synopsis

The Fermilab mission 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 May 2014 Report of Particle Physics Project Prioritization Panel (P5) titled *Building for Discovery* in which the Laboratory's trajectory has been established. The future of science at Fermilab will include international partnerships to construct large-scale, energy intensive experimental facilities unlike any constructed in the U.S. to date.

Fermilab's strategic plan for research dictates increased electrical energy usage following a period of several years' reduced consumption due to the shutdown of the Tevatron and subsequent upgrades to the remaining accelerator complex. While the operation of future high energy mission specific machines are beyond the projections in this plan, future progress on the Long Baseline Neutrino Facility (LBNF) and the Proton Improvement Plan II (PIP II) continue at a fast pace and will be included in future reports. Additionally, in the near term 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.

In FY2015 Fermilab began significant upgrades that will have positive impacts on water and electrical energy efficiencies. A significant portion of aging primary piping that supports Fermilab's industrial cooling water system is being replaced. Additionally, a new primary electrical substation that will step down incoming high voltage power will be completed in 2016. Operating or general plant project funds may also be used to improve operating efficiencies in existing buildings based on building assessments.

Successes and Challenges

Fermilab has consistently developed new technologies to become more efficient. Past experiments have been constructed using salvaged items from across both Fermilab and the DOE complex. The G minus 2 experiment has re-used a large detector salvaged from Brookhaven National Laboratory instead of building a new one, saving materials, limiting pollution and realizing cost savings.

Waste minimization and pollution prevention have been areas of active improvement at the Laboratory for more than two decades. A site-wide recycling program is administered by Fermilab's custodial sub-contractors is consistently diverting well over 50% of municipal waste and construction and demolition waste from landfills. Fermilab has operated a very successful scrap metal program for decades, which has recouped significant savings for the Laboratory over the years, and conserved many tons of virgin metals.

Between 1998 and 2001 five Utility Energy Service Contracts (UESC) and Utility Improvement Projects (UIP) totaling $58M were completed, which resulted in significant improvements to Laboratory infrastructure and energy and water savings. During FY2011 a $3M Energy Savings Performance Project (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.

In FY2014 an ESPC investment grade audit was completed that unfortunately provided only marginal opportunity for energy savings projects. Despite not moving forward with this ESPC Fermilab will continue to assess future opportunities including technology specific measures.

Fermilab relies heavily on capturing and retaining precipitation that falls on the 6,800 acre site in on-site surface water features to provide adequate Industrial Cooling Water (ICW). Water is retained and recycled many times before returning naturally through evaporation to the atmosphere. This practice minimizes the amount of water Fermilab is required to extract from external sources. The Laboratory also supplements the ICW system by capturing and utilizing water from the underground Main Injector Neutrino Oscillation Search (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. Although northern Illinois has an abundance of fresh water available, water management, especially ICW is an

important challenge in managing the Laboratory. Experimental equipment demands large volumes of cooling water to dissipate high thermal loads.

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 7 in this plan illustrates the variability in power needs from year to year, based on mission.

Fermilab' successes notwithstanding, several of the goals from Executive Order 13693 and DOE's Strategic Sustainability Performance Plan (SSPP) are problematic for a site whose mission is driven by the use of large amounts of energy. The Fermilab Site Sustainability Plan for FY2016 and Figure 1 illustrates that more than 90% of our Greenhouse Gas (GHG) emissions in FY2015 were due to electrical power purchases, and most of that power was used to operate High Energy Mission Specific Facilities (HEMSF) that are necessary to produce scientific results, even in a year in which many of the HEMSF facilities were in shutdown mode. Clearly, Fermilab cannot substantially reduce our emissions of GHGs without incurring severe adverse impacts on our planned scientific mission for FY2025 and beyond.

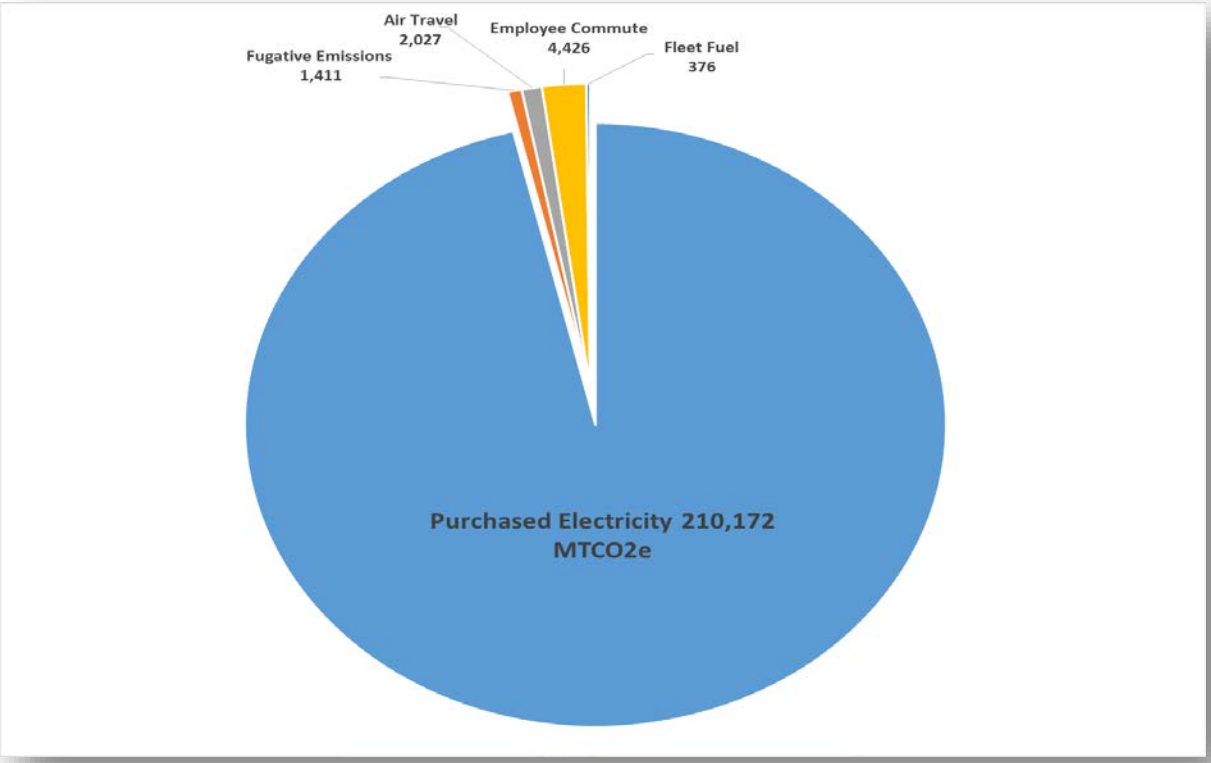


Figure 1. Greenhouse Gas Emissions, Primary Sources.

Table 1 Summary Table

SSPP Goal No.	*DOE Goal*	*Performance Status through FY2015*	*Planned Actions and Contribution*	*Non-attainment Risk*
Goal 1: Greenhouse Gas Reduction				
1.1	50% Scope 1 & 2 GHG reduction by FY 2025 from a FY2008 baseline (2015 target: 19%)	54.8% reduction in FY2015 due to continued gradual accelerator startup.	Use RECs to meet goal as HEMFs increase in 2016.	Low
1.2	25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (2015 target: 6%)	Met goal for T&D losses using RECs	Continue to use RECs to meet T&D losses	Low
Goal 2: Sustainable Buildings				
2.1	25% energy intensity (Btu per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY2025 from a FY 2015 baseline.	29.5% reduction from 2003 Baseline. Current intensity is 90,673 BTU/GSF (new baseline)	Continue to modernize facilities.	Low
2.2	EISA Section 432 energy and water evaluations	Goal met. Entire building complex evaluated two years ago.	Continue with next 4-year audit cycle.	Low
2.3	Meter all individual buildings for electricity, natural gas, steam and water, where cost-effective and appropriate	Goal is met.	Continue to use metering data to evaluate building performance.	Low
2.4	At least 15% (by building count or gross square feet) of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the *revised* Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter.	In FY2015, Fermilab completed an ECM to bring one additional building into compliance with the 2008 Guiding Principles.	Fermilab plans to have 3 buildings 100% compliant with the 2008 GP in FY2016.	High (based on Financial Risks)
2.5	Efforts to increase regional and local planning coordination and involvement	See narrative 2.5.	See narrative 2.5.	Low

SSPP Goal No.	DOE Goal	Performance Status through FY2015	Planned Actions and Contribution	Non-attainment Risk
2.6a	Net Zero Buildings: Percentage of the site's existing buildings above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY2025.	New DOE Goal	See Narrative 2.6	N/A
2.6b	Net Zero Buildings: Percentage of new buildings(>5,000 GSF) entering into the planning process designed to achieve energy net-zero beginning in FY 2020	New DOE Goal	See Narrative 2.6	N/A
2.7	Data Center Efficiency. Establish a power usage effectiveness target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers.	Modified DOE Goal	See Narrative 2.7	N/A

Goal 3: Clean and Renewable Energy

3.1	"Clean Energy" requires that the percentage of an agency's total electric and thermal energy accounted for by renewable and alternative energy shall be not less than: 10% in FY 2016-2017, working towards 25% by FY2025.	New DOE Goal	REC purchases will be used to meet this requirement.	Low
3.2	"Renewable Electric Energy" requires that renewable electric energy account for not less than 10% of a total agency electric consumption in FY16-17, working towards 30% of total agency electric consumption by FY 2025.	Onsite renewable electricity generation is negligible. Used RECs equivalent to 15.7% total energy consumption in lieu of onsite generation.	Continue to investigate potential for onsite renewable electricity generation.	Low (with RECs)

SSPP Goal No.	DOE Goal	Performance Status through FY2015	Planned Actions and Contribution	Non-attainment Risk
Goal 4: Water Use Efficiency and Management				
4.1	36% potable water intensity (Gallons per gross square foot) reduction by FY 2025 from a FY 2007 baseline. (2015 target: 16%)	Exceeded goal	Maintain usage less than 2025 goal	Low
4.2	30% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline. (2015 target:10%)	Exceeded goal	Continue to implement good water conservation measures	Low
Goal 5: Vehicle Management				
5.1	20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter. (2015 target: 20%)	59% reduction since 2005.	Continue to maintain petroleum consumption below baseline.	Low
5.2	10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter. (2015 target: 10%)	61% increase in alternative fuel use relative to baseline.	Continue alternative fuel use below baseline.	Low
5.3	30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY 2025 from a FY2014 baseline. (2015 target: N/A; 2017 target: 4%)	New DOE Goal	Evaluate new fleet purchases	Low
5.4	75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2015 target: 75%)	Greater than 75% light duty vehicles are AFV.	Investigate purchase of diesel hybrid bus and other technologies.	Low
5.5	50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025. (2015 target: N/A)	New DOE Goal	Purchase vehicles as appropriate.	Low

SSPP Goal No.	DOE Goal	Performance Status through FY2015	Planned Actions and Contribution	Non-attainment Risk
Goal 6: Sustainable Acquisition				
6.1	Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts.	Goal is met.	Continue current practices.	Low
Goal 7: Pollution Prevention and Waste Reduction				
7.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris.	68% diverted from the landfill.	Continue current waste diversion strategies.	Low
7.2	Divert at least 50% of construction and demolition materials and debris.	91% diverted from the landfill.	Continues current strategies.	Low
Goal 8: Energy Performance Contracts				
8.1	Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of E.O. 13693.	Most recent ESPC unsuccessful.	Continue to investigate future opportunities.	Medium
Goal 9: Electronic Stewardship				
9.1	Purchases – 95% of eligible acquisitions each year are EPEAT-registered products.	Goal is met.	Continue current purchasing practices.	Low
9.2	Power management – 100% of eligible PCs, laptops, and monitors have power management enabled.	Goal is met.	Continue current computer management strategies.	Low
9.3	Automatic duplexing – 100% of eligible computers and imaging equipment have automatic duplexing enabled.	Goal is met.	Continue current computer management strategies.	Low

SSPP Goal No.	DOE Goal	Performance Status through FY2015	Planned Actions and Contribution	Non-attainment Risk
9.4	End of Life – 100% of used electronics are reused or recycled using environmentally sound disposition options each year.	Goal is met.	Continue current electronics disposition practices.	Low
Goal 10: Climate Change Resilience				
10.1	Update policies to incentivize planning for, and addressing the impacts of climate change.	See narrative 10.		
10.2	Update emergency response procedures and protocols to account for projected climate change, including extreme weather events.	See narrative 10.		
10.3	Ensure workforce protocols and policies reflect projected human health and safety impacts of climate change.	See narrative 10.		
10.4	Ensure site/lab management demonstrate commitment to adaptation efforts through internal communications and policies.	See narrative 10.		
10.5	Ensure that site/lab climate adaptation and resilience policies and programs reflect best available current climate change science, updated as necessary.	See narrative 10.		

II. Performance Review and Plan Narrative

Goal 1: Greenhouse Gas Reduction

1.1 50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline (2015 target: 19%)

Performance Status
This year Fermilab exceeded the FY 2025 goal for Scope 1 and 2 reduction. Emissions for FY2015 were 54.8% lower than the baseline of FY 2008, as reported in Tab 1.2a of the Consolidated Energy Data Report (CEDR). This was primarily due

to the gradual restart of the accelerator complex throughout the year. Scope 2 emissions are much greater than Scope 1 and are due exclusively to purchased electrical power, most of which is used to operate the particle accelerator complex and high performance mission specific facilities (HEMSF, see Figure 2).

Fermilab continues to implement strategies to help minimize Scope 1 emissions through energy conservation and retrofits. Fermilab continues the development of a Campus Master Plan, a central element of which is the movement of personnel into more densely populated, modern, energy efficient facilities and the elimination of old and inefficient facilities accordingly.

Fugitive Emissions

Fugitive emissions occur at Fermilab at several locations. Experiments like SeaQuest use special gas mixtures for particle detection and utilize once-through gas systems. Technical challenges limit the recapture of detector gasses, but flow rates are minimized. A significant contributor to fugitive emissions in the past was SF_6, however, the current inventory of sulfur hexafluoride (SF_6) is limited to small amounts located in various pieces of high voltage electrical distribution equipment at Fermilab and minor amounts in mission-related equipment. The Dilo recovery system described in the FY2014 SSP will continue to be used to recapture SF_6 from equipment requiring maintenance, repair or decommissioning. There have been no losses of SF_6 from these sources.

Plans, Actions, and Projected Performance

Energy use during 2015 remained relatively low due to the continued gradual restart of the accelerator complex throughout the year. The operation of new projects like Mu2e and G minus 2 and an upgrade of the Main Injector to 700kW beam power is expected in 2016-2017, and in subsequent years is expected to steadily increase the demand for electrical power. The chart of "Electricity Projections for Fermilab" (Figure 7) shows that electricity usage in 2025 is expected to increase, along with concomitant Scope 2 and Scope 3 (T&D) emissions. Previously discussed future projects, e.g., PIP-II and LBNF/DUNE are not projected to be operational until after FY2025, due to funding decisions, but when these projects eventually come on line, they will demand significant additional electrical power consumption. Fermilab's projected energy use for 2025 has been substantially modified from the projection in last year's SSP as revised programmatic initiatives and schedules have been developed.

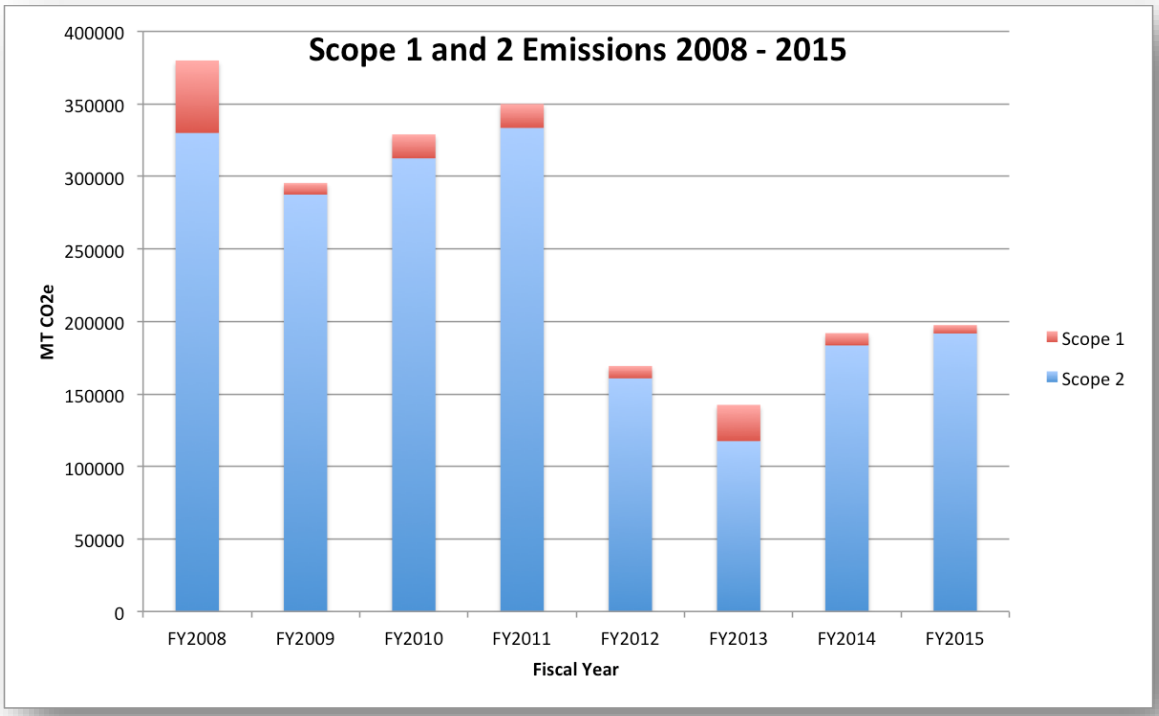


Figure 2. Scope 1 and 2 GHG emissions from 2008 (baseline) to 2015. Reduction from 2008 is approximately 54.8%

Given the energy-intensive nature of the Fermilab mission, it is not currently feasible to reduce the consumption of electrical power to accommodate the reduction in GHG levels prescribed by the SSP goal without compromising the science mission. Fermilab plans to purchase sufficient Renewable Energy Certificates (RECs) to offset emissions of Scope 1, 2, and Scope 3 transmission and distribution (T&D) losses of GHG in order to meet the 2025 goals. Following the schedule in Appendix F of the 2015 SSP guidance, the GHG reduction goal is 19% for 2015-2016, with an ultimate goal of 50% by 2025. Additional RECs will be purchased during FY2016 accordingly (see Figure 3).

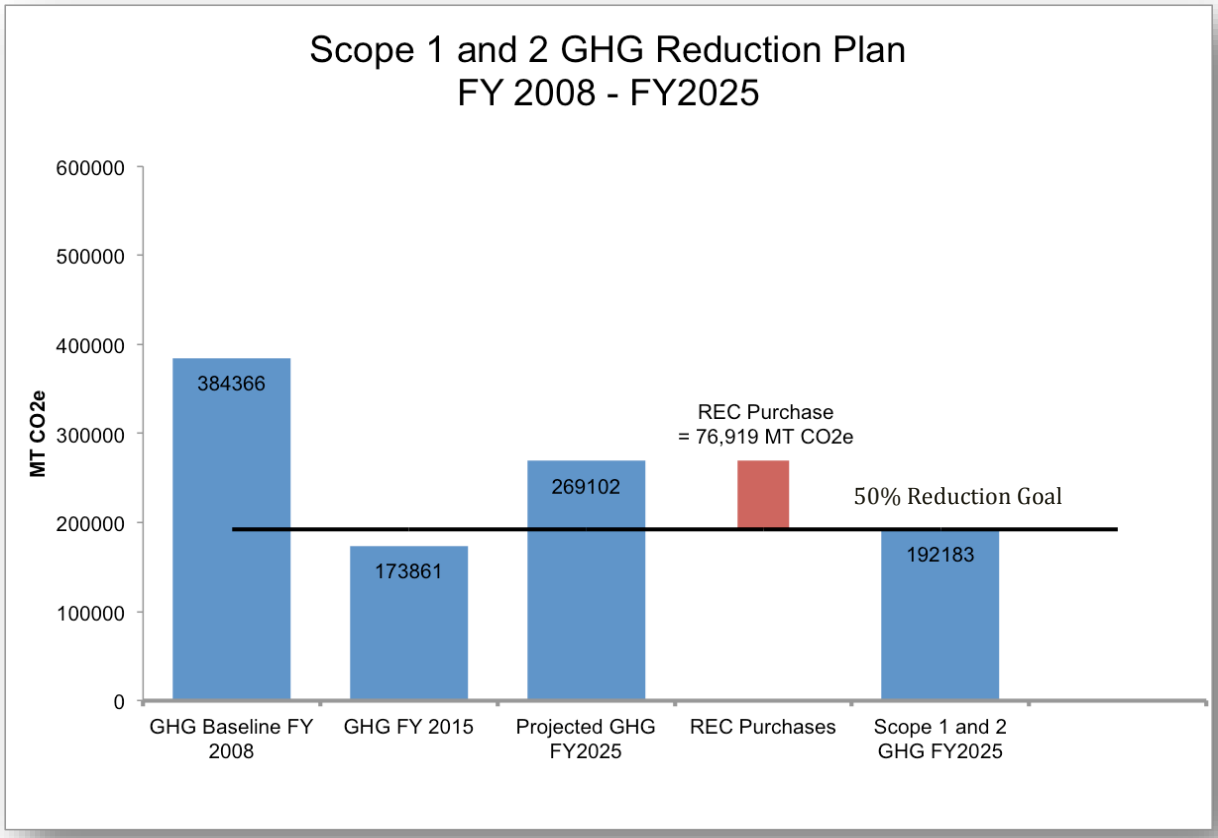


Figure 3. Fermilab GHG Reduction Plan REC Purchases

1.2 25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline

Performance Status

<u>Transmission and Distribution</u>
Transmission and distribution losses associated with purchased electric power are Fermilab's most significant source of Scope 3 emissions (see Figure 4). T&D losses reported in the CEDR are automatically calculated from the Megawatt-hours (MWH) of electricity purchased, using the loss factor of 6.18% from the Emissions & Generation Resource Integrated Database (eGRID) regional standard. However, T&D losses for FY2015 calculated by using actual information supplied by the site's electrical energy provider, Com Ed, and supplier, GDF Suez, were 3.46%. This difference results in reporting 12,630 metric tons of carbon dioxide equivalent ($CO2_e$) instead of 7,071 metric tons, an additional 5,559 metric tons of $CO2_e$ above actual generation emissions.

The eGRID standard is based primarily on low voltage supply to customers with step-down transformer losses occurring prior to their electricity meters. However, Fermilab receives power from the grid at 345kV with no step-down losses before our meters. This results in double counting the T&D emissions because when the eGRID standard is applied, transformer losses are accounted for before (as part of Scope 3 emissions) and again after the Fermilab electricity revenue meter (as part of Scope 2 emissions).

Employee Commuting

The majority of the approximately 1800 Fermilab employees and 15 Fermi Site Office (FSO) employees commute to work by automobile an average distance of 14 miles. Fermilab GHG emissions due to employee commuting have decreased slightly over the last two years from approximately 5,000 to 4500 metric ton (MT) CO_2e/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 2015 they logged 22,147 person-miles commuting to and from work. The Fermilab campus supports a network of bike trails and bike lanes that encourage this mode of alternative transportation.

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 2015, employee airline trips totaled over 10 million miles and accounted for 2027 MT CO_2e. This represents an increase of 8.53% over FY2014, and a 9.15% reduction compared to the baseline year FY2008. Fermilab employees accumulated 64,715 miles from automobile trips from fleet vehicles, rentals and reimbursed trips in personal vehicles. This resulted in the emission of 198.1 MT CO_2e, an increase of 17.3% from the baseline year).

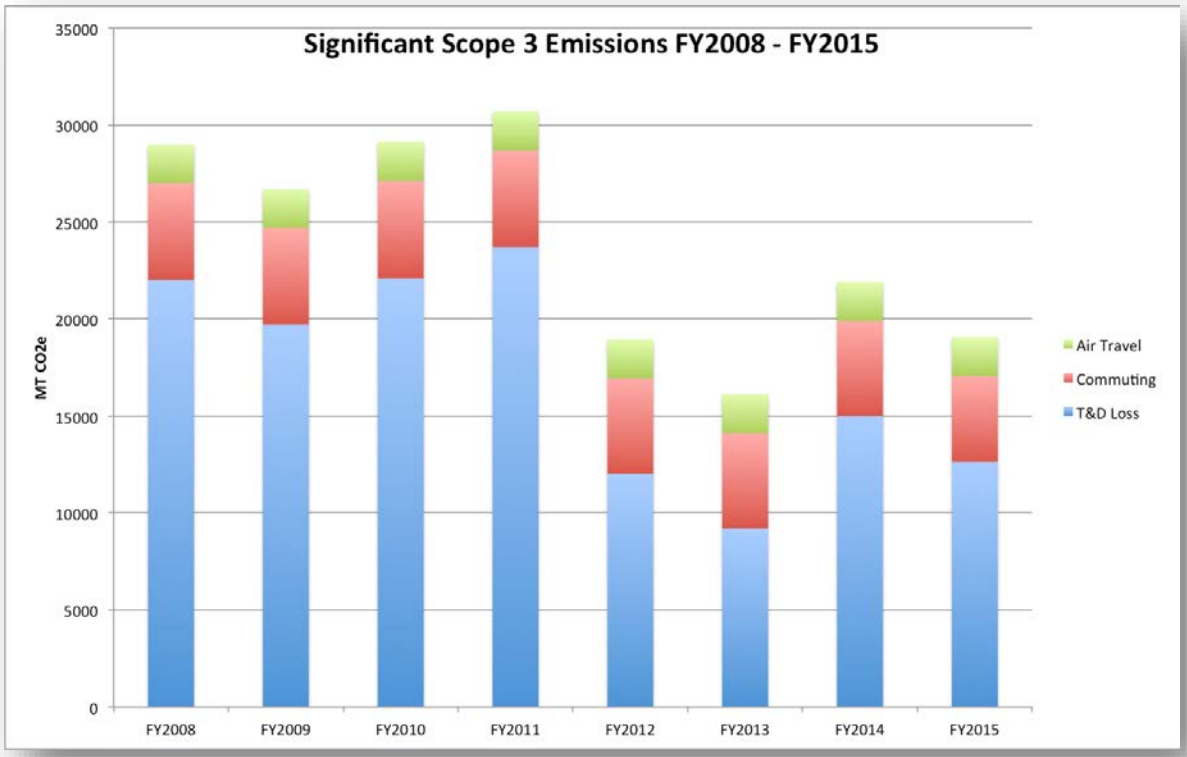


Figure 4. The significant increase in Scope 3 GHG is substantially due to T&D losses, which is a due to the gradual restating of the HEMSF accelerator complex at Fermilab.

Plans, Actions, and Projected Performance

Transmission and Distribution Losses

Fermilab purchased RECs in FY2015 to cover T&D loss emissions calculated using the eGRID standard under Scope 3. Current plans call for Fermilab to increase power usage from FY2016 forward. Barring a way to implement cost effective renewable energy of the scale needed to cover these losses, REC purchases are currently the only identified means to compensate for these losses. Fermilab has not identified any cost effective renewable energy opportunities on this scale, consequently, Fermilab will purchase RECs to cover GHG emissions due to T&D losses in excess of the 2008 baseline calculated, using the eGRID standard under Scope 3.

Employee Commuting

Beginning in October 2014 the regional public transit provider began regular Pace Bus service to Wilson Hall at Fermilab. Pace runs daily shuttle service between the Chicago Metra commuter train station located in Geneva, and Wilson Hall. The shuttle service is coordinated with commuter rail service and includes two early morning trains and three evening trains to provide flexibility for employees choosing to commute by train. Additionally, Pace operates an on-demand *Call-n-*

Ride service that services Wilson Hall whereby employees may call to use the shuttle to travel to the city of Batavia and the train station. Service is available from 6:30 am to 6:50 pm daily.

Employees have been encouraged to carpool and vanpool by registering for GreenRide Connect, an electronic ride board application hosted by Argonne National Laboratory. GreenRide Connect also tracks commutes and calculates greenhouse gas emissions and reductions. To create an incentive to carpool, the Laboratory increased the number of carpool parking spots located at Wilson Hall and the Feynman Computing Center. These spots are located in prime locations encouraging employees to carpool.

In FY2015, Fermilab introduced the Flexible Work Policy. The policy defines and establishes guidelines for voluntary flexible work arrangements. Those arrangements include flexible hours (alternative start and end times) and work location (such as telecommuting). Flexible hours authorizes employees with their supervisor's approval to shorten or lengthen their work days to accommodate varying schedules. The flexible work schedule and telecommuting both reduce the number of employee commuting trips to and from the Laboratory. Fermilab's timekeeping system allows for employees to make note of their participation in this program, but does not require it. During FY2016 a better system to track these hours will be developed.

<u>Business Ground and Air Travel</u>
Fermilab continues to extensively use 38 fully equipped conference rooms to accommodate video-conferencing for a significant number of meetings. Although difficult to quantify many seminars and training sessions are conducted via web-based meeting software and/or tele- and video-conferencing means. Fermilab's latest enterprise the Illinois Accelerator Research Center's Office (IARC) , Technology and Education (OTE) center boasts a new fully video and audio equipped lecture hall that seats 170. The Compact Muon Solenoid (CMS) control room remotely and successfully operates the CMS experiment at the LHC in Geneva, Switzerland. This capability makes many trips to Geneva unnecessary and thereby avoids significant GHG emissions from air travel. Another remote operations control room (ROC West) was completed in late 2014. ROC West will be utilized for operating domestic experiments that are significant distances from Fermilab.

Air travel in FY2015 increased by 8.7% compared to FY2014. The total increase in mileage was approximately 845,000 miles. This correlates to approximately 400 additional, primarily long distance flights. This upsurge is a result of increased collaboration with international and domestic partners. In addition, a small part of this increase is a result of the planned Deep Underground Neutrino Experiment (DUNE) experiment to be located at the Sanford Underground Research Facility in Lead, South Dakota. There were three times as many trips to Lead in FY2015 as compared to FY2014. Air travel to Lead will likely increase as construction of the DUNE experiment is planned to begin in FY2017.

Overall, Fermilab is sustaining almost a 10% reduction in air travel emissions compared to the baseline year.

Goal 2: Sustainable Buildings

2.1 25% Energy intensity (BTU per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY 2025 from a FY 2015 baseline.

Performance Status
Fermilab's current energy intensity of 90,673 British thermal units (BTU)/Gross square feet (GSF) is a 29.5% reduction from the 2003 baseline of 128,599 BTU/GSF as shown on Tab 1.2a of the CEDR. This is slightly below the 2015 goal of 30%. The new base line for Fermilab will be this year's energy intensity value.

During FY2015, 22 buildings, constituting over 45,000 GSF, were demolished as part of the Campus Master Plan to consolidate and modernize our facilities. These structures were primarily old and inefficient and had a negative impact on our energy intensity calculation. The Campus Master Plan envisions the replacement of up to 90 such structures in the future.

Plans, Actions, and Projected Performance
Fermilab worked with DOE to establish a new ESPC with the potential to reduce the energy intensity in goal subject facilities, but was unable to secure a viable contract. Accordingly, all Energy Conservation Measures (ECMs) formerly listed as identified on Tab 3.3a of the CEDR are now shown as cancelled on Tab 3.3b.

Fermilab implemented lighting and water High Performance Sustainable Building (HPSB) retrofits at FIMS #921 – Site 37 facility, lighting upgrades at both FIMS #938 – Warehouse 1 and FIMS #940 – Warehouse 2 with its own funds, as well as various low-cost/no-cost measures in other facilities that helped minimize energy intensity.

Fermilab optimizes reduced fossil fuel usage in its new building designs, per Energy Independence and Security Act (EISA) Section 433, through fuel substitution, assessing renewable energy opportunities, greater equipment efficiencies, and controls strategies.

Fermilab has a new energy manager this year. He is working towards getting the Certified Energy Manager (CEM) certification through the Association of Energy Engineers as required by DOE and participates in sustainability webinars and conferences throughout the year.

Fermilab's goal in this area for FY2016 is to investigate new opportunities to help further reduce energy consumption in goal subject facilities.

2.2 EISA Section 432 energy and water evaluations

Performance Status
Two years ago, Fermilab evaluated the entire 3,464,257 GSF of all of its facilities including Other Sites and Facilities (OSFs). This represents 98.9% of the total 3,503,787GSF of all its energy consuming facilities reported this year, which exceeds the 75% goal of DOE for the current 4 year cycle. This year, desk audits were performed on 332 buildings, which totaled 899,066 GSF.

Fermilab benchmarks all applicable facilities on site using the Energy Star Portfolio Manager (PM).

Plans, Actions, and Projected Performance
Fermilab has exceeded DOE goals under EISA to look for energy and water conservation and retro-commissioning opportunities on site.

Fermilab will continue to complete audits every 4 years so as to meet EISA cycle requirements. All of the facilities on site are considered covered facilities under the EISA Section 432 requirements.

Fermilab continues to track all applicable buildings using the PM. This year Fermilab expanded tracking to 102 of its facilities greater than 5,000 GSF in size in PM with DOE Sustainability Performance Office (SPO) access granted. Of these facilities, 11 fall under standard PM categories and are automatically benchmarked against comparable building performance nationally. One of these buildings, the Grid Computing Center (GCC) has qualified for Energy Star performance recognition. Another building, the Office, Technical and Education building has achieved LEED-Gold certification for new construction.

Fermilab's goal in this area for FY 2016 is to evaluate how best to fund new ECMs.

2.3 Meter all individual buildings for electricity, natural gas, stream and water, where cost-effective and appropriate.

Performance Status
Fermilab has completed the installation of all identified cost-effective metering at the individual building or process level as required under Energy Policy Act of 2005 (EPACT2005). These meters are used for energy diagnostics, emergency response, planning, and reporting. The Laboratory has also used these meters to participate in power curtailment programs that reduce electric costs. Fermilab does not use steam.

Plans, Actions, and Projected Performance
The construction of new facilities, including the OTE building for the IARC, and MC-1 for the Muon Campus, have increased the percentage of utilities metered at the building/process level on site. Most of the unmetered natural gas use at the building level is used in 137 small facilities, many of which are expected to be eliminated under the Campus Master Plan initiative to consolidate operations, and therefore are unsuitable for metering upgrades.

Fermilab will continue to use metered data for benchmarking in PM, verification of utility bills, energy system diagnostics and verification, as well as for participation in power curtailment agreements. Readings from the site's advanced meters provide trending and historical information used to analyze progress on the DOE goals. The site metering plan was updated again this year to reflect changes at the Laboratory and meet the requirements of EPACT2005

There are obstacles to cost-effectively expanding the use of non-electric metering to cover 90% of total site utilities usage by 2015. However, Fermilab will continue to approach this goal as operations are consolidated under implementation of the Campus Master Plan and as new facilities come on line.

2.4 At least 15% (by building count or gross square feet) of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the revised Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter

Performance Status
Two Fermilab buildings currently meet the 2008 Guiding Principles (GPs). The GCC received the U.S. EPA Energy Star certification in FY2015 for the fifth straight year, and currently is in compliance with 100% of the GPs for Existing Buildings. The OTE building was certified as a LEED-NC Gold building on March 11, 2015.

In FY2015, we completed an ECM to meet the existing (2008) Guiding Principles. The Roads and Grounds Shop building at Site 37 is expected to obtain certification as compliant early in FY2016. All existing buildings were assessed during FY2013 and 2014 as part of an ESPC Preliminary Assessment exercise. Due to a number of issues, none of the ECMs identified by the Energy Savings Company (ESCo) were deemed to be viable.

Plans, Actions, and Projected Performance
The total building area at Fermilab is 2,451,419 GSF, which excludes the FIMS OSFs (Research Accelerator Ring/Tunnel and the Neutrinos at the Main Injector (NuMI) Tunnel).

The current budget plan does not make funds available for completing documentation for GP compliance for additional buildings after FY2016. We expect

to have a total of three buildings compliant with the guiding principles by early FY2016, including the GCC, OTE building and Site 37 Roads and Grounds Shop building.

Fermilab 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. New construction other than HEMSFs will meet the GPs. 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 Ozone Depleting Substances in new projects.

It is unrealistic in the current budget climate to expect that sufficient funds will be found to design and implement measures to bring additional existing buildings into compliance with the GPs beyond the three that we have committed to completing by early FY2016. Our ability to attain compliance is further complicated by the fact that revised GPs, mandated by Executive Order 13693 are not yet final, but are expected to be more demanding than those currently in place.

Among the challenges to meeting the GPs 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

2.5 Efforts to increase regional and local planning coordination and involvement

Performance Status

Fermilab enjoys a positive relationship with our neighbors and with the regional planning groups. The Community Advisory Board is an integral part of the planning function at Fermilab, participating in all aspects of Fermilab operations, including sustainability. Fermilab has established partnerships with organizations such as Chicago Wilderness – a regional organization made up of over 260 public and private organizations that work to protect, restore and study local ecosystems.

As mentioned previously in goal 1.2 in the Employee Commuting section, Fermilab contacted Pace, the local mass transit system, and shared data collected from a survey. Pace met with the Fermilab Sustainability Committee members on several occasions and used the survey data to incorporate Fermilab as a regular stop for Pace's new Call-n-Ride bus service. Fermilab has an established relationship with Pace, which facilitates the use of public transportation by Fermilab employees.

Fermilab's Director met with surrounding communities' mayors for advice on making the site more user-friendly for their citizens. As a result, there are more public biking and pedestrian areas available. Fermilab's Community Advisory Board, consisting of citizens and leaders from surrounding communities, has developed improved signage for the public in those areas.

In 2015 the Ecological Land Management Committee added new members from local city, county, state and federal agencies in order to share ideas and add additional expertise in managing Fermilab's environment. Also, the ELM Committee was added as part of the formal review process for all buildings and projects being constructed at the Laboratory.

Plans, Actions, and Projected Performance
There are no plans to modify the relationship Fermilab has with our surrounding communities.

2.6 Net Zero Buildings

Performance Status
Fermilab currently has no net-zero buildings for energy, waste or water.

Plans, Actions, and Projected Performance
Fermilab currently has not yet developed a plan to design to net-zero standards for FY2020. It is unlikely that many future buildings could be designed to that standard because the majority of buildings at Fermilab are HEMSFs, which, by design consume large amounts of energy in order to accomplish the research mission.

The use to which buildings at Fermilab are put (primarily HEMSF), the low cost of conventional electrical energy and sub-optimal meteorological factors make large applications of renewable energy prohibitively expensive.

2.7 Data Center Efficiency

Performance Status
Energy efficiency improvement is a key goal in operating and upgrading Fermilab's existing data centers. Efficiency measures employed include hot and cold aisles, cold aisle containment, 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 Uninterruptible Power Supply (UPS) units with greater than 90% efficiency.

The Power Usage Effectiveness ratings (PUE) for the three data centers are currently in the range of 1.5 to 1.6. The Fermilab was awarded the Energy Star award for data centers in each of the last five consecutive years.

Air management of the computer rooms is a priority for the Laboratory. Plating of the racks empty server positions, and any air penetrations, minimizes the mixing of the cool supply air and the warm return air. Rack plating and cable management within computing racks are integrated into the normal business processes.

Over the past 5 years, Fermilab has dedicated resources to maintain and expand a virtual server service that underpins many of the Lab's business, infrastructure and scientific applications. Migrating workloads from single-purpose physical systems to virtual machines running on a clusters of physical systems we've seen significant savings in network cabling, network switch ports, power distribution networks, physical server hardware, hardware maintenance costs, operating licensing costs, power, cooling, system management and floor space. The savings estimate for these items is more than $2M or about 75% over those 5 years. In addition to cost and resource savings, we've been able to provide shorter deployment times for new systems, improved system backup and recovery options, elastic capacity, no single vendor lock-in and significantly better redundancy for all systems.

Plans, Actions, and Projected Performance

This past year a proposal was submitted through the Sustainability Performance Office Funding Opportunity Announcement (SPOFOA) program to partially fund datacenter energy efficiency upgrades. The upgrade proposal included variable speed fan upgrades for computer room air conditioner units, and smart load balancing controllers for the computer room cooling systems. The return on investment for this upgrade proposal is four years and is part of the solution to reach the 1.4 PUE goal. The proposal was not accepted, and there is consideration to alternatively fund these upgrades.

A computer room at the Lattice Computing Center was retired in July, 2015, making available about 1,100 square feet of space. Since 2011, the total computer room space consolidated is nearly 9,000 square feet. In all cases, the spaces were re-purposed for offices, storage, lab areas or other uses that meet the changing mission of the Laboratory. Fermilab has plans to retire the Lattice Computing Center in 2016 or early 2017, consolidating another 1,800 square feet of computer room space.

Fermilab expects the trend towards virtualization technologies to continue with a greater focus on utilizing client and server-side application virtualization. By virtualizing client software, we hope to allow a broader range of devices, reduce complexity, improve security, simplify license tracking and provide a better end user experience. As we investigate server-side application virtualization technologies, we'll focus on reducing the total number of servers we need to support a given application, decrease the deployment time for applications and provide better isolation for applications.

The Laboratory will continue its stringent maintenance program for peak efficiency of electrical and mechanical computing center systems. The engineering and facility

operations team will investigate potential energy efficiency improvements and emerging technologies for existing and future computer rooms.

Goal 3: *Clean & Renewable Energy*

3.1 Renewable and alternative energy accounts for not less than 10% of total agency electric and thermal energy in FY2016 – 17, working towards 25% by FY 2025

Performance Status
Renewable electric energy produced on site currently amounts to less than 6 MWH/year as listed in Tab 3.2a of the CEDR. The new OTE building (FIMS 328) is heated and cooled by a geothermal well network, which has a design output of 2,015.5 x 10^6 BTU per year.

Plans, Actions, and Projected Performance
Fermilab will continue purchasing RECs to meet the DOE goals each year, until cost effective opportunities for renewable power generation are identified. Planned future procurement of RECs to cover each year's GHG requirement will simultaneously be used to cover the percentages required under this goal.

The application of renewable energy systems is considered in all new construction. Solar hot water heating is regularly assessed, but is difficult to implement cost effectively due to the potential for freezing in the site's climate zone.

Fermilab's goal in this area for 2016 – 2017 will be the purchase of RECs equivalent to the either 10% of the total electric and thermal power consumed on site or the reduction of Scope 1 and 2 GHG emissions from a 2008 baseline following the schedule in Appendix F of the SSP guidance for the 2016 DOE Site Sustainability Plans, whichever is greater.

3.2 Renewable electric energy accounts for not less than 10% of total agency electric consumption in FY2016 – 17, working towards 30% of total agency electric consumption by FY 2025.

Performance Status
Renewable electric energy produced on site currently amounts to less than 6 MWH/year as listed in Tab 3.2a of the CEDR. Fermilab purchased RECs in FY2015 equivalent to 15.7% of the site's total annual electric energy consumption in lieu of onsite renewable energy generation, as documented in Tab 3.2b of the CEDR. The goal was exceeded due to operational uncertainties during the year.

Plans, Actions, and Projected Performance
Fermilab will continue purchasing RECs to meet the DOE goals each year, until cost effective opportunities for renewable power generation are identified. Planned

future procurement of RECs to cover each year's GHG requirement will simultaneously be used to cover the percentages required under this goal.

Renewable energy projects are difficult to implement cost effectively due the high demand for electrical power by HEMSFs, the excessive initial cost, and the relatively low cost for conventional power.

Fermilab's goal in this area for 2016 – 2017 will be the purchase of RECs equivalent to the either 10% of the power consumed on site or the reduction of Scope 1 and 2 GHG emissions from a 2008 baseline following the schedule in Appendix F of the SSP guidance for the 2016 DOE Site Sustainability Plans, whichever is greater.

Goal 4: Water Use Efficiency and Management

4.1 36% potable water intensity (gallons per gross square foot) reduction by FY 2025 from a FY 2007 baseline.

Performance Status
As reported on Tab 1.2a of the CEDR, the 36% goal for potable water reduction relative to a 2007 baseline continues to be significantly exceeded. Domestic water use measured for 2015 represents a 46.7 % reduction relative to the baseline year of 2007. The reduction has been achieved primarily through monitoring and management of leak detection in the large network of onsite water mains. The water management plan to monitor and appraise potable water consumption was updated for this year's analysis.

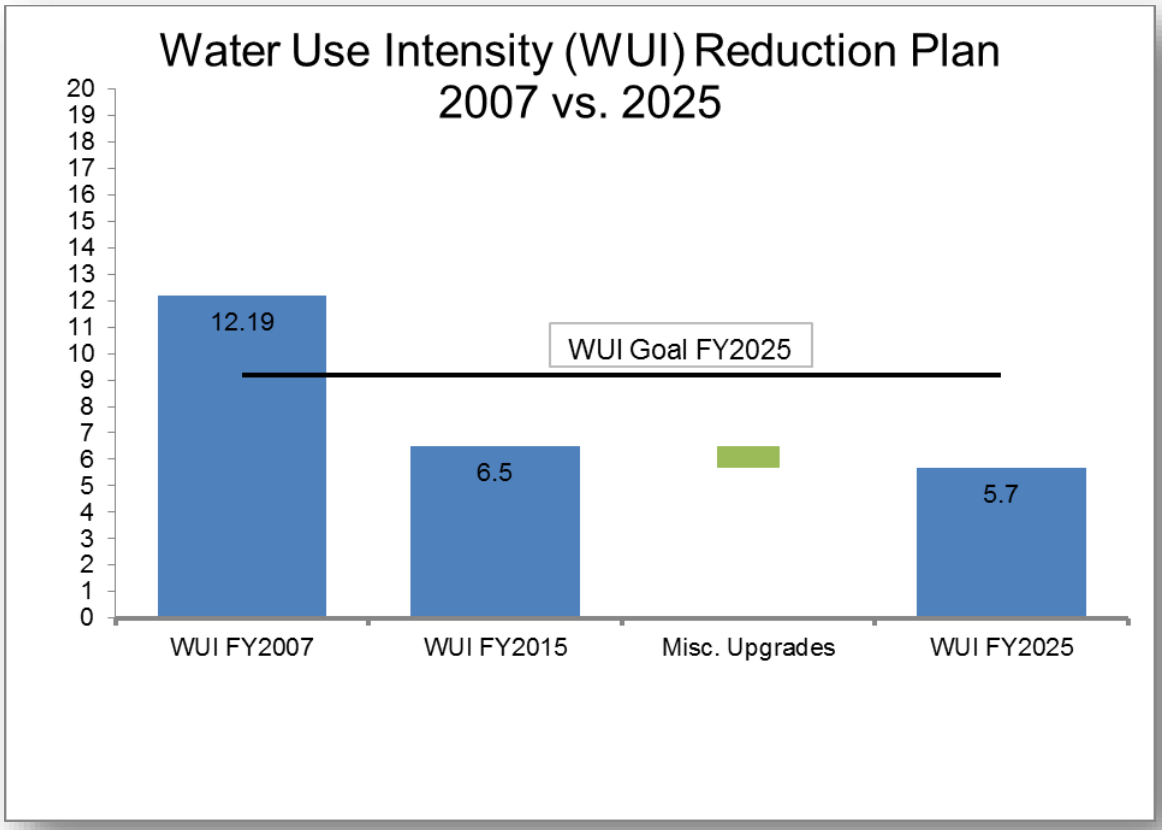


Figure 5. Fermilab Water Use Intensity status and goals. Note: Since the goal is already met, no table of strategies to meet the goal is included for this chart.

Plans, Actions, and Projected Performance
Fermilab has far exceeded this goal and plans to maintain the Water Use Intensity (WUI) level necessary to meet the goal (see Figure 5, above). Fermilab's goal in this area for 2016 will be to maintain the consumption of potable water at a level that exceeds the reduction goal compared to the 2007 baseline.

4.2 30% consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline

Performance Status
Virtually all ILA water used at Fermilab is contained in an Industrial Cooling Water (ICW) system to provide cooling for the accelerator complex. Water for the ICW system is obtained principally from precipitation captured in ponds and ditches throughout the site. In a normal year, precipitation accounts for approximately 78 billion gallons of water, which is not reported in the CEDR. The ICW system volume is supplemented by water captured from the bedrock formation in the tunnel associated with the MINOS facility and injected into the ICW piping, water pumped from the Fox River, and water pumped from a deep on-site well. These

supplemental sources help make up for losses of surface water. Losses are due mostly to evaporation and a small volume that leaves the site through three small tributaries to the Fox and DuPage Rivers during storm events. In FY2015 volumes from these three sources were as follows:

MINOS formation water	56.78 million gallons
Fox River water	6.57 million gallons
Deep well water	900,000 gallons

As reported on Tab 1.2a of the CEDR, ILA water use during 2015 is calculated as the sum of these three supplemental sources, and was 21% lower than the baseline year of 2010. This exceeds the 2015 DOE interim goal of 10% reduction.

Fermilab's ICW system supplies cooling water to the complex through a network of pipes. After passing through a heat exchanger, the water is discharged to surface water and returns to the main reservoir by gravity to be re-used. This system results in the recycling of all cooling water on the site, regardless of source, many times. It should be noted that we obviously have no control over rainfall. The water collected from the MINOS facility is natural infiltration of formation water into the tunnel, so it is also beyond our control.

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 ICW are used during times of drought to water ornamental trees. There is no use of potable or non-potable water for routine landscaping or the irrigation of crops at Fermilab. This practice is formalized by a memorandum from the Head of the Facilities Engineering Services Section (FESS), which includes the Roads and Grounds Department.

Plans, Actions, and Projected Performance
Precipitation that falls on site dominates the water available for industrial use at Fermilab. This water is considered an *alternative water source* and not subject to reduction goals, however, Fermilab will continue to take measures to increase the efficiency of the system in terms of maximizing the recycling of cooling water. Fermilab commenced the "Utility Upgrade Project" in FY2016, part of which will return ICW more directly from the point of use to the main reservoir using piping rather than surface water ditches. The project is expected to be completed during FY2017.

All of Fermilab's ILA water is used to support HEMSF operations. The demand for cooling water cannot be met solely by the capture of storm water retained on site and as new facilities come on line, accelerator loads will inevitably increase and the volume of needed cooling water will rise. Projects such as the Utility Upgrade Project are prohibitively expensive without supplemental funding if the science mission of the Laboratory is maintained.

Goal 5: Fleet Management

5.1 20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter

Performance Status
Fermilab continues to maintain an annual petroleum consumption at a level 20% less than the FY 2005 baseline. This is being accomplished by continuing the current practice of acquiring alternative fuel vehicles (AFVs), using the appropriate alternative fuel and purchasing more fuel efficient vehicles. These efforts have yielded a 59% reduction in petroleum consumption since the baseline 2005 fiscal year, exceeding the 20% target by nearly 200%.

Plans, Actions, and Projected Performance
Fermilab will continue to be diligent pursuing the current petroleum reduction strategy to the maximum extent practical.

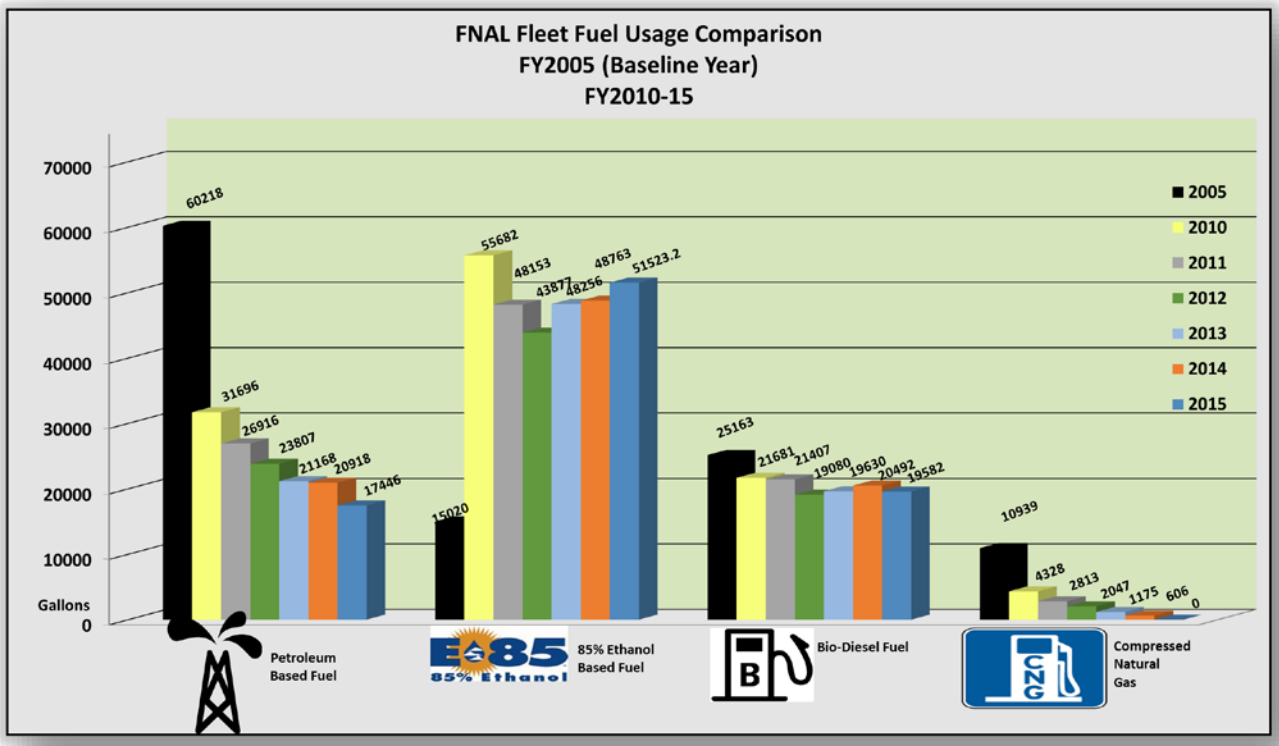


Figure 6. This chart illustrates progress towards implementing greater alternative fuels use.

5.2 10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter

Performance Status
Fermilab continues to maintain our annual alternative fuel consumption at a level 10% greater than our FY 2005 baseline. Increases in the use of alternative fuels is directly related to reductions in petroleum as stated in goal 5.1. These efforts have yielded a 61% increase in alternative fuel use since the baseline 2005 fiscal year exceeding the 10% target by over 600% (see Figure 6).

Plans, Actions, and Projected Performance
Fermilab will continue efforts to reduce petroleum fuel use and increase alternative fuel use by employing proven strategies to right-size the fleet and maximizing the percentage of AFVs.

5.3 30% reduction in fleet-wide per-mile greenhouse gas emissions by FY 2025 from a FY 2014 baseline (2015 target: N/A; FY 2017 target: 4% reduction)

Performance Status
As reported in the Federal Automotive Statistical Tool (FAST), Fermilab's FY 2014 Fleet baseline GHG emissions is 479.36 gCO2e/mile.

Plans, Actions, and Projected Performance
Fermilab plans to meet and/or exceed the 30% reduction by 2025. Efforts towards reaching the target will be accomplished by purchasing new zero emission and reduced GHG emission vehicles, continuing to monitor the utilization of the existing fleet, and replacing older, less GHG emission efficient vehicles with new, more efficient GHG emission vehicles.

5.4 75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV) by 2015 and each year thereafter

Performance Status
Historically and presently, 75% of Fermilab's new light duty vehicle acquisitions are AFVs. Additionally 100% of Fermilab's existing diesel fleet is operating on B20 biodiesel.

Plans, Actions, and Projected Performance
Fermilab is considering the purchase a diesel hybrid bus if available, and other new-technology diesel engines to replace our existing diesel fleet. These actions are expected to reduce diesel fuel use overall.

5.5 20% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by 2020, working towards a goal of 50% by 2025

Performance Status

This is a new goal. Fermilab currently has no zero emission or plug-in hybrids in our fleet.

Plans, Actions, Projected Performance

Fermilab will purchase zero emission or plug-in hybrid vehicles to replace the existing fleet of alternatively fueled or petroleum fueled passenger vehicles as availability allows. Fermilab is currently investigating how to best integrate onsite vehicle charging stations into existing infrastructure. Working with Fermilab's Sustainability Committee, the Laboratory will foster and fund an environment conducive to electrical vehicle use and fueling.

Goal 6: Sustainable Acquisition

6.1 Promote sustainable acquisition and procurement to the maximum extent practicable ensuring BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts

Performance Status
Fermilab maintains an internal website to educate and provide resources to employees on Sustainable Acquisition (SA). The website is regularly updated with new information about SA and links to outside resources such as the General Services Administration (GSA) Green Facilities Tool. The Fermilab stockroom also provides many SA products and continues to look for SA options to include in their catalog as well as eliminate non-environmentally friendly items such as polystyrene coffee cups and soap containing Triclosan. A new stock catalog has also been developed that allows employees to identify "green" products in the catalog. Products with SA qualities are labeled "environmentally friendly."

All employees also undergo SA training, which is supported by the Fermilab Environment, Safety and Health Manual (FESHM) chapter 1100 and requires employees to indicate a preference for SA items. Procurement processes in individual Division/Section/Centers, require that senior safety officers review

purchase orders to determine whether an environmentally preferable alternative is available.

Fermilab contractual language requires that 100% of sub-contracts abide by SA requirements, including biobased procurements. Design guides construction specifications have been adopted that include applicable SA requirements.

Plans, Actions and Projected Performance
Fermilab will continue to apply SA requirements to our procurement policies and practices as appropriate. In 2016, Fermilab plans to pilot a program called I-*Procurement*, an electronic catalog system for procurement of common use items. This system will reduce amount of paper requisitions for several items and will allow employees to order from their desktop, making procurement streamlined and more efficient. All of the SA requirements currently in place will be required by any vendor that supplies Fermilab through i-Procurement. Employees will have a greater opportunity and selection of SA items.

Product level purchasing data is difficult to track and manage, and is currently limited to purchases made directly by the Laboratory. The current decentralized procurement system used at Fermilab requires that individual purchasers, spread throughout the Laboratory, must become aware of the purchasing requirements and spend extra time to seek sustainable alternatives to materials or items that have historically been purchased. The i-Procurement pilot program will help alleviate some of these barriers.

Goal 7: *Pollution Prevention and Waste Reduction*

7.1 Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris

Performance Status
As reported in the CEDR, Fermilab generated 781.2 metric tons of non-hazardous waste, compost and recycled materials in FY2015. 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 531.7 of the 781.2 metric tons (68.1%) were diverted from waste in FY2015. This includes paper, plastic, and aluminum can recycling as well as scrap metal and other items such as alkaline batteries and polystyrene. The Fermilab cafeteria contractor has an established compost program for kitchen scraps that generated 5.4 metric tons taken off site for composting.

Modular office walls and work surfaces are reused through a centralized program. Equipment, such as compressors, dewars, and cables, have been repurposed from the Tevatron for reuse in new experiments by the Accelerator Division.

Fermilab has a mature scrap metal recycling program. In FY2015, 398 metric tons of metal were recycled. Since the July 2000 suspension on recycling metal from radiological control areas, Fermilab has accumulated about 3,000 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. Following recommendations from a review done by the Office of Science of our materials and radiological clearance operations, Fermilab adjusted its clearance criteria for certain materials to align with the strict federal definition of a Radiological Area. This adjustment is expected to allow for the additional release of materials formerly held under the suspension.

Surrounding governmental units and their sub-contractors dispose of their fall leaf refuse on Fermilab's agricultural fields. In 2015, approximately 17,500 cubic yards were composted, and then incorporated into fields as a soil amendment.

In May 2014, the cafeteria food service provider started composting their kitchen scraps, coffee grounds and paper towels. In 2015, 5.4 metric tons of food and compostable waste was diverted from the landfill and hauled to a compost facility.

The kitchen's grease traps are cleaned out every two months and the sludge is taken to an anaerobic digester at either Fair Oaks Dairy Farm in Indiana or the Downers Grove sanitation district. It is mixed with other organic waste as fuel to create electricity. In FY2015, 6.8 metric tons of sludge was converted to energy.

Plans, Actions, and Projected Performance
Fermilab intends to continue aggressive waste minimization programs, including recycling and compost collection in the cafeteria kitchen.

7.2 Divert at least 50% of construction and demolition materials and debris

Performance Status
Construction projects generate construction and demolition (C&D) waste, much of which is available for recycling. Fermilab continues to maintain a series of dumpsters that sub-contractors utilize to dispose of small amounts of C&D wastes. Asphalt is also recycled from roadwork construction. The Roads and Grounds department reuses grindings from pavement replacement work as well. During FY2015, 674.73 metric tons of C&D waste was removed from the site and 91% of that total was ultimately recycled. Construction sub-contract language sets a goal of at least 80% recycling of C&D waste. Sub-contractors are also required to document recycling amounts of recycled materials.

Plans, Actions, and Projected Performance
Fermilab will continue to assess the recycling efficiency to ensure more effective recycling and reuse of materials during all design, construction and maintenance activities.

Goal 8: Energy Performance Contracts

8.1 Energy Performance Contracts

Performance Status
Over the last 15 years, Fermilab has completed 6 UESC (formerly called UIP) and ESPC projects valued at nearly $60 million. Last year, Fermilab worked with DOE to secure a viable ESPC to help meet the DOE goals but it was unsuccessful. This process revealed that there is marginal opportunity for alternative financed energy savings projects.

Plans, Actions, and Projected Performance

Fermilab will continue to assess future opportunities including technology specific measures.

Goal 9: Electronic Stewardship

9.1 Purchases – 95% of eligible acquisitions each year are EPEAT-registered products

Fermilab has a long track record of purchasing EPEAT registered products. In 2015 over 95% of eligible acquisitions each year were EPEAT-registered.

9.2 Power management - 100% of eligible desktops, laptops, and monitors have power management enabled

In 2015 100% of eligible PCs, laptops, and monitors had power management enabled. All monitors connected to non-exempt computers have power management enabled and are centrally managed. All non-exempt desktops and laptops have the majority of the power settings enabled. However, some old hardware does not behave properly when put into sleep mode. An ongoing refresh of old hardware is underway that will improve the adaptation of the sleep setting.

9.3 Automatic duplexing – 100% of eligible computers and imaging equipment have automatic duplexing enabled

At Fermilab 100% of eligible computers and imaging equipment have automatic duplexing enabled. All managed print devices are default 2-sided. Plotters or special purpose printers cannot be defaulted to duplex settings.

9.4 End of Life – 100% of used electronics are reused or recycled using environmentally sound disposition options each year

Fermilab continues to manage electronics no longer needed effectively. One hundred percent of used electronics are reused or recycled using environmentally sound disposition options each year. All electronic equipment was either transferred, donated or recycled by a certified recycler.

Goal 10: Climate Change Resilience

10.1- 10.5 Update policies to ensure planning for, and addressing the impacts of, climate change.

In FY2015 Fermilab continued an ongoing effort to understand and incorporate potential future impacts due to climate change to the facility and operations. In 2014 the Laboratory completed at DOE's request the extreme weather screening assessment. This was done by identifying impacts to infrastructure and operations due to past events. In particular, over the last decade Fermilab has been impacted by severe weather related to the following:

- *Extreme flooding:* Fermilab has been affected more than once by rain events producing excessive precipitation over short periods of time. Fermilab accumulates precipitation that falls on the site in lakes and ponds to be used for operational cooling. However, during extreme rain events, systems can become overwhelmed and infrastructure impacted. Impacts in the past have included significant water damage to low-lying buildings, inundation of the sewage piping system, minor disruptions on site power distribution and flooded roads.
- *Drought and heat: O*ver the last decade three periods of summer-time drought conditions have jeopardized the ICW system and required additional measures to maintain adequate cooling water. At no time however was the cooling supply at levels that required curtailment of operations.
- *Snow/ice Storms:* Fermilab was impacted both by a single blizzard event that produced record snowfalls regionally that resulted in a shutdown of the Laboratory and record seasonal snowfall that impacted the Laboratory through the duration of the winter of 2013-14. In these cases significant effort went towards keeping infrastructure operational including clearing the Laboratory's 36 miles of roads, parking lots and sidewalks.

The types of extreme weather impacting Fermilab in the recent past align with projected future concerns for the Midwest as described in the National Climate

Assessment. Both near term and long term challenges persist that may impact operations due to climate change.

Fermilab will seek to incorporate climate change resilience into future operational plans. In the near term a Utilities Upgrade Project that commenced in 2015 addresses anticipated future demands on the ICW supply and an upgrade to the Laboratory's high voltage distribution system. Improvements will include replacement of aging backbone piping of the cooling water system, upgrades to a water supply well to provide make-up cooling water in the event of shortfalls from other sources, and the replacement of Fermilab's master electrical power substation.

Fermilab has developed a Campus Master Plan (FCMP) that seeks to consolidate and combine Laboratory operations and functions into a vibrant interconnected facility. This 20-year transformative plan for Fermilab specifically includes the *Guiding Principles* that address sustainable design, environmental stewardship and greater accessibility to pedestrians and cyclists. The proposed improvements provide benefits that reduce the impacts of climate change on operations. The plan is structured around three themes.

> Consolidation – The FCMP would significantly reduce the number of buildings on site and up to 90 structures may be eliminated. Structures being eliminated include those that are prone to flooding, or are outdated and inefficient. A series of trailer portacamps currently outfitted as offices are a priority for elimination. In addition to being inefficient and antiquated, they are more easily impacted by the extremes of severe weather.
>
> Centralization – The FCMP seeks to interconnect facilities around strategic hubs based on similar operational functions, with Fermilab's main building Wilson Hall serving as an anchor. A more centralized campus would reduce on-site vehicular use by minimizing the need to travel around the site encouraging more pedestrian and bike use.
>
> Modernization – Advanced design and construction practices will provide opportunities to incorporate many elements of sustainable design, including features better adapted to climate change, such as buildings engineered to accommodate greater fluctuations in temperature and improved stormwater management.

As a single-purpose facility dedicated to particle physic research, Fermilab has had limited opportunities to partner with outside entities concerning the impacts of climate change. However, Fermilab has established partnerships with organizations such as Chicago Wilderness – a regional organization made up of over 260 public and private organizations that works to protect, restore and study local ecosystems. Fermilab actively engages the local community concerning present and future operations through our Community Advisory Board. The Laboratory has also

coordinate with local emergency response organizations and have mutual aid arrangements in the event of catastrophic events that include severe weather. Future local planning for the impacts of climate change will require an ongoing interaction between Fermilab and the surrounding area community.

In FY2014, members from DuPage County emergency management agencies toured Fermilab as a potential base camp for the Chicagoland area for future emergency operations related to weather and other disaster scenarios.

Modernizing Programs

Fermilab will use planning documents such as the FCMP to provide direction for future infrastructure investments. The FCMP is grounded in progressive design concepts that encourage a sustainable approach to modernizing the facility that include fostering climate change resilience.

Conducting Risk or Vulnerability Assessments

Fermilab has not pursued specific climate vulnerability studies on operations, however planning activities consider risks due to climate change as appropriate based on anticipated climate change impacts.

Organizing Resources to Address Climate Change

As indicated in the "Climate Change Adaptation Screening Assessment", the potential impacts of climate change on Fermilab operations are incremental to weather-related variation typically experienced. These impacts are principally due to intensified storm and/or drought conditions. Fermilab has not assigned this responsibility to a single individual or organization, although responding to these conditions typically falls under the responsibilities of the Facilities Engineering Service Section and the Accelerator Division.

III. Fleet Management Plan

Fermilab maintains an ongoing effort to monitor and oversee fleet utilization. Many years ago senior management appointed a committee made up of representatives from the major organizations of the Laboratory to develop and review fleet utilization on a quarterly basis. The committee's primary objective is to establish criteria and practical units of measurement relevant to yearly utilization standards for the entire fleet. Factors considered include operational need, daily work assignments, miles driven, types of use, cost and related conditions. The committee has been instrumental in our right-sizing efforts over the past 25 years and is very diligent and serious about their role in determining the necessity for vehicles. In this current right-sizing effort, the committee has reviewed each fleet vehicle to provide an impartial look at mission criticality.

Characterization of the Fleet
The vehicle fleet consists of 168 DOE owned and 25 GSA leased vehicles (193 total). The average age is 6.55 years per vehicle. Fermilab has replaced an average of 13 vehicles per year over the last 10 years.

Vehicle Type	Fleet
E85	116
Gas Hybrid	12
B20	37
Gasoline	28

Utilization of Vehicles
The Fermilab campus is 6,800 acres with infrastructure spread out among various locations. In support of mission need, technicians assigned to the various projects and experiments at Fermilab require vehicles to drive from one service building to another to measure, diagnose, troubleshoot, fabricate, and inspect components and apparatus. Physicists and engineers may also be required to inspect their projects and adjust or calibrate devices at their locations.

Typical facility support personnel activities include snow removal in the winter, maintaining roads and grounds all year, moving heavy equipment with tractor/trailer combination units, delivering mail and small packages, heating and air conditioning maintenance and repair, water and sewer system maintenance, telecommunication system maintenance and repair, natural gas system maintenance and repair, etc. Vehicles are required to support the Laboratory environment, safety, and health program: transport hazardous and radioactive materials; environmental monitoring; instrument installations, calibrations, and exchanges; on-site radiation surveys; construction inspection, fire protection and emergency coordinator activities. Emergency service departments have specialized vehicles assigned to them to respond to fires, injuries, hazardous spills, and security issues. All of these vehicles are mission critical.

Fermilab reviews the fleet on a quarterly basis and based on the reviews, determine if the current fleet is the right size for the high energy physics research being performed at the Laboratory. Many factors are considered in the review process as described in the Utilization of Vehicles component of this plan. Fermilab has been informed that a contract has been established with a vendor to perform a Vehicle Allocation Methodology (VAM) for the DOE fleet(s). Although we have some reservations regarding a contractor reviewing our fleet, Fermilab will cooperate in supplying data to this vendor and will consider the results and recommendations.

IV. Funding

Performance Status
There is no currently funded sustainability-related research being conducted at the site for demonstration or implementation purposes. Fermilab is a single purpose high-energy physics Laboratory. However, within these constraints, sustainability continues to be an important consideration in Laboratory operations.

Summary of Sustainability Funding ($K)

Category	FY14 Actual	FY15 Actual	FY16 Projected
Sustainability Projects	0.0	160.0	0.0
ESPC/UESC Payments	164.7	171.5	179.5
Renewable Energy Credits Cost	59.4	21.5	19.1
Total	224.1	353.0	198.6

Plans, Actions, and Projected Performance
The only planned Sustainability project currently is the renovation of the Roads and Grounds Shop building at Site 37 (reflected in the table above). The goal is to bring that building into 100% compliance with the Guiding Principles of HPSB. ESPC payments are from a sustainability project completed in 2011. Fermilab plans to purchase RECs in order to offset Scope 2 and the T&D loss portion of Scope 3 GHG emissions, as well as in lieu of renewable energy projects on site. There are no other planned sustainability projects with funding at this time.

The Environmental Policy at Fermilab includes the commitment to "Incorporate the philosophy of sustainability in all our activities wherever, and to the maximum extent, consistent with our mission". During FY 2012, a Sustainability Committee was formed to investigate potential approaches to making Fermilab more sustainable. The committee meets monthly and is chaired by the Head of the Office of Campus Strategy and Readiness, directly under the Chief Operations Officer. A sustainability website was launched in 2013 that highlights our initiatives and actions we have taken, and that encourages employees to document their own sustainability success stories. We are constantly looking for ways to increase the effectiveness and energy efficiency of our operations. There are currently significant plans underway in the areas of sustainable acquisition, and new design standards for new construction and major renovation are being implemented lab-wide.

A primary barrier to progress is Fermilab's status as a single purpose laboratory, which means that many of our efforts are peripheral to our overall mission in particle physics research. A related barrier is the nature of the research itself. As

stated elsewhere in this report (see especially Section V on HEMSFs below), the research requires the use of large amounts of energy to obtain experimental results.

V. Electrical Energy and Cost Projections and High-Energy Mission-Specific Facilities (HEMSFs)

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:

<u>Particle Accelerators</u>
These include accelerators, detectors and support facilities (including power and cooling) for the laboratory's multi-stage accelerator complex consisting of the Radio-Frequency Quadrupole Unit, Linac, Booster, Recommissioned Recycler and PBar Facilities, Main Injector, and Tevatron. The Tevatron completed its mission and was permanently shut down in 2011, but ongoing research and other activities will continue in many of its facilities for the foreseeable future.

In FY2014, 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 - 203 & 204),
- Booster Gallery (206),
- MC-1 facility (209),
- MuCool facility (210),
- Linac, Cross-Gallery,
- Transfer Gallery (212),
- Central Utility Building (214),
- A0 facilities (216, 217 & 218),
- Accelerator Service Buildings (220 – 267 & 283,
- Refrigeration facilities (299 – 322 & 324),
- Collider Detector Facility (323),
- D-0 Assembly Building (325),
- Office, Technical, Educational facility (328),
- Meson facilities (402, 404, 406, 408, 410, 412, 414, 418, 426, 428, 430, 434),
- KTeV/NM4 facility (630),
- Cryo Module Test Facility (702),
- Main Injector facilities (708, 710, 712, 713, 715, 720, 730, 731, 739, 740, 750, 752, 760 & 762),
- SciBooNE facility (714),
- NuMI (765) facility,
- MiniBooNE facility (780),

- MINOS facility (785),
- LArTF facility (787),
- CHL facility (851),
- Master Substation (854),
- Kautz Road Substation (860),
- Research Accelerator Ring/Tunnel, and,
- NuMI Tunnel (OSF).

High Performance Computing

High performance computing (HPC) facilities includes 3 HPC clusters consisting of 1117 individual HPC servers housed primarily in one existing facility designated as "excluded" under the FIMS identifiers in parentheses: the HDCF Grid Computing Center (628).

Experiments like those at the 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.

Future Accelerators

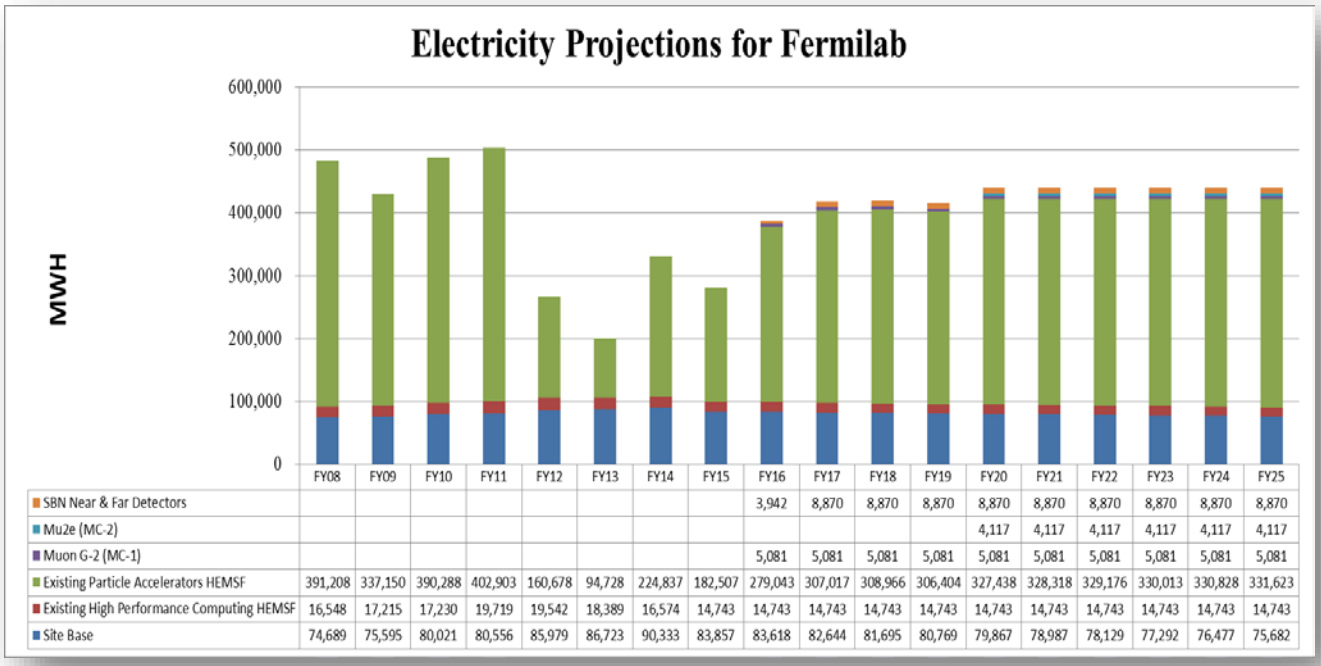
New experiments and facilities are anticipated to come online through FY2020 as Fermilab pursues the Five Drivers of Science for High Energy Physics. However, funding constraints have pushed back the schedule again for new HEMSF facilities and reduced anticipated annual electrical power needs.

In the mid-term, a new Muon Campus will support new muon experiments by reducing costs and capitalizing on synergies. The new Muon g-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.

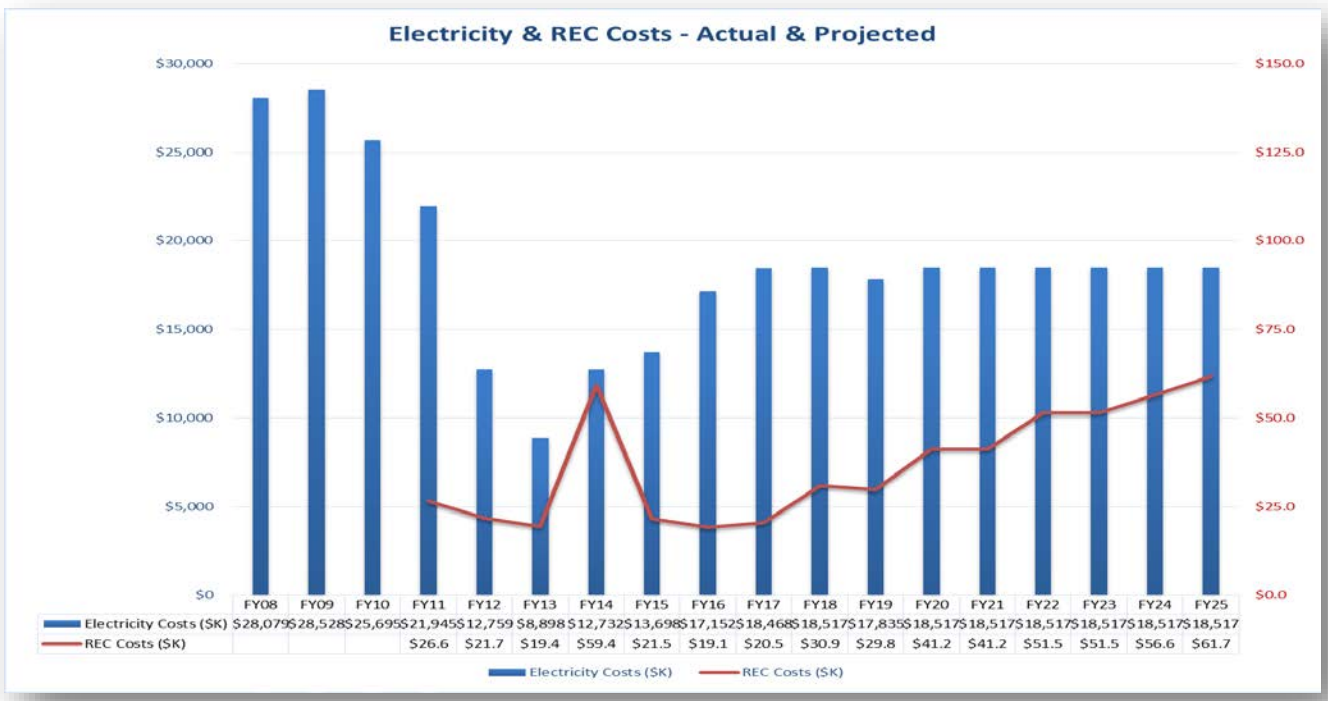
Figure 7 represents the anticipated effects on Fermilab electricity usage through FY 2025 from the following HEMSF activities and Figure 8 represents expected costs for electrical Power and RECs over the planning period.

- FY 2016 – Startup of the new Muon g-2, and the discontinuation of Minos+, Minerva, and SEAQuest
- FY 2017 – Startup of the new Muon Campus, running of the Main Injector at 700kW beam power, and startup of SBN Far & Near detectors
- FY 2018 – Discontinuation of MicroBooNE and the Holometer
- FY 2019 – Startup of the new Mu2e



	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25
SBN Near & Far Detectors									3,942	8,870	8,870	8,870	8,870	8,870	8,870	8,870	8,870	8,870
Mu2e (MC-2)													4,117	4,117	4,117	4,117	4,117	4,117
Muon G-2 (MC-1)									5,081	5,081	5,081	5,081	5,081	5,081	5,081	5,081	5,081	5,081
Existing Particle Accelerators HEMSF	391,208	337,150	390,288	402,903	160,678	94,728	224,837	182,507	279,043	307,017	308,966	306,404	327,438	328,318	329,176	330,013	330,828	331,623
Existing High Performance Computing HEMSF	16,548	17,215	17,230	19,719	19,542	18,389	16,574	14,743	14,743	14,743	14,743	14,743	14,743	14,743	14,743	14,743	14,743	14,743
Site Base	74,689	75,595	80,021	80,556	85,979	86,723	90,333	83,857	83,618	82,644	81,695	80,769	79,867	78,987	78,129	77,292	76,477	75,682

Figure 7.. 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 square foot, and estimated percentages of metered process loads not specifically identified as HEMSF or applicable support system facilities, such as enterprise computing facilities.



	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25
Electricity Costs ($K)	$28,079	$28,528	$25,695	$21,945	$12,759	$8,898	$12,732	$13,698	$17,152	$18,468	$18,517	$17,835	$18,517	$18,517	$18,517	$18,517	$18,517	$18,517
REC Costs ($K)				$26.6	$21.7	$19.4	$59.4	$21.5	$19.1	$20.5	$30.9	$29.8	$41.2	$41.2	$51.5	$51.5	$56.6	$61.7

Figure 8. Site Projected Electrical and REC costs without inflation.

Appendix A – Self Certification Submittal (separate attachment)

Fermilab's Excluded Buildings List and Self-certification is provided separately to DOE.

Appendix B – Metering Plan

Fermilab FY2016 Metering Plan for DOE (December 4, 2015)

This Fermilab plan is the FY2016 annual update developed in response to DOE metering goals that exceed Federal requirements by requiring 90 percent of electricity, natural gas, steam, and chilled water to be metered. The Federal requirements are based on EPAct 2005 Section 103, EISA 2007 Section 432, and EO 13693 Section 3. The "DOE Federal Building Metering Guidance" issued November 2014 is used to determine the metering priority at each facility as outlined in the template provided.

Summary of Existing Metering Infrastructure Survey Findings

Fermilab began its use of advanced site-wide electric metering in 1988 with the initial installation a Square-D based SCADA system on its 13.8kV electrical feeders. This system was funded through DOE's In-House Energy Management (IHEM) program as a retrofit project. Since that time, the system has been greatly expanded as part of new projects built over the years.
System operation and maintenance is provided by the Facilities Engineering Services Section out of its annual operating budget. Data analysis is performed routinely by electrical operations personnel, accelerator operations personnel, engineering personnel and energy management personnel using information distributed from remote monitoring workstations located in each of Fermilab's two 345kV substations (MSS & KRS) and in the main accelerator control room (MCR). The Fermilab survey submitted to DOE in response to its "Data Call for DOE Advance Metering Plan due July 7, 2006/ Program SC- Site Electric Metering Inventory" found that 10 FIMS line-items encompassing 39 key installations were metering 93% of the site's power usage that is required to be monitored under EPACT guidance.

This metering has allowed Fermilab to effectively participate in curtailment programs offered by its electric utility companies which have occasionally reduced its electric bill significantly. Other applications at the site have included energy use diagnostics, power quality, emergency response, and planning and reporting. Fermilab decommissioned its Tevatron accelerator in September 2011, which affects many of its support buildings on the site. Until a further use is found for these facilities (if ever) they have been characterized as vacant for screening purposes.

Description of How the Site will use Metered Data

The uses of data to be obtained from the meters installed under EPACT per the DOE Building Electric Metering Guidance reflected in this plan, plus others needed to meet the HPSB goal and new meters now routinely installed in new construction, are as follows:

Name of Building from FIMS data base	FIMS Property Sequence Number	Energy Use Diagnostic	Emergency Response	Planning & Reporting
Wilson Hall & Auditorium	1	X	X	X
MI 31 Service Bldg. E-Cool	731	X	X	X
Industrial Center	806	X	X	X
Industrial Building #1	800	X	X	X
Industrial Building #2	801	X	X	X
Industrial Building #3	804	X	X	X
Industrial Building #4	805	X	X	X
Acc Rings	Rpt 20	X	X	X
Booster Gallery East & West	206	X	X	X
Accelerator - Linac, X-Gallery	212	X	X	X
Feynman Computer Center (FCC)	003	X	X	X
NML (LCC)	700	X	X	X
Central Utility Building	214	X	X	X
WBL (GCC)	628	X	X	X
Central Helium Liquefier	851	X	X	X
Industrial Building #3A	808	X	X	X
Science Education Center	005	X	X	X
PPD Office Buildings at CDF	326	X	X	X
PPD Office Buildings at D-0	327	X	X	X
MI 8 Service Building	708	X	X	X
Low Level Waste Handling	840	X	X	X
Site 37 Shop	921	X	X	X
Site 38 Maintenance	922	X	X	X
Site 39	926	X	X	X
Receiving Warehouse #1	938	X	X	X
Receiving Warehouse #2	940	X	X	X
CMTF	702	X	X	X
LArTF	787	X	X	X
MINOS Service Building	785	X	X	X
Mini BooNE Detector	780	X	X	X
OTE (2015)	328	X	X	X
MC-1 (2015)	209	X	X	X
MC-2 (2016)	TBD	**Future**	**Future**	**Future**

Building energy and water use data for advanced and standard meters will be uploaded to Portfolio Manager on a monthly basis.

Summary of the Site-wide Building Metering Practicability Screenings

Fermilab has completed its building level natural, chilled water, and water meter screening for feasible on the site (no steam is used) using the latest utility costs. The screening process used the latest electric power costs. Currently all identified cost effective metering installations have been completed. This year the percentage of total electricity delivered to the site metered at the building/process level is at 98%. This percentage is anticipated to rise when accelerator operations increase in subsequent years. The percentage of natural gas and water remains below 90% due to the limits of cost effective installations now being in place.

Installation Schedule for New Advanced Meter Applications

New advanced meters for energy and water will continue to be installed in all new facility construction.

Fermilab is currently upgrading its Industrial Cooling Water (ICW) infrastructure to replace aged piping and equipment and to prepare for the increased capacity required for increasing accelerator loads in the upcoming years. The short term focus for the metering plan is to meter approximately 20 of the highest ICW use buildings. Reducing ICW use to what is required in these buildings will reduce pumping energy, reduce make-up water demand from wells or the Fox River, and allow the system to retain its capacity to cool the accelerator on hot days. The list of buildings is complete, however the installation priority is currently being compiled.

Site Metering Financing Plan

Implementation costs for design, procurement, and installation of metering system hardware and software have been completed with the use of Laboratory funds.

Site-wide Metering Program Support Requirements

Currently, the Laboratory's support staff for the existing site-wide SCADA system and site building meters is all that is needed to ensure the continued operations, maintenance and analysis of the metering system under this plan and its data.

Staff Accountable for the Completion of Program Activities

- Timothy Meyer (Fermilab Chief Operating Officer)
  Accountable for financing and oversight

- Randy Ortgiesen (Associate Lab Director for Operations)
  Accountable for implementation oversight

- Kent Collins (Section head for Fermilab Facilities Engineering Services)
  Accountable for design, procurement, installation, operations and maintenance

- Andy Martens (Fermilab Energy Manager)
  Accountable for annual metering plan reviews and updates, data analysis and annual reporting to FEMP on metering program progress

List of Values, Variables and Site Criteria Used to Develop the Plan

- Simple Payback Requirement: 10 years
- Installation Cost for Each New Meter: $6,000 default or actual cost
- Annual Metering Cost for Each New Meter: $300
- Annual Electricity Cost Savings: 2.5%
- Annual Vacant Facilities Btu/sf: 16,000
- Annual Warehouse Btu/sf: 21,000
- Annual Standard Buildings Btu/sf: 109,047
- Annual Lab & Industrial Btu/sf: 221,190
- Annual Metered Process Btu/sf: 350,411
- Annual OSF Btu/sf: 1,338,418
- Latest Power Cost per kWh: $0.039