Argonne NATIONAL LABORATORY

ARGONNE NATIONAL LABORATORY

Site SUSTAINABILITY Plan

FY 2014

blogs.anl.gov/greenlab

U.S. DEPARTMENT OF ENERGY

Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

ARGONNE NATIONAL LABORATORY

Site SUSTAINABILITY Plan

U.S. DEPARTMENT OF ENERGY

Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

Argonne NATIONAL LABORATORY

Table of Contents

List of Acronyms v

Executive Summary vii

Performance Review And Plan Narrative 1

1.0 Greenhouse Gas Inventory and Reduction and Energy Conservation 1
- 1.1 Scope 1 & 2 Greenhouse Gas Inventory and Reduction 1
- 1.2 Scope 3 Greenhouse Gas Reduction 4

2.0 Buildings, ESPC Initiative Schedule, and Regional & Local Planning 7
- 2.1 Energy Intensity Reduction 7
- 2.2 Energy and Water Evaluations 9
- 2.3 Metering 9
- 2.4 Cool Roofs 9
- 2.5 High Performance Sustainable Buildings - Existing Buildings 10
- 2.6 New Construction - Guiding Principles 11
- 2.7 Regional & Local Planning 12

3.0 Fleet Management 15
- 3.1 Alternative Fuel Consumption 15
- 3.2 Petroleum Consumption 16
- 3.3 Alternative Fuel Vehicle Purchases 16
- 3.4 Fleet Reduction 16

4.0 Water Use Efficiency and Management 19
- 4.1 Potable Water Reduction 19
- 4.2 Industrial, Landscaping, and Agricultural (ILA) Water 21

5.0 Pollution Prevention and Waste Reduction 23
- 5.1 Solid Waste Diversion 23
- 5.2 Construction & Demolition Debris Diversion 24

6.0 Sustainable Acquisition 25
- 6.1 Necessary Provisions in Procurements Documents 25

7.0 Electronic Stewardship and Data Centers 27
- 7.1 Data Centers & Electronic Stewardship 27
- 7.2 Power Utilization Effectiveness (PUE) 27
- 7.3 Electronic Stewardship – Power Management 28

8.0 Renewable Energy 29
- 8.1 Annual Electricity Consumption from Renewable Sources 29

9.0 Climate Change Adaptation 33
- 9.1 Goal 1: Improve the Understanding of Climate Change Effects and Impacts 33
- 9.2 Goal 2: Improve Understanding of Climate Change Vulnerabilities and Risk 33
- 9.3 Goal 4: Improve the Climate Resiliency of all DOE Sites 34

Table of Contents, continued

Site Innovation 35

Management and Funding 37

Electrical Energy Projections and High-Energy Mission-Specific Facilities (HEMSFs) 39

Utility Costs 43

Tables

Table 1: FY 2014 Sustainability Goals, Status, and Plans viii
Table 2: Scope 3 GHG Reduction Strategies 4
Table 3: ESPC Energy Conservation Measures, Energy Savings, and Cost Savings 8
Table 4: FY 2013 Energy, Water, and Cost Savings for In-House Program 8
Table 5: High Performance Sustainable Building Plan 10
Table 6: Future Expected HPSB Compliant Argonne Buildings 11
Table 7: Renewable and Clean Energy Projects 29
Table 8: Renewable Energy Credit Purchases 32
Table 9. Funding Summary, FY 2013 - FY 2015 37

Figures

Figure 1: Scope 1 and 2 GHG Emissions Performance and Goal (1,000s MT/FY) 2
Figure 2: GHG Emissions, Scopes 1, 2, and 3 Reduction Plans, FY 2008-2020 2
Figure 3: Scope 3 GHG Emissions Performance and Goal (1,000s MT/FY) 5
Figure 4: Energy Intensity Ratio (kBtu/GSF) for Goal-Subject Buildings 7
Figure 5: Total Number of HPSBs, Actual (through FY 2013) and Projected (DOE Goal: 15% by 2015) 10
Figure 6. Fuel Type Consumption Year by Year 15
Figure 7: Water Consumption, FY 2013 19
Figure 8: Potable Water Intensity Reduction Actual vs. Target, FY 2013 (Annual Million Gallons/GSF) 19
Figure 9: Potable Water Intensity Reduction Plan, FY 2013 20
Figure 10: Industrial Water Consumption (Mgal) 22
Figure 11: Solid Waste Diversion 23
Figure 12: Argonne Sustainability Organizational Chart 38
Figure 13: Location of Argonne HEMSFs 39
Figure 14: Site Electricity Consumption with HEMSFs (excluding PUE for HPC), FY 2008-2020 40
Figure 15: Utility Consumption, FY 2013 43
Figure 16: Utility Costs, FY 2013 43
Figure 17: Energy Breakdown, FY 2013 (MBtu) 44
Figure 18: Site Electricity Consumption FY 2003-2013 44

List of Acronyms

AHU – air handling unit
ALCF – Argonne Leadership Computing Facility
APCF – Advanced Protein Crystallization Facility
APS/CNM – Advanced Photon Source/Center for Nanoscale Materials
ATLAS – Argonne Tandem Linear Accelerator System
AWS – alternative work schedule
C&D – construction and demolition
CD-2 – a stage in a Department of Energy project review process
Btu – British thermal unit
CHP – combined heat and power
EISA – Energy Independence and Security Act
Gal – gallon
GHG(s) – Greenhouse Gas(es)
GP(s) – guiding principle(s)
GSA – General Services Administration
GSF – gross square foot
HEMSF – high-energy mission-specific facility
HPSB – high-performance sustainable building
ILA – industrial, landscaping, and agricultural
KBtu – thousand British thermal units
Kgal – kilogallon
LEED – Leadership in Energy and Environmental Design
LOM – laboratory/office module
MSW – municipal solid waste
MT – metric tons
MT/FY – metric tons per fiscal year
NECPA – National Energy Conservation Policy Act
PUE – power utilization effectiveness
R-30 – insulation level rating
REC – renewable energy credit
SA – sustainable acquisition program
SCADA – supervisory control and data acquisition
SSP – Argonne's Site Sustainability Plan
SSPP – DOE's Strategic Site Sustainability Plan
T&D – transmission and distribution
TCS – Theory and Computing Sciences building
VFD – variable frequency drive

Executive Summary

Argonne's GreenLab Initiative: Turning Ideas into Action

At Argonne, we work to create a more sustainable world by developing new green technologies with the potential to revolutionize the way energy is generated, stored, transported and used, all around the world. We also work to promote sustainability right here on our own campus, by finding effective ways to reduce our greenhouse gas emissions, cut down on energy use, and make our buildings greener and more efficient.

As leaders in our nation's sustainability efforts, we present our world-leading research at scientific conferences around the world. We also reach out to students, teachers and community leaders, to share our experience and expertise and to encourage everyone to think more sustainably. Our sustainability website further expands that outreach, offering resources that organizations and individuals can use to guide their own sustainability projects and initiatives.

Our experience here at Argonne demonstrates that thoughtful sustainability initiatives can have a real impact. For example, through our water conservation plan, we have reduced our potable water intensity on campus by 32%, and we are almost halfway to our 2020 goal of reducing Scope 1 and 2 greenhouse gas emissions by 28%.

That's a great start, but we still face real challenges in our quest to meet our sustainability goals. For example, the addition of high performance computing facilities has led to an overall increase in the lab's energy consumption. Scientific innovation drives the growth of our computing facilities; however, consolidation and improved configuration of data centers poses significant challenges. Also, a solid commitment to retrofitting all campus buildings to ensure the safety, comfort, and baseline energy efficiency competes for resources to transform select facilities to the highest-performing HPSB standards. Also, while Argonne is working to implement complex, long-range solutions, sustainability program funding is facing a decrease by 20% going into FY 2014.

To counter challenges like these, Argonne funds sustainability programs through innovative sources including Energy Savings Performance contracts and a campus reinvestment program. Argonne also uses a three-pronged approach in determining the feasibility of sustainability solutions by evaluating cost effectiveness, environmental impact, and educational and outreach value. With our FY 2014 sustainability plans (Table 1), we will continue to pursue sustainability excellence and innovative solutions to the challenges we face.

FY 2013 Argonne Sustainability Highlights:

1. The energy savings reinvestment program generates more than $1 million in annual energy and water savings.

2. Preliminary design for a new Combined Heat and Power (CHP) plant has been completed. The CHP will be the laboratory's main source of steam for district heating, generating 5.8 MW of electricity as a by-product and reducing GHG emissions by more than 35,000 metric tons.

3. Scope 1 and 2 greenhouse gas (GHG) emissions were reduced by 13% from the FY 2008 baseline, due in large part to an aggressive program that reduces fugitive sulfur hexafluoride (SF_6) emissions.

4. Scope 3 GHG emissions are down 6% from the FY 2008 baseline, due in part to reduced business travel emissions.

5. Facility Energy Intensity reduction is on track with a 25% decrease since baseline FY 2003.

6. Argonne exceeded all fleet management goals by increasing use of alternative fuels, reducing the number of fleet vehicles, and increasing the use of neighborhood electric and biodiesel vehicles.

7. Argonne reduced potable water intensity by 32% through a site-wide cooling water recirculation program, yielding annual savings of $43,375.

8. Industrial water consumption has been down by 17% for the last two years, saving more than $10,000 per year.

9. Argonne added 60 polycrystalline panels to its solar PV array — the solar farm was installed in FY 2012 — to increase energy output from 95kW to 109 kW.

10. Argonne held two Sustainability Workshops for Middle School and High School Teachers to teach educators about sustainable technologies, infrastructure, and conservation methods so they can teach the next generation about these topics within their classrooms. Educators from across the Chicagoland region, including teachers from Chicago Public Schools, participated in the program.

Table 1: FY 2014 Sustainability Goals, Status, and Plans				
Argonne SSP Goal	**DOE Goal**	**Argonne's Performance through FY 2013**	**Argonne's FY 2014 Planned Actions & Contributions**	**Risk of Non-attainment**
Goal #1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory				
1.1	28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline; 2013 target: 17%	13% reduction	CHP plant; energy efficiency projects; ATLAS will reduce SF_6 use after FY 2013; continue REC purchases	Medium
1.2	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline; 2013 target: 4%	On target: 6% reduction but high risk going forward due to increased T&D losses	Increase use of videoconferencing; continue to expand employee green commute participation and alternatives; T&D reduction through on-site power generation	High
Goal #2: Buildings HPSB, ESPC Initiative, Regional and Local Planning				
2.1	30% energy intensity (Btu per GSF) reduction by FY 2015 from a FY 2003 baseline; 2013 target: 24%	On target: 25% reduction	CHP plant, In-house energy efficiency projects; steam loss reductions; APS lighting upgrade; data center consolidation	Medium
2.2	EISA Section 432 energy and water evaluations	On target	Continue EISA energy and water evaluations per regulations	Low
2.3	Individual building metering for 90% of electricity by October 1, 2012; for 90% of steam, natural gas, and chilled water by October 1, 2015; 2013 target: 90% and 50%, respectively	Met: 100% of facilities metered for electricity, steam, natural gas, and chilled water	Continue deployment of advanced metering and development of analytics for facility utility consumption	Met
2.4	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	Met: 100% of new roofs are cool roofs and R-30	Continue roof replacements with a site goal of 30% of all roofs; plan to meet site goal by 2015	Met
2.5	15% of existing buildings greater than 5,000 GSF are compliant with the Guiding Principles of HPSB by FY 2015; 2013 target: 11%	9% HPSB compliance; 1 new HPSB building (LOM 435) in FY 2013	HPSB improvements and certification for existing and new buildings in FY 2014 and beyond	Medium
2.6	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs	Met: All new buildings specify LEED Gold and HPSB	Design all new buildings to meet or exceed LEED Gold and HPSB	Met
Goal #3: Fleet Management				
3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; 2013 target:114% cumulative since 2005	Met: 153% increase	Continue and expand use of alternative fuel vehicles on site	Met
3.2	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline; 2013 target:16% cumulative since 2015	Met: 60% reduction	Continue use of alternative fuel vehicles, hybrids, and electric vehicles on site	Met

Table 1: (Cont.)				
Argonne SSP Goal	DOE Goal	Argonne's Performance through FY 2013	Argonne's FY 2014 Planned Actions & Contributions	Risk of Non-attainment
3.3	100% of light duty vehicle purchases must consist of alternative fuel vehicles (AFVs) by FY 2015 and thereafter (by 75%, FY 2000 – 2015)	Met: All vehicle purchases are AFVs	Continue acquisition of AFVs as fleet changeover occurs	Met
3.4	Reduce fleet inventory of non-mission critical vehicles by 35% by FY 2013 relative to a FY 2005 baseline	Met: FY 2013 Fleet Management Plan identified zero non-mission critical vehicles	Continue utilization of GSA leasing program and increase utilization of neighborhood electric vehicles for on-site transport	Met
Goal #4: Water Use Efficiency and Management				
4.1	26% potable water intensity (gal per gross sq. ft.) reduction by FY 2020 from a FY 2007 baseline; 2013 target: 12%	Met: 32% reduction from FY 2007 baseline	Continue water recycling, installation of low-flow fixtures	Met
4.2	20% water consumption (gal) reduction of industrial, landscaping, and agricultural water by FY 2020 from a FY 2010 baseline; 2013 target: 6%	On Target: 17% reduction from FY 2010 baseline	Implement cooling water recycling; increase use of native, no-irrigation landscaping	Low
Goal #5: Pollution Prevention and Waste Reduction				
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015	44% diverted	Use tracked waste management data to target and improve diversion rate for select materials	Low
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015	53% diverted	Use tracked construction & demolition debris data to target and improve diversion rate for select materials	Met
Goal #6: Sustainable Acquisition				
6.1	Procurements meet requirements by including necessary provisions and clauses (sustainable procurements/bio-based procurements)	Met: Sustainable acquisition clauses included in contracts	Develop and launch a sustainable purchasing training module	Met
Goal #7: Electronic Stewardship and Data Centers				
7.1	All data centers are metered to measure a monthly Power Utilization Effectiveness (PUE) of 100% by FY 2015; 2013 target: 80%	No current means to measure PUE	Begin metering of data centers in FY 2014 to acquire baseline performance	High
7.2	Maximum annual weighted average PUE of 1.4 by FY 2015 2013 target:1.60	No current means to measure PUE	Laboratory Business System Datacenter relocation project to improve overall PUE	High

Table 1: (Cont.)				
Argonne SSP Goal	**DOE Goal**	**Argonne's Performance through FY 2013**	**Argonne's FY 2014 Planned Actions & Contributions**	**Risk of Non-attainment**
7.3	Electronic Stewardship - 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012	Met: All eligible PCs managed using management software	Continue to identify additional programmatic PCs for deployment of power management systems	Met
Goal #8: Renewable Energy				
8.1	20% of annual electricity consumption from renewable sources by FY 2020; 2013 target: 7.5%	On target: 8% consumption from renewable sources, installed or purchased RECs	Continue exploring potential for renewable installations and continue to increase purchase of RECs	Low
Goal #9: Climate Change Adaptation				
9.1	Climate Change Adaptation - Address DOE Climate Adaptation Plan goals	Met: Goals addressed in SSP narrative	Continue to track climate change and adaptation research, collaborations, and site planning efforts	Met

Performance Review and Plan Narrative

FY 2014 GOALS

13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline (2013 target: 4%) 1.2

1.1 28% Scope 1 & 2 greenhouse gas (GHG) reduction by FY 2020 from a FY 2008 baseline (2013 target: 17%)

1.0 GREENHOUSE GAS INVENTORY AND REDUCTION AND ENERGY CONSERVATION

1.1 Scope 1 & 2 Greenhouse Gas Inventory and Reduction

Goal	28% Scope 1 and 2 GHG reduction by FY 2020 from a FY 2008 baseline
2013 Target	17% reduction
Status	13% reduction

Argonne's strategy to reduce Scope 1 and 2 GHG emissions involves several programs, including a combined heat and power project, fleet management, energy efficiency, and fugitive emission controls.

Status

Scope 1 and 2 GHG emissions have increased slightly since 2011 but are down 13% from the FY 2008 baseline (Figure 1). Efforts to improve site energy efficiency included reducing SF_6 fugitive emissions, installing energy efficient technologies, and maximizing fleet vehicle replacements with alternative fuel vehicles. However, the increases to site energy consumption from new high-energy computing and laboratory processes is difficult to counter, resulting in the increase in FY 2013 and the reduction status below the FY 2013 goal.

Argonne's plan to achieve future reductions in energy consumption relies heavily on the construction of a new CHP plant. Figure 2 illustrates Argonne's plan to achieve Scope 1 and 2 emission reduction goals.

Space Management and Alternative Workplace Arrangements

The elimination of surplus and substandard facilities is a critical component of space utilization at Argonne. With aging facilities, decommissioning and demolition is necessary to reduce the laboratory's utility and maintenance overhead. The construction of new energy-efficient buildings must be coupled with decommissioning efforts to efficiently operate the campus and support the laboratory's science.

The Energy Sciences Building (ESB) and the Advanced Protein Crystallization Facility (APCF) both utilize reduced laboratory footprints and more flexible office/cubicle arrangements to ***optimize space for research*** and allow for future reconfiguration and adaptability. By designing new facilities with these characteristics, Argonne is creating offices and laboratory spaces that remain relevant, utilized, and as energy-efficient as possible.

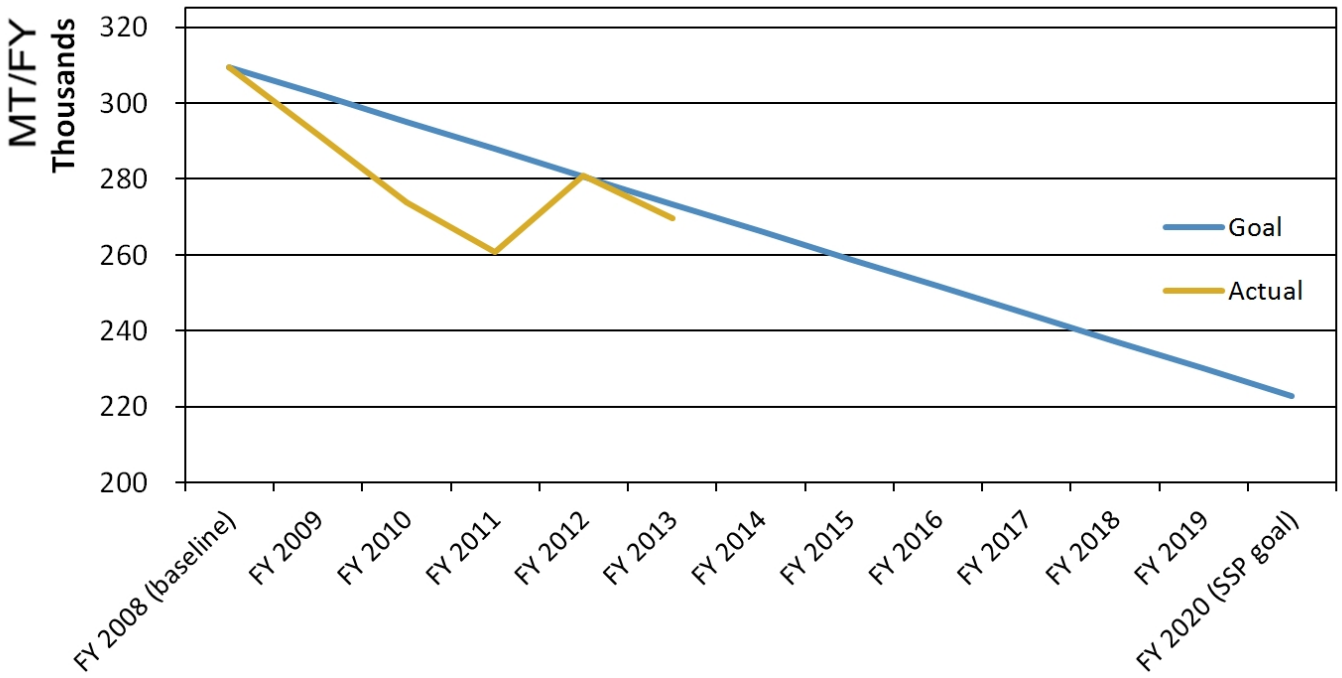


Figure 1: Scope 1 and 2 GHG Emissions Performance and Goal (1,000s MT/FY)

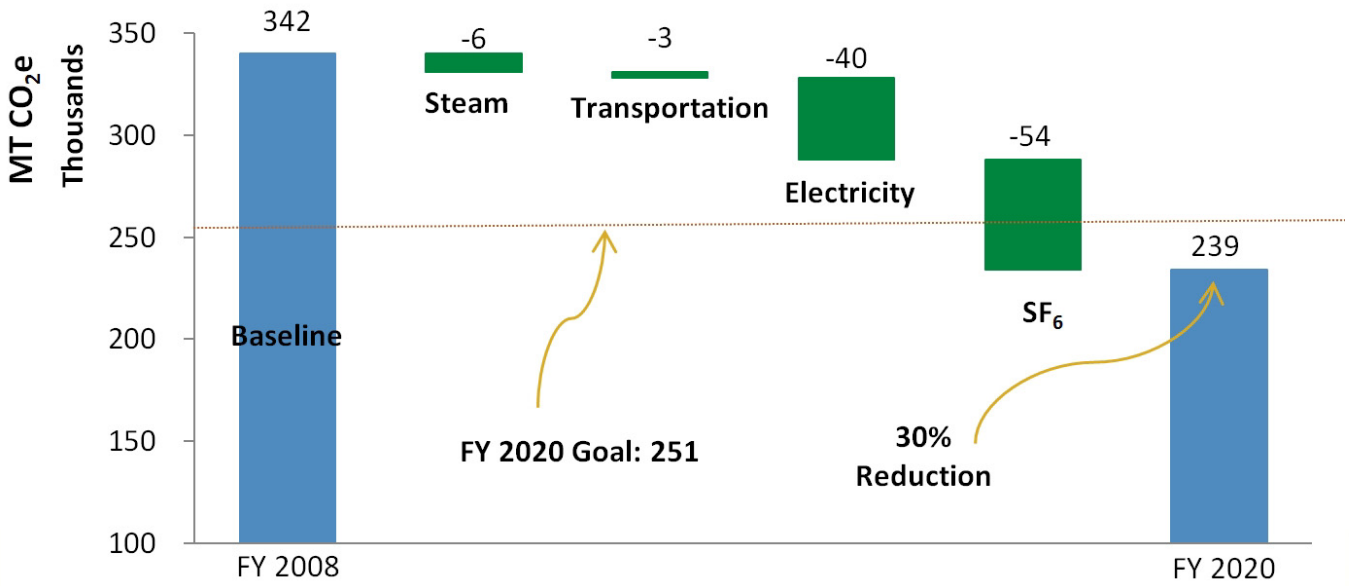


Figure 2: GHG Emissions, Scopes 1, 2, and 3 Reduction Plans, FY 2008-2020

Fugitive Emissions

The FY 2013 Scope 1 fugitive emissions decreased 32% from FY 2012, and 57% from the FY 2008 baseline. These results exceed DOE's 2011 Strategic Sustainability Performance Plan (SSPP) goal to reduce fugitive emissions by 50% by FY 2012 and beyond.

The most significant fugitive gas contribution is sulfur hexafluoride (SF_6) which is used in a variety of scientific electrical equipment, including accelerators and electron microscopes. ***One pound of SF_6 is equivalent to 11 tons of CO_2.*** Argonne recaptures, ***recycles***, recharges and ***reuses*** SF_6.

In 2011, U.S. Energy Secretary Steven Chu recognized the Fugitive Emissions Working Group, of which Argonne is a part, with the Secretary's Achievement Award, the Department of Energy's highest non-monetary honor for a group or team effort.

In 2013, to further reduce SF_6 emissions, Argonne used a ***portable system*** to successfully recover ***50 pounds*** of ***SF_6*** (equivalent to ***542 metric tons*** of ***CO_2***) from Argonne's Van de Graaff generator.

U. S. Energy Secretary Steven Chu (left) presented Argonne Environmental Engineer Greg Barrett (right), with the Secretary's Achievement Award on behalf of Argonne National Laboratory and all Argonne employees who have contributed to the laboratory's sulfur hexafluoride (SF_6) reduction efforts.

HEMSF GHG Reductions and Challenges

High-Energy Mission-Specific Facilities (HEMSFs) pose a challenge to the laboratory's reduction of Scope 1 and 2 GHG emissions. Figure 14 (in the *Electrical Energy Projections and High-Energy Mission-Specific Facilities* section) shows the energy consumed by HEMSFs versus the energy used by other laboratory facilities. The most prominent HEMSFs at Argonne are high performance computing facilities and the Advanced Photon Source (APS). These facilities use more than half of the electricity consumed on site.

Plans

Space Management and Alternative Workplace Arrangements

Argonne will continue to design and build laboratory and office facilities using flexible and optimized space configuration, and encouraging the use of alternative workplace arrangements such as telecommuting. Decommissioning and demolition of surplus building stock will be a key to maintaining site sustainability.

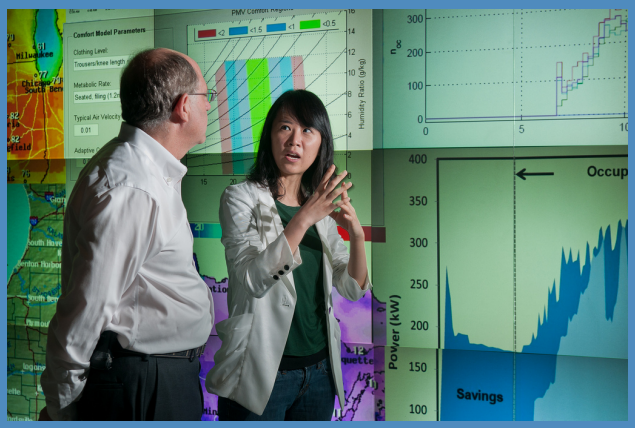
Fugitive Emissions

The reconfiguration of ATLAS will mean that a large scale recovery effort for reclaiming its SF_6 will need to be evaluated and implemented. Argonne will also pursue further recovery of SF_6 from smaller generators and will support repairs to SF_6 distribution equipment in FY 2014.

HEMSF GHG Reductions and Challenges

Improvements to HEMSFs will continue to take the form of traditional energy efficient projects such as lighting and HVAC improvements. However, at the Advanced Photon Source (APS), waste heat capture and redistribution has ***reduced the facility's dependence on the central steam plant***. That same waste heat recapture system is being tested for potential expansion to other HEMSFs. In FY 2014, a lighting conversion project at the APS will commence and is expected to lead to electricity reductions at that facility over the next several years.

The APS office building's BuildingIQ system also makes use of weather forecast information and building temperature predictions to optimize, in real time, the air delivery conditions of the air handling units.



Mechanical Engineer Marvin Kirshenbaum and Researcher Yeonsook Heo use the Advanced Photon Source's BuildingIQ system to optimize air delivery conditions.

1.2 Scope 3 Greenhouse Gas Reduction

Goal	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline
2013 Target	4% reduction
Status	6% reduction

The major sources of Scope 3 GHG emissions at Argonne are employee commuting, business air travel, and electrical transmission and distribution (T&D) losses. The laboratory's strategy for reducing Scope 3 emissions is summarized in Table 2 and includes promotion of green employee commute options such as on site mobility, alternative work schedules, telecommuting, and videoconferencing.

Status

Scope 3 GHG emissions have dropped from the FY 2008 baseline by 6% due in large part to a reduction in business travel (Figure 3). The travel reduction offset increases in T&D losses through expanded population and High-Energy Mission-Specific Facilities. The increase in electricity consumption is offset to the greatest degree possible by the programs listed in this section.

Table 2: Scope 3 GHG Reduction Strategies

Action	FY 2013 Status	FY 2014 Plan
Bike Share program	New low-maintenance bicycles purchased; more than 2,600 participants registered in the program	Continue Bike Share Program and partnership with Chicago Transportation Alliance
Encourage walking and biking	Continued promotion of joint sustainability/employee wellness activities	Continue participation in Active for Life competition and "Bike to Work" weeks
Videoconferencing	Installed additional videoconferencing centers; beginning promotion of videoconferencing resources	Continue to expand videoconferencing infrastructure, services, and promote use
Use of high efficiency vehicles and ride sharing	GreenRide Connect ride share tool promoted; initiated preferred parking to incentivize ride sharing and HEV use in FY 2013	Create mechanism for reporting and promoting use of high-efficiency vehicles and car- and van-pooling
Use of mass transit	Initiated pre-tax spending program	Provide additional on-site transportation options and continue pre-tax commuter spending program
On-site commuter mobility	Initiated a pilot shuttle service to encourage ride sharing and mass transit usage	Investigate on-campus neighborhood vehicle sharing pilot
Telecommuting and alternative work schedule	Encouraged telecommuting and alternate work schedules; some divisions implement alternate work schedules year-round, others during summer months	Promote telecommuting once a week when practical and promote use of alternative work schedule (AWS)

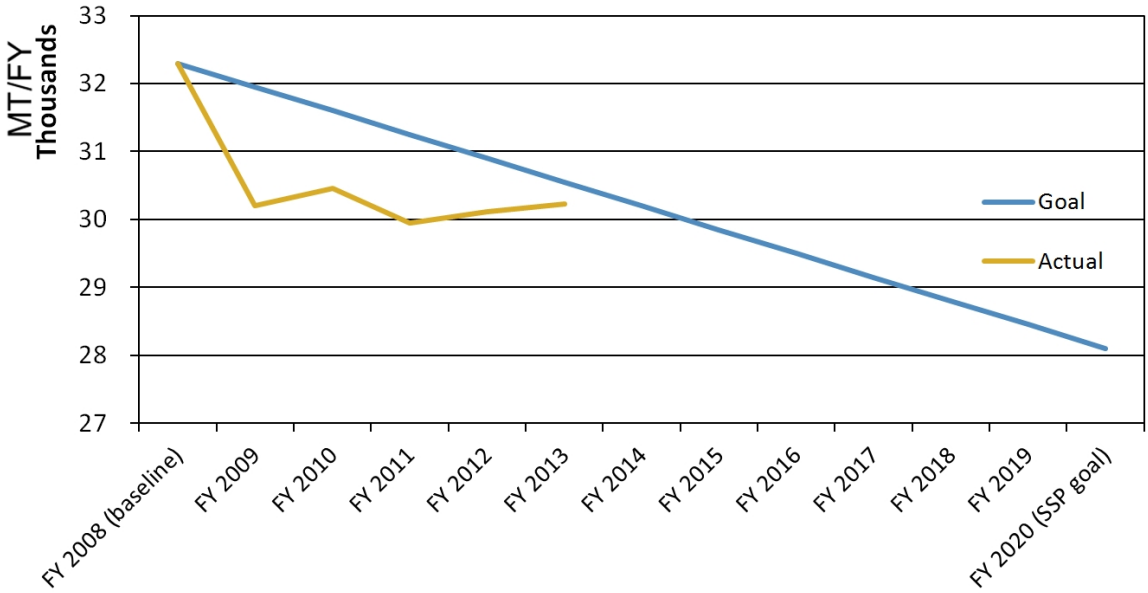


Figure 3: Scope 3 GHG Emissions Performance and Goal (1,000s MT/FY)

Employee Commuting

Argonne's sustainable employee commuting strategy includes:

- Better access to and greater participation in the regional mass transit system
- Increased on-site campus transportation options (e.g., bike share, shuttles, etc.) in support of commuters who choose transit options
- Greater and more formally tracked telework and alternative work schedule participation
- Greater and more formally tracked ride sharing, by car- or van-pool.

In FY 2013 Argonne continued to offer employees a pre-tax saving option to incentivize mass transit use. Additionally, transit riders were offered a pilot on-site shuttle during the winter months to enable "last mile" transportation from the lab's entrance gate to their buildings and mobility while on campus.

Telecommuting promotes a healthy work-life balance and enables employees to reduce their commuting costs and emissions. Argonne promoted both telework and alternate work schedule options through a marketing campaign throughout FY 2013. In addition, tracking of employee telework and alternate work day schedules has been significantly improved through the use of GreenRide Connect.

Argonne's Bike Share program provides an alternative to automobile use for travel on the laboratory site, it further enhances on-site mobility for public transit users, and it promotes wellness in the workplace. Argonne's Bike Share program was improved in FY 2013 with 60 new low-maintenance bicycles. The Bike Share fleet is made up of ***120 bicycles***, placed in populated areas throughout the site. It's a popular program, with ***more than 2,600 employees*** having registered to ***participate in the program***.

More than 2,600 employees have registered to participate in the Bike Share program.

Three vanpools operated in FY 2013 (with the assistance of Pace, the Chicago suburban regional bus transportation authority) and 538 employees have profiles in the laboratory's GreenRide Connect website. ***Since FY 2012, Argonne employees have saved 125 MT CO_2e, 12,800 gallons of gas, 8,664 trips, and $61,800 in commute expenses.***

Three vanpools operated in FY 2013, with the assistance of Pace, a Chicago suburban regional bus transportation authority.

Business Ground and Air Travel

Argonne employees traveled 26,000 fewer ground miles and 2.6 million fewer air miles in FY 2013 compared to FY 2012. Efforts to reduce travel mileage include:

- Evaluation of air travel to determine the necessity of trips needed for mission accomplishment
- Evaluation of alternative transportation modes (e.g., rail, bus) for short trips (<300 miles)
- Increased use of web-based meetings and teleconferencing to replace business trips

FY 2013 saw an increase in the amount of videoconferencing, which displaced a portion of business ground and air travel. Centralized management of videoconferencing began in FY 2012. In FY 2013, ***a successful five-month videoconferencing pilot resulted in travel savings of about $153,000 and 79 MT CO_2e***. The pilot included a videoconferencing management service that streamlined requests and provided enhanced support during and prior to videoconferencing sessions.

Transmission and Distribution Losses

T&D losses are directly related to the amount of electricity consumed on site. In FY 2013, T&D losses increased by 18% due to increased electric load with the addition of the Energy Sciences Building (ESB) and a high-energy process at the Theory and Computing Science Center (TCS).

Off-site Wastewater Treatment

Argonne's wastewater is processed entirely on site; therefore no off-site wastewater treatment emissions are produced.

Off-site Municipal Waste Disposal

As Argonne works towards better tracking and improvement of diversion rates and recyclable streams of its non-hazardous municipal waste, it is expected that emissions from off-site municipal waste disposal will likewise decline.

Plans

Employee Commuting

In FY 2014, Argonne will continue to focus efforts on its four-part commuting strategy by increasing participation in mass transit, increasing options for "last-mile" and on-site mobility, tracking telework and alternative work schedules, and increasing and tracking ride sharing.

Laboratory staff will monitor the success of its pre-tax commuter savings program participation and will work with Pace to examine the possibility of new vanpools or links to transit services. In order to improve transit and vanpool users' on-site mobility, the laboratory will consider piloting an on-site vehicle sharing program. Argonne will also pilot a program to allow employees access to electric vehicle charging stations for personal vehicle charging.

Transmission and Distribution Losses

Argonne's commitment to reducing overall site base electric load for existing facilities will continue to address actual ancillary transmission and distribution losses through FY 2014. Argonne's capacity to generate nearly 6 MW of electricity on-site through the CHP will greatly reduce T&D losses.

Offsite Municipal Waste Disposal

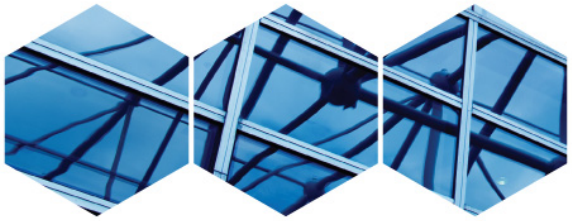
Argonne's efforts to improve its recycling, composting, and reuse programs will lead to continued reduction of off-site municipal waste disposal emissions in FY 2014.

2.0 BUILDINGS ESPC INITIATIVE SCHEDULE REGIONAL & LOCAL PLANNING

2.1 24% energy intensity reduction by 2015 from a FY 2003 baseline

2.2 EISA Section 432 energy and water evaluations

2.3 Individual buildings metered for 90% of electricity and for 50% of steam, natural gas, and chilled water



2.4 New roofs are cool roofs with thermal resistance of at least E-30

2.5 11% of existing buildings 5,000 gross square feet (GSF) and over are compliant with HPSB Guiding Principles (GPs)

2.6 All new construction, major renovations, and alterations 5,000 GSF and over comply with HPSB GPs

2.7 Participate in regional and local planning

2.1 Energy Intensity Reduction

Goal	30% energy intensity reduction by FY 2015 from a FY 2003 baseline
2013 Target	24%
Status	25%

Status

Figure 4 demonstrates that Argonne is on track to meet energy intensity goals for goal-subject buildings. Thirty-four energy and water conservation measures were completed in FY 2013 at a cost of $800,000. Cost savings from these projects are estimated at $156,000 per year.

About 58% of total site electricity was consumed by four HEMSFs: ATLAS, APS/CNM, ALCF, and TCS (see Figure 14 in *Electrical Energy Projections and High-Energy Mission-Specific Facilities* section).

Energy Savings Performance Contracts

Table 3 shows the energy conservation measures, energy savings, and cost savings from the laboratory's four energy-saving performance contract (ESPC) projects.

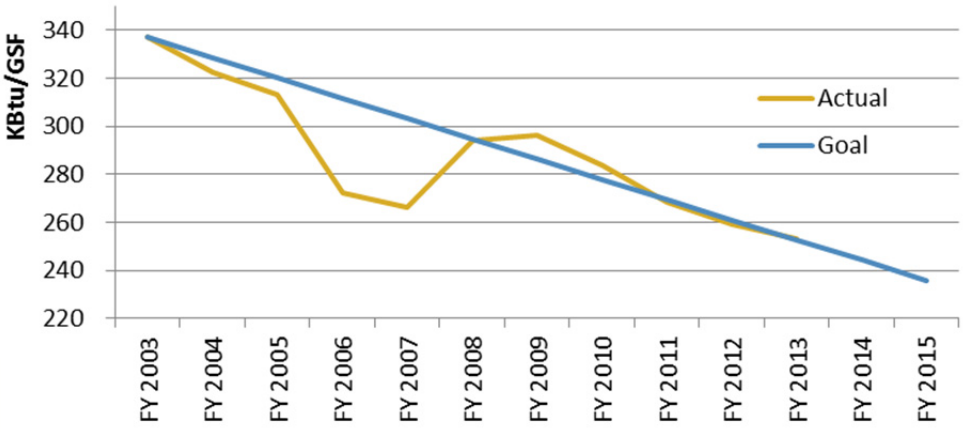


Figure 4: Energy Intensity Ratio (kBtu/GSF) for Goal-Subject Buildings

Table 3: ESPC Energy Conservation Measures, Energy Savings, and Cost Savings		
	Energy Savings (MBtu/yr)	Cost Savings ($/yr)
ESPC 1: Upgrade controls; reduce unoccupied outside air; lighting upgrades; steam pipe insulation; VFD installation	**43,182**	**$344,235**
ESPC 2: Coal fired boiler upgrade; chiller replacement; FMS upgrade; APS heat recovery; lighting improvements; window replacements; condensate return improvements; APS pumps/VFDs	**59,204**	**$1,226,670**
ESPC 3: APS Improvements: Free cooling and metasys upgrade; AHU modifications; AHU heat reclamation; lighting upgrades	**33,296**	**$463,791**
ESPC 4: Combined Heat & Power Plant (expected December 2013 award)	**342,454**	**$2,219,421**
Grand Total ESPC Savings	**478,136**	**$4,254,117**

Savings Reinvestment Program

Beginning in late FY 2008, Argonne created its in-house Energy Savings Reinvestment Program initiative to complement the ESPC program. Under this initiative, the laboratory's maintenance foremen and engineering team identify, evaluate, and prioritize energy conservation projects. Projects are completed using Argonne maintenance mechanics or small contracts to achieve quick savings. Savings are reinvested in additional energy and water savings projects. By the end of FY 2013, the program had generated more than $1M in savings since its inception (Table 4).

Table 4: FY 2013 Energy, Water, and Cost Savings for In-House Program	
	Savings
Electricity	715,195 kWh/yr
Water	13,206 kgal/yr
Steam	20,174 MBtu/yr
Cost Savings	$156,644/yr

Plans

Argonne will continue to pursue projects which reduce the energy intensity of buildings on site.. Pending an award in early FY 2014, the major energy intensity reduction project will be a new CHP plant. Preliminary design is complete and the ESPC contracting process is underway. Construction and startup is planned for FY 2016.

The ***CHP plant will be the main source of campus steam for heat and will generate 5.8 MW of electricity as a by-product. The project will reduce Argonne's carbon footprint by 13%, more than 35,000 metric tons***, and reduce emissions of nitrogen oxides, sulfur dioxide, and other air pollutants. The CHP is also projected to provide 8.4% of the overall 30% site-wide energy reduction required for goal-subject buildings.

2.2 Energy and Water Evaluations

Goal EISA Section 432 energy and water evaluations

Status

Activities completed in FY 2013 include:

- Comprehensive energy and water evaluations for Buildings 212, 360 and 362; and
- Benchmark and FY 2013 data was entered into Labs21, a web-based benchmarking tool, and into Energy Star Portfolio Manager.

Plans

Argonne will continue to perform comprehensive energy and water evaluations, and follow up on findings to improve facility energy and water efficiency. About 25% of facility gross square footage (constituting more than 75% of Argonne energy use) is evaluated each year.

2.3 Metering

Goal Individual buildings metering for:

- 90% of electricity (by October 1, 2012)
- 90% of steam, natural gas, and chilled water (by October 1, 2015)

2013 Target 90% electricity and 50% steam, natural gas, and chilled water

Status 100% of all utilities metered at building level

Status

Electrical metering on campus remains a high priority. The high voltage (>480 V) electrical supervisory control and data acquisition (SCADA) system is well established and collects data from electrical meters. The low voltage (<480 V) electrical system is being upgraded as scheduled maintenance occurs. In FY 2013, six 480 V switchgears in the 400 building were upgraded or added. In addition, new 480V switchgears in Building 203 and the Energy Sciences Building were added.

Argonne made a major upgrade to the domestic water and natural gas metering system in FY 2013. The existing meters were been connected to a water SCADA system. New devices were installed across half of Argonne's campus, with the remaining devices slated for installation in early FY 2014. Natural gas meters in the boiler house and on the gas distribution system main header were connected to the SCADA system, resulting in 100% of gas usage being advance- metered and over 98% of it metered at the building level.

A chilled water meter survey was completed in FY 2013 that resulted in the purchase of three replacement meters and five new meters that will be installed in early FY 2014.

Plans

Argonne will continue to install and network advanced meters, and upgrade existing metering systems to include advanced reporting capabilities. In FY 2014, as these metering systems mature, the laboratory will begin to develop data analysis capabilities to evaluate the increased amount of data captured by the advanced meters. To lead these efforts, Argonne has created an Advanced Metering and Building Automation group within its Sustainability and Energy Program.

2.4 Cool Roofs

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

Status All new roofs are cool roofs with R-30 insulation.

Status

Argonne now requires that all new buildings have cool roofs with R-30 insulation. In FY 2013, Argonne replaced 45,700 sq. ft., or 3.5% of its total roof surface, with cool roofs that had R-30 insulation. In addition, 46,511 sq. ft. of cool roof surface was installed on new Argonne facilities. Since FY 2004, when Argonne began installing cool roofs, 23.5% of the laboratory's building roof surfaces have been finished with cool roofs.

Plans

The laboratory is slated to complete construction of two facilities in 2014 which are being built with cool roofs and R-30 insulation. Argonne also plans to replace roofs on two or more existing buildings in FY 2014 with cool roofs.

2.5 High Performance Sustainable Buildings - Existing Buildings

Goal 15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of High-Performance Sustainable Building (HPSB) by FY 2015

2013 Target 11%

Status 9%

Status

At the end of FY 2013, seven buildings (or 9% of all campus buildings) met HPSB standards. All existing buildings on site currently meet 58% of the Guiding Principle requirements through institutional procedures and processes.

Table 5 shows the 12 buildings which Argonne expects to meet HPSB criteria, and the dates by which HPSB was or is expected to be achieved. The number of buildings meeting HPSB standards through 2015 is illustrated in Figure 5.

Table 5: High Performance Sustainable Building Plan

	Building No.: Name	Criteria	FY 2011 or prior	FY 2012	FY 2013	FY 2014	FY 2015 + after
1	046: Shipping and Receiving	LEED Silver	X				
2	216: Sub-Angstrom Microscopy & Microanalysis (SAMM)	LEED Gold	X				
3	214: Facilities Management	HPSB		X			
4	302: Security	HPSB		X			
5	438: Lab/Office Module (LOM)	HPSB		X			
6	440: Center for Nanoscale Materials (CNM)	LEED Silver		X			
7	435: LOM	HPSB			X		
8	241: Energy Sciences Building (ESB)	LEED Gold & HPSB				X	
9	437: LOM	HPSB				X	
10	446: Advanced Protein Crystallization Facility (APCF)	LEED Gold & HPSB					X
11	213: Cafeteria and/or Energy Innovation Center (EIC)	HPSB					X
12	TBD	HPSB					X

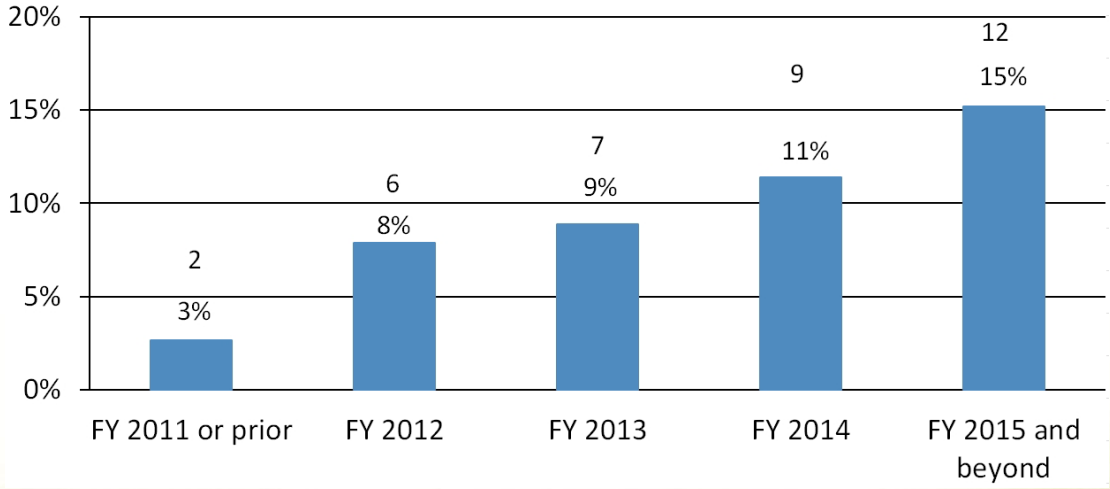


Figure 5: Total Number of HPSBs, Actual (through FY 2013) and Projected (DOE Goal: 15% by 2015)

Building 435, an Advanced Photon Source (APS) Laboratory Office Module achieved the HPSB Guiding Principles in FY 2013. Building 435 is a 23,831 sq. ft. laboratory/office facility. The facility is heated using the APS waste heat recovery system. Potable water improvements included replacement of restroom plumbing fixtures with high-efficiency fixtures, reducing the potable water use by 71%, calculated from the HPSB baseline, and exceeding the 20% reduction goal. Other improvements included commissioning, replacement of T-12 fluorescent lighting fixtures with T-5 florescent lighting (which led to a 66% reduction in lighting energy consumption) and installation of occupancy sensors in both private and public areas.

The Advanced Photon Source employs a waste heat recovery system to heat adjacent buildings such as Laboratory Office Module 435.

Argonne's Facilities Management and Services division staff updated the Facility Information Management System for all laboratory facilities in FY 2013.

Plans

Two buildings, the Energy Sciences Building and Building 437 LOM, will achieve HPSB standards in FY 2014 through the application of APS waste-heat recovery, water efficient fixtures, lighting improvements, ventilation improvements, and tenant education. In FY 2015, two additional facilities, the APCF and Cafeteria, are expected to achieve HPSB. One additional facility, as yet to be determined, would need to achieve HPSB by FY 2015 to meet the goal of 15% HPSB by 2015.

After 2015, and as resources and technology permit, Argonne will continue to pursue energy and water efficiency upgrades to bring the site to 100% compliance with HPSB Guiding Principles.

2.6 New Construction - Guiding Principles

Goal All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs

New Argonne buildings (over 5,000 sq. ft. that cost $5 million or more) will meet both LEED-NC Gold Certification and the HPSB Guiding Principles. New construction is specified to comply with these requirements.

Status

If a building was committed to LEED Certification prior to October 1, 2008, then when certified, the building also meets the requirements of HPSB. Three Argonne buildings (Buildings 046, 216, and 440) met the HPSB requirements in this manner.

Plans

Argonne will build the following new, HPSB-compliant lab/office buildings after FY 2015:

Table 6: Future Expected HPSB Compliant Argonne Buildings

Building	HPSB/LEED Gold Certification Date (Expected)	Size (sq. ft.)
241: Energy Sciences Building (ESB)	2014	140,000
446: Advanced Protein Crystallization Facility (APCF)	2015	59,500
Energy Information Center (EIC)	2016	40,000
242: the Materials Design Laboratory (MDL)	2017	100,000
TBD	After 2017	TBD

Additionally, Argonne recognizes that all new buildings that enter the planning process in 2020 and thereafter are required to be designed to achieve net zero energy standards and performance by 2030. Argonne staff is investigating the commitment needed for facility conversion to net zero. Meeting this goal will require significant financial and technological resources.

2.7 Regional & Local Planning

Argonne programs and researchers participate in regional and local planning initiatives with a goal to contribute to the region's success and to collaborate for improved understanding of local and regional challenges.

Status

Argonne National Laboratory is the nation's oldest National Laboratory, and has existed as an integral site within the Chicago Suburbs since its inception in 1946. All new construction and facility renovation occurs within the confines of the original laboratory site. Argonne was not involved with Environmental Impact Statement or Environmental Assessment activities in FY 2013.

Argonne maintains a walkable, bike-able campus setting which is located in a thriving economic and employment center ***near the City of Chicago***. New construction within the laboratory is planned with an eye toward improving the site's pedestrian and bike accessibility. An effort to improve "last-mile" on-campus transportation options provides a crucial link to enabling more Argonne employees to choose mass transit as a viable commuting option. Argonne employees maintain a working relationship with Pace, the regional bus transportation authority, to ensure ongoing connectedness between mass transit options and Argonne.

Argonne's natural resources staff coordinates with ecosystem, watershed, and environmental management efforts outside the lab. For almost a decade, Argonne staff has had a seat on the ***Chicago Wilderness (CW) Executive Council***, a local consortium of more than 100 federal, state, and local organizations that ***promote the welfare of nature and society***.

Argonne partners with organizations throughout Chicagoland to enhance sustainability in the region. Photo credit: Tom Carroll via Flickr

Argonne also hosts quarterly ***Community Leader Roundtable Meetings***. Members include local and state elected officials, school district leadership, leaders of environmental boards and other governmental agencies, and officers of labor unions and homeowners associations. These roundtable meetings serve as a link to communicate Argonne plans and direction to members of local and regional groups that may have an interest in the laboratory's initiatives.

Outreach

To make others aware of Argonne's Sustainability Program, Argonne produces a variety of external communications and participates in a number of outreach activities. These include:

- ***Argonne's award-winning Sustainability Workshops for Middle and High School Teachers*** are college-accredited courses that attract middle and high school teachers from across the Chicagoland area. Each five-day workshop session explores current renewable sources of energy such as solar, wind, biofuel and hydropower. Educators also learn about the pros and cons of today's energy options from Argonne scientists, and hands-on laboratory experiments are conducted as part of the workshop's practical learning application.

Teachers participated in a hands-on wind energy activity during Argonne's Sustainability Workshop for Teachers.

- Argonne's Sustainability group employs college students as interns, educating the next generation of scientists and engineers on sustainable practices and principles.

- Argonne's GreenLab Initiative website features articles and videos highlighting Argonne's "green" research and development, on-site pollution

prevention, energy and water conservation efforts, renewable energy installations, and outreach activities.

- Argonne invites middle-school students from the surrounding community, including students from Chicago Public Schools, to attend learning-based sustainability demonstrations.

Pressure/Energy Systems Engineer Dejan Ristic spoke with a group of visitors about renewable energy in front of Argonne's 109 kW solar array as part of a green infrastructure tour.

- Argonne OutLoud, Argonne's new public lecture series, highlights cutting-edge research taking place at Argonne, particularly "green" energy research.

- Argonne partners with local high school districts to provide students with real-world experience by engaging them in sustainability and environmental compliance learning-based activities.

- Argonne regularly hosts sustainability tours and presentations for students, teachers, municipalities, government agencies, and educational organizations.

Plans

Argonne will continue to participate in national, regional and local planning efforts in order to more comprehensively contribute to the social, environmental, and economic successes of the region and the nation. Sustainability staff will continue to provide outreach education to students, teachers, partner organizations and other groups who want to learn more about Argonne's sustainable best practices and green energy research.

3.0 FLEET MANAGEMENT

3.1 114% increase in fleet alternative fuel consumption relative to a FY 2005 baseline

3.3 75% of light duty vehicle purchases consist of alternative fuel vehicles (AFV)

3.2 16% reduction in fleet petroleum consumption relative to a FY 2005 baseline

3.4 Reduce fleet inventory of non-mission critical vehicles by 35% relative to a FY 2005 baseline

3.1 Alternative Fuel Consumption

Goal	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline
2013 Target	114% cumulative since 2005
Status	153%

Status

Argonne vehicles are almost exclusively fueled on site. The laboratory dispenses biodiesel (B20 and B5 – during the winter season), E85 (ethanol) and unleaded fuels. Laboratory fuel consumption is shown in Figure 6.

Ninety-three percent of the vehicles in Argonne's fleet are alternative fuel vehicles (AVF). Argonne maintains a fleet of 12 hybrid-electric vehicles (e.g., compact sedans and trucks) and 26 non-fleet "neighborhood" electric and biodiesel vehicles for on-site transport. To support the plug-in neighborhood and electric vehicle fleet vehicles, the lab began installation of a network of charging stations across campus. The electricity used for vehicle charging has not yet been quantified and is not counted toward the total amount of alternative fuel used on site.

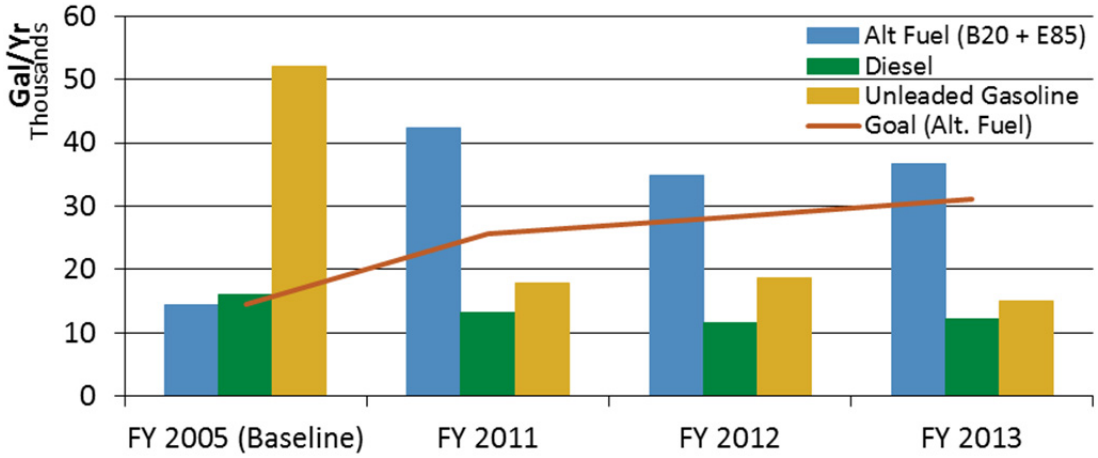


Figure 6. Fuel Type Consumption Year by Year

Argonne's neighborhood electric vehicles and solar-powered electric vehicle charging station

Plans

In FY 2014, staff will evaluate performance and additional opportunities to use General Services Administration (GSA) plug-in electric or other alternative fuel vehicles to replace current gasoline models.

The laboratory will also initiate a pilot campus vehicle program to improve last-mile connectivity for transit riders and to improve on-site mobility.

Argonne will also begin a pilot program allowing employees to use on-site charging stations for personal vehicles.

3.2 Petroleum Consumption

Goal	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline (30% by 2020)
2013 Target	16% cumulative since 2015
Status	42%

Status

Since January 2012, Argonne has reduced its fleet by 14 vehicles. These reductions, as well as meeting new transportation demands, have been accomplished through the purchase of "neighborhood" electric and bio-diesel fueled vehicles.

In an effort to further reduce fuel consumption, Argonne has elected to participate in a GSA-sponsored electric vehicle pilot program.

To reduce vehicle miles traveled, Argonne continues to support telework and alternative work schedules, the use of mass transit, and videoconferencing. These strategies are discussed in detail in Section 1.2.

Plans

To continue the laboratory's excellent performance in reducing petroleum use, staff will continue to investigate the effectiveness of existing alternative fuel vehicle infrastructure, and will continue support and implement new programs as described in Section 3.1.

3.3 Alternative Fuel Vehicle Purchases

Goal	100% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2015 and thereafter
2013 Target	75%
Status	met; no light-duty purchases

Status

Since 2009, Argonne has replaced its light-duty fleet with GSA-leased vehicles. Per Section 3.2, the laboratory is participating in a GSA-sponsored electric vehicle pilot program, and will test two types of electric vehicles in FY 2014.

Plans

Argonne will continue its participation in GSA lease programs including alternative fuel vehicle leases. The laboratory will also investigate other alternative fuel vehicle applications, such as neighborhood electric vehicles for on-site transport and mobility.

3.4 Fleet Reduction

Goal	Reduce fleet inventory of non-mission critical vehicles by 35% by FY 2013 relative to a FY 2005 baseline
Status	met; fleet reduced to only mission-critical vehicles

Status

Argonne completed a significant fleet reduction effort in 2005 and has continued to eliminate vehicles as they become unnecessary. In FY 2013, all vehicles were mission-critical, and the 35% reduction goal was met.

Argonne's fleet vehicles are selected for addition or replacement based on the operational needs of the laboratory. Low GHG GSA vehicle options are considered for passenger vehicle and light duty truck applications when available.

Plans

Argonne will continue to operate a lean, efficient fleet and to participate in the GSA fleet lease program, including the use of alternative fuel and electric vehicles as available.

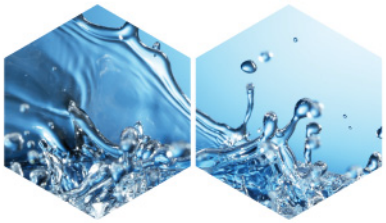
Argonne's service fleet consists of alternative fuel and electric vehicles.

Fleet Management Plan

Argonne issued its final Fleet Right-Sizing Plan in December 2012. As a result of austerity measures taken prior to FY 2005, Argonne had already succeeded in drastically reducing its fleet from 205 vehicles in FY 1999 to 135 vehicles by the end of FY 2005. In FY 2012, 128 fleet vehicles remained and all of the vehicles were determined to serve a mission-critical purpose. However, the laboratory also indicated that some of these mission-critical vehicles could be retired from the fleet if suitable fleet-alternative vehicles ("neighborhood" electric vehicles) could be identified and purchased. A fleet reduction team was established to pursue additional efforts to further reduce the fleet; through aggressive purchasing of neighborhood vehicles, an additional nine fleet vehicles were retired, bringing the current fleet count down to 119 vehicles.

4.0 WATER USE EFFICIENCY AND MANAGEMENT

4.2 6% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water from a FY 2010 baseline



4.1 12% potable water intensity (Gal per gross square foot) reduction from a FY 2007 baseline

Argonne has realized tremendous success in reducing its water consumption (Figure 7) despite a growing population and new energy-intensive research processes.

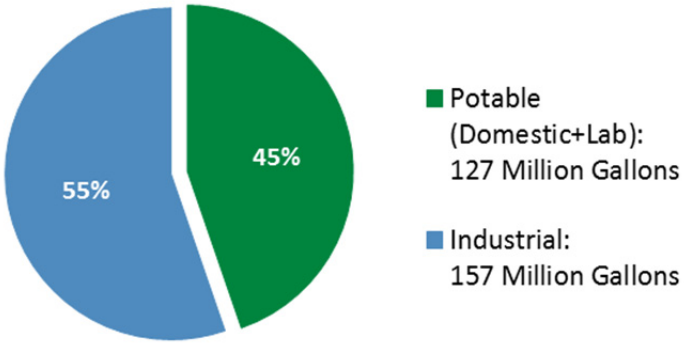


Figure 7: Water Consumption, FY 2013

4.1 Potable Water

Goal	26% potable water intensity reduction by FY 2020 from a FY 2007 baseline
2013 Target	12% reduction
Status	32% reduction

Status

Figure 8 demonstrates the progress that Argonne has achieved in meeting potable water intensity reductions. The small FY 2012 to FY 2013 increase was primarily due to a temporary increase in laboratory water use in Building 450, testing of pipes, leaks at several buildings, and added service to new buildings.

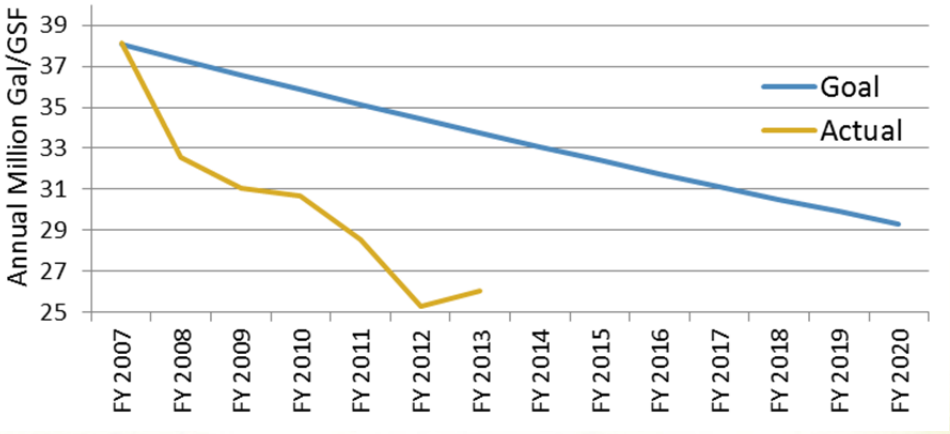


Figure 8: Potable Water Intensity Reduction Actual vs. Target, FY 2013 (Annual Million Gallons/GSF)

A number of water conservation measures were completed or initiated in FY 2013. The most significant reductions were made by replacing potable water used for once-through cooling water in large air conditioning units at Buildings 206 and 360 with industrial cooling water, which is then recirculated within the central chilled water loop. ***Potable water savings for this project was 8.2 million gal/yr, equal to a cost savings of $27,349 in FY 2013***.

Plans, Actions, and Projected Performance

Figure 9 illustrates the potable water intensity reduction strategy, including the strategy to reduce water intensity beyond the goal by FY 2020, and up to a possible 40% reduction, based on current plans. Argonne's main potable water strategy is to continue to repair condensate and steam traps and to continue its water recycling program. Retrofitting to low-flow fixtures will also be accomplished during renovations, as well as low-flow installations in new construction. Recycling alone has yielded annual water reductions in excess of the FY 2020 26% reduction goal.

Storm Water Management

Argonne incorporates green infrastructure features into new construction or renovation projects that are 5,000 sq. ft. or greater in size. Green infrastructure reduces storm water runoff and suspended storm water pollutant levels. Using a green infrastructure maintains or restores pre-development hydrology and hydraulics.

Storm water management at Argonne is implemented largely through green building projects and natural resource management. The new green infrastructure projects listed below include directing runoff from roofs, parking lots, and sidewalks toward rain gardens,

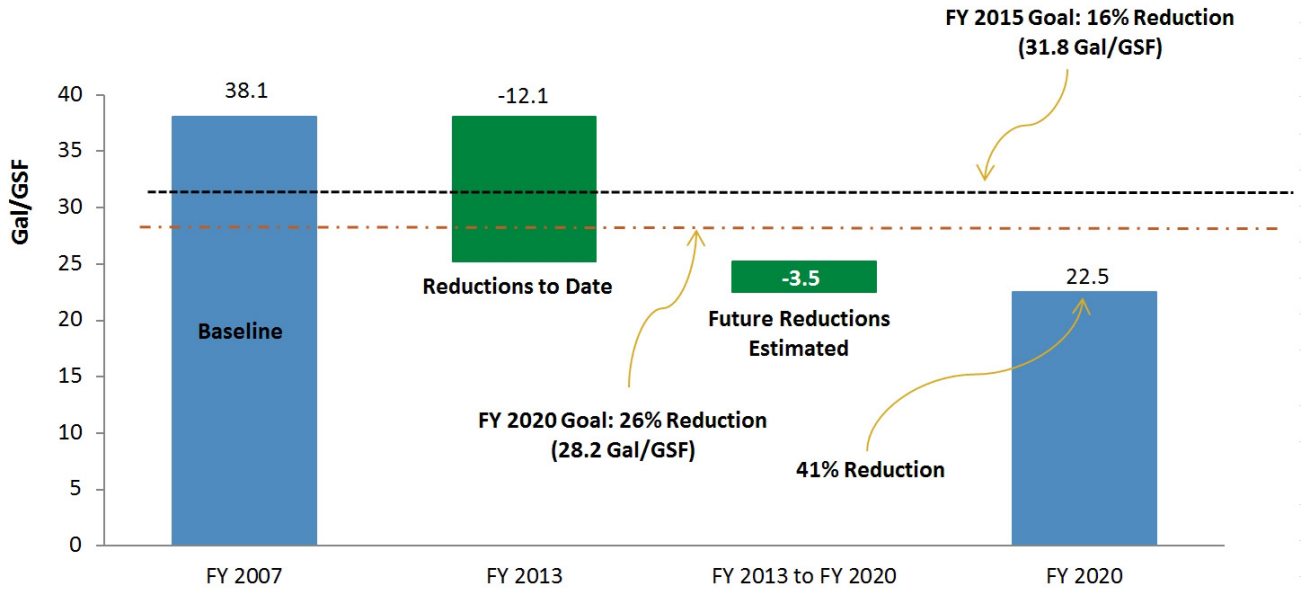


Figure 9: Potable Water Intensity Reduction Plan, FY 2013

bioswales, and infiltration basins which promote infiltration, transpiration, and filtration of collected runoff.

- Energy Sciences Building – vegetated storm water infiltration basin
- Advanced Protein Crystallization Facility – vegetated bioswale
- Kearney Road Parking Lot – flush curbing for sheet runoff; bioswales; vegetated infiltration basin

Researchers Larry Moos and Nathan Visser collecting a sediment sample from Sawmill Creek, south of the Argonne site.

Natural Resource Management

In addition to the construction projects described above, Argonne incorporates green infrastructure elements into its natural resource management activities.

- East Area – Argonne planted 3 acres of deep-rooted prairie grass in an effort to replace shallow-rooted orchard grass. This is an annual project to convert vacant contiguous parcels to native landscape.
- APS Area – Wetland improvements were made near the APS through targeted invasive species removal.
- Site-wide Snow Management – Argonne implements a snow management plan during the winter season to reduce salt usage during road closures, restricting salt application near environmentally sensitive areas, and mixing organic beet juice derivatives with salt.
- 800 Area/ Large Soil Stockpiles – 150,000 cubic yards of soil were stored for on-site reuse following decontamination and decommissioning projects.

In FY 2014, Argonne plans to plant an additional 3 acres of deep-rooted prairie grass. Argonne also plans to convert selected storm water ditches into bioswales to promote infiltration and to improve contaminant removal.

4.2 Industrial, Landscaping, and Agricultural (ILA) Water

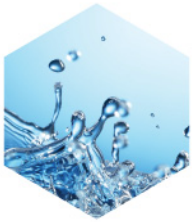
Goal	20% water consumption (gal) reduction of ILA water by FY 2020 from a FY 2010 baseline
2013 Target	6% reduction
Status	17% reduction

Status

Industrial

Argonne is well ahead of the targeted reduction goal and achieved a 17% reduction in industrial water use compared to FY 2010. During FY 2013, Argonne reduced its industrial water use by 14.6 million gallons, or 8% compared to FY2012, and realized a cost savings of $11,952 (see Figure 10). To date, a majority of this reduction was achieved by recycling cooling tower water.

At the Building 450 cooling towers, industrial water reuse cycles nearly doubled through advanced water quality monitoring, careful chemical metering and conductivity adjustment based on real-time conditions. Increase in reuse cycles resulted in an 18 million gallon reduction of industrial water compared to pre-water reuse efforts. This represents a 10-20% reduction in industrial water usage from FY 2011 (pre-water reuse efforts).



Landscaping/Agricultural

Argonne's landscaping efforts continue to employ water-use reduction practices, including the selection of drought-tolerant plants and seasonally appropriate planting, scheduled so new plants are established without intensive watering. Regionally native plants such as prairie dropseed and bur oak reduce landscape water demands. Argonne's consumption is shown in Figure 10.

Plans

The laboratory's main opportunity for ILA water reduction continues to be in the area of reducing the volume of cooling tower blowdown.

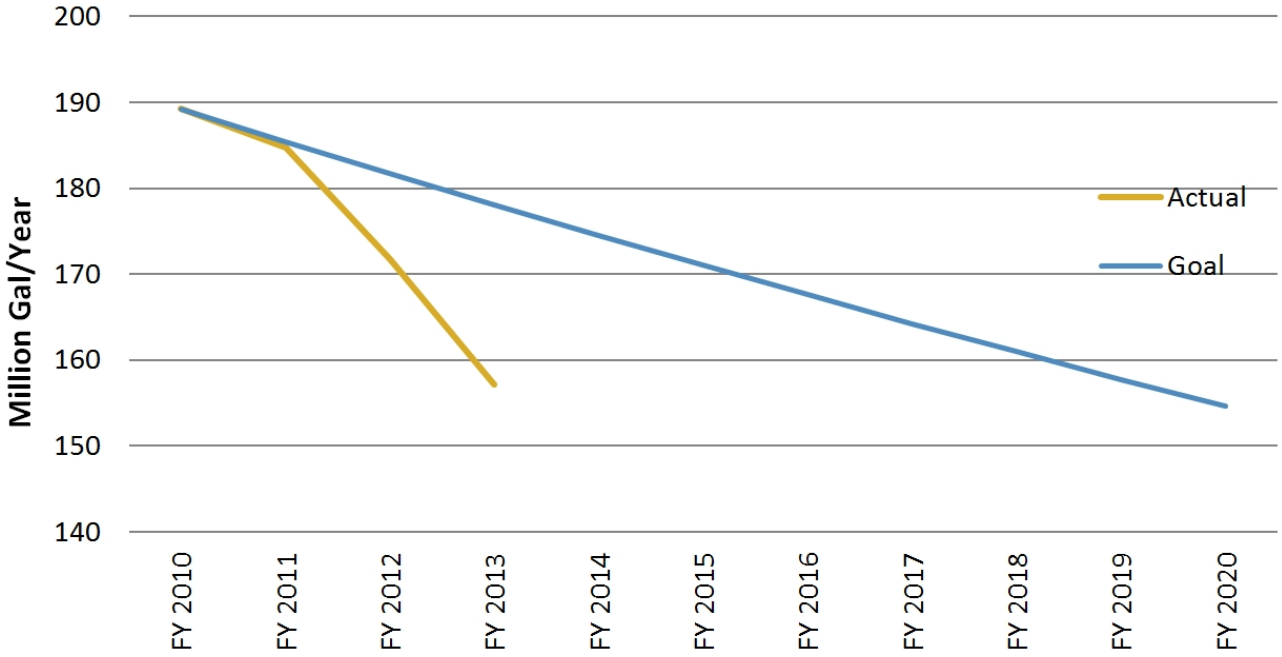


Figure 10: Industrial Water Consumption (Mgal)

5.0 POLLUTION PREVENTION AND WASTE REDUCTION

5.2 Divert at least 50% of construction and demolition materials and debris by FY 2015

5.1 Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015

5.1 Solid Waste Diversion

Goal Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris by FY 2015

Status 44% diversion

Status

In FY 2013, the non-hazardous solid waste diversion rate excluding construction and demolition (C&D) debris was 44% (Figure 11). This is lower than diversion rates for the last two years, but FY 2013 was the first reporting year for separate tracking of C&D waste from other municipal solid waste (MSW).

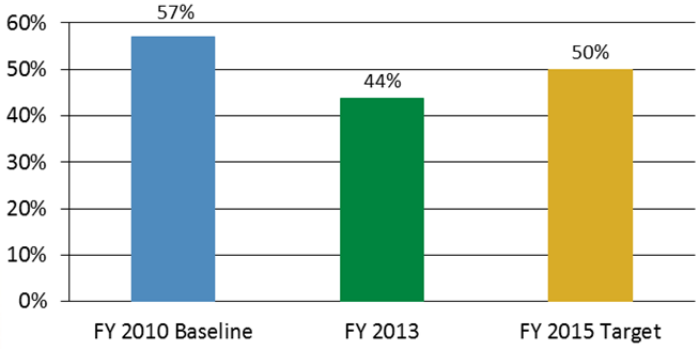


Figure 11: Solid Waste Diversion

Materials not cleared for unrestricted release (e.g., hazardous or radioactive) are tracked and reported each quarter.

Two Argonne recycling programs (metal and mixed office paper) produce approximately $50,000 annually. Funds are used for solid waste diversion and pollution prevention programs such as sustainable employee commute activities, bikes and helmets for Argonne's Bike Share Program, recycling containers, and filtered water reusable bottle fillers. Argonne has had great success in assessing pollution prevention opportunities and increasing source reduction of pollutants and waste, including:

- Recovering electronics, scrap metals, plastic, glass, engine oil and antifreeze, construction demolition debris (asphalt and concrete), batteries, cardboard, and mixed office paper;
- Using 125 new recycling containers placed on site in FY 2013;
- Using a compost management unit (CMU) on-site and following a plan to collect compostable food scraps from the laboratory's cafeteria. A total of ***3.3 metric tons of compost was diverted from offsite landfills in FY 2013***; and
- Using a minimum of 30% post-consumer recycled paper, with printers set up to default to duplex printing.

Plans

Argonne will continue to improve solid waste diversion through the following planned actions in FY 2014:

- Improve the measurement and tracking of municipal, hazardous, C&D, and sanitary waste and recycling volumes;
- Conduct a waste and diversion analysis to determine what MSW materials may be most effectively captured to increase the Laboratory's diversion rate;
- Develop sustainability specifications to increase the number of projects with Sustainability Program requirements, such as reporting of diverted C&D waste;
- Pilot a zero-waste event (e.g., a conference, workshop, or social gathering); and
- Track composting volumes managed in the East Area CMU and develop strategies for increasing composting volumes from additional site locations.

5.2 Construction & Demolition Debris Diversion

Goal	Divert at least 50% of construction and demolition materials and debris by FY 2015
Status	53% diversion

Status

In FY 2013, ***Argonne diverted 53% of construction and demolition debris, realizing the FY 2015 goal ahead of schedule for the second year***. Argonne generated 583 metric tons of C&D debris for off-site landfill disposal and 661 metric tons of C&D debris was diverted to local recycling and reuse facilities.

Argonne diverts C&D debris from three primary sources: maintenance of existing infrastructure (buildings and roads), demolition of existing buildings, and construction of new buildings.

Construction and demolition debris recycled from Argonne's construction sites includes brick/concrete, ceiling tile, paper and corrugated cardboard, drywall, glass, metal, plastic, and wood.

Plans

Argonne will continue to specify that construction and demolition debris should be recycled to the highest level practicable in all infrastructure work, demolition, and construction projects. The lab will explore opportunities for recycling more construction demolition debris.

C&D management excelled in new construction projects. The ***Energy Sciences Building (ESB) construction project*** generated 467 metric tons of waste in 2013, 95% of which was diverted to recycling facilities. Construction on the Advanced Protein Crystallization Facility (APCF) generated 144 metric tons of waste, 93% of which was diverted to recycling.

The Energy Sciences Building (ESB) construction project diverted 95% of its waste, about 444 metric tons, to recycling facilities.

6.1 Necessary Provisions in Procurements Documents

Goal Procurements meet requirements by including necessary provisions and clauses

Status Argonne includes necessary provisions

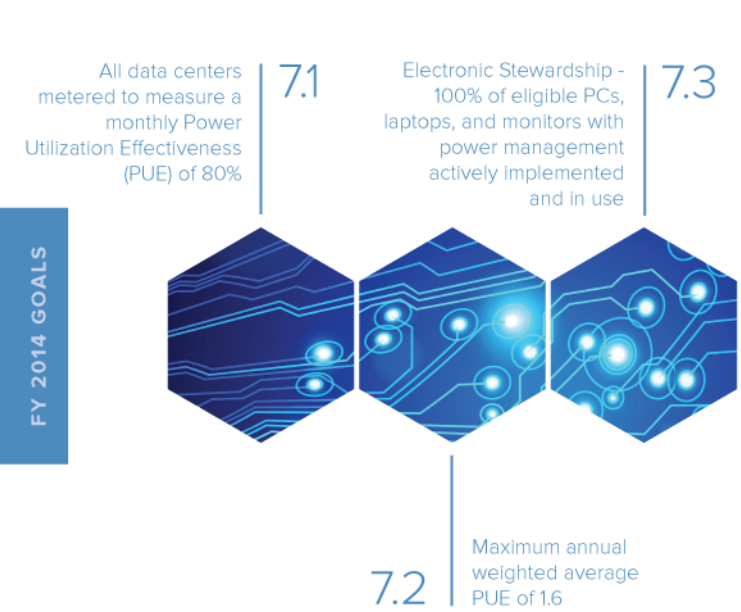
Status

In FY 2013, Argonne published its Sustainable Acquisition (SA) program, the efforts of which continued through FY 2013. The plan streamlined a number of new and previous directives into one comprehensive list of SA requirements.

Employees at Argonne can specify the use of SA products and services in Argonne contracts. The SA program establishes how preference is shown to SA items when meeting the requirements of the purchaser. In addition, Argonne captures SA statistics to allow for annual reporting and validation of SA implementation.

The laboratory's standard terms and conditions include SA requirements for the purchase of recycled content and janitorial products, office paper, plastic trash bags, toner cartridges, retread tires, and re-refined lubricating oils.

Argonne will continue the integration of SA into all laboratory purchases, and will also investigate the possibility of hosting a green products fair for division and employee education and promotion.



7.0 ELECTRONIC STEWARDSHIP AND DATA CENTERS

7.1 Data Centers & Electronic Stewardship

Goal	All data centers are metered to measure a monthly Power Utilization Effectiveness (PUE) of 100% by FY 2015
2013 Target	80%
Status	one data center metered (14%)

Status

During FY 2013, all seven data centers were evaluated for feasibility of metering installations. Two data centers were slated for advanced metering projects. Meter installation of one data center took place at the end of FY 2013. In addition, chilled water meters were purchased for two data centers; installation is due to be completed in FY 2014.

The laboratory is also pursuing best management practices to:

- Drive centralization of new server deployments to high-efficiency, on-site central data centers (implemented as “colocation space”); and
- Where feasible, use commercial cloud services rather than locally operated servers.

Plans

During FY 2014, Argonne will install and connect meters at data centers in the Center for Nanoscale Materials (CNM) and Advanced Photon Source (APS). Meeting the goal of metering all laboratory data centers will be financially difficult. Likewise, consolidation of data centers into a new building or retrofitting into existing buildings would require significant capital funds and staff effort to complete.

7.2 Power Utilization Effectiveness (PUE)

Goal	Maximum annual weighted average PUE of 1.4 by FY 2015
2013 Target	1.60
Status	PUE not known

Status

PUE is a metric used to describe the energy efficiency of a data center. Argonne is investigating a means to accurately measure PUE in its seven data centers. In most cases, accurate measurements of IT load can be measured at the equipment or rack level, but no accurate measurement of facility load exists. The estimated average PUE for datacenters at Argonne ranges from 1.20 to 1.72. Accurate estimates cannot be made for the three large data centers that account for nearly 60% of the laboratory’s datacenter floor area

Plans

Two data centers will have advanced meters installed in early FY 2014 that will allow accurate measurement of PUE. The remaining data centers are being evaluated for metering upgrades.

Maximum weighted annual PUE of 1.4 by FY 2015 will be a technical and financial challenge. Some of the laboratory's seven data centers are spaces which were retrofitted for the purpose, i.e., the buildings or spaces were not originally designed to house high performance computing equipment. Therefore, the reduction of PUE in some data centers may prove to be unfeasible. It will take time to determine the PUE for all datacenters on campus. After the PUE is determined, energy efficiency measures to lower the PUE would be identified and prioritized.

7.3 Electronic Stewardship – Power Management

Goal	Electronic Stewardship - 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012
Status	70% of eligible equipment actively implementing power management

Status

A baseline energy use analysis performed in FY 2011 estimated that lab-wide power consumption due to desktop and laptop computers was 2.7M kWh annually. Argonne ensures use of power management, duplex printing, and other energy-efficient options and features on all eligible electronic products. A pilot in FY 2012 calculated a 44.6% reduction in energy consumption using these techniques.

During FY 2013, Argonne also set all its eligible printers and copiers to duplex printing by default.

Additionally, the laboratory also contributed to desktop power management and responsible electronic stewardship through the following efforts:

- Purchased laptop computer units that were 85% EPEAT Gold; 12% bronze; and 3% non-EPEAT;
- Purchased Desktop computer units that were 10% EPEAT Gold and 90% bronze;
- Purchased LCD monitors were that 81% EPEAT Gold; 1% Silver; and 18% non-EPEAT; and
- 46 tons of electronics (computers, printers, monitors, toner cartridges, and miscellaneous electronics) were recycled by a certified recycler in FY 2013.

Plans

Argonne will continue to promote the importance of computer power management in its programmatic areas and support will be provided to put this management in place.

The laboratory will continue to manage electronics from purchase through end-of-life disposition to ensure responsible electronic stewardship while meeting applicable DOE goals.

7.5% of annual electtricity consumption from renewable sources | 8.1

8.0 RENEWABLE ENERGY

8.1 Annual Electricity Consumption from Renewable Sources

Goal 20% of annual electricity consumption from renewable sources by FY 2020

2013 Target 7.5%

Status 8%

Status

Argonne is meeting on-site renewable energy goals primarily through the purchase of Renewable Energy Credits (RECs). Table 7 describes the laboratory's renewable and clean energy status and strategies.

Table 7: Renewable and Clean Energy Projects

Project	Plan	FY 2013 Status
SPC #4: Combined Heat and Power	Begin construction in FY14	Final review being conducted by DOE
Solar PV array	Install small-scale solar PV array on-site	109 kW solar array installed
Wind turbine	Install wind turbine on-site	10 kW wind turbine installed
Purchase RECs	Purchase credits to meet balance of goal versus on-site generation	Purchases made in FY 2013 account for 8% of electrical power use
Develop biofuel combustion capability	Continue efforts to use biofuel in solid fuel boiler	Renewable solid fuel market was cost-prohibitive in FY 2013. Will reevaluate in FY 2014, based on NREL's assessment update and market price.
Ground source heat pumps	Complete installation of geothermal heat pump at building 224	Building 224's 23-ton geothermal heat pump system installation was completed
Large-scale solar photovoltaic array	Evaluate the potential for large-scale (10 MW) solar array to offset programmatic growth	Explored Power Purchase Agreements (PPA) financing. Current maximum 10-year contract duration not favorable for developers.

Plans

Argonne is evaluating the feasibility of other clean energy systems, such as fuel cells. Smaller scale renewable energy installations will be considered, including solar outdoor lighting and possibly solar thermal or hybrid solar thermal/PV systems, at the Building 213 cafeteria, the Argonne Guest House, and in the design of new construction.

Solar Photovoltaic Systems

In FY 2013, Argonne ***expanded its 95 kW solar PV array, installed in FY 2012, by 14 kW for a total capacity of 109 kW***. The expansion was accomplished by adding 60 polycrystalline panels. With this most recent expansion, all three commercially-available solar PV panel types are represented: thin film, monocrystalline, and polycrystalline.

The solar array consists of more than 700 PV panels and provides electricity for the laboratory's Emergency Operations Center (EOC) located in Building 372. It generates about 120,000 kilowatt-hours per year, saving about $8,000 and 110 MT CO2e annually. The solar panels are coated with anti-reflective glass to improve power delivery and approach 20% solar-to-direct current conversion efficiency.

Argonne researchers use the solar PV system to study the performance of different panel materials in a Midwestern environment. Data collected will be used to deploy bench scale quantities of experimental solar panel material and to improve the accuracy of solar power forecasting.

To this end, Argonne researchers partnered with IBM to innovate forecasting technology. Information gained by integrating data processing, machine learning and atmospheric cloud modeling will help grid managers and power plant operators better manage the unevenness of solar generation. This management could lead to more efficient and cost-effective energy distribution.

Argonne's 109 kW solar farm provides power to a nearby building, saving the lab about $10,000 and 109 metric tons of GHG annually.

Solar Photovoltaic Systems (Cont.)

Argonne's Solar Array was expanded in FY 2013 and is used for both research and to power nearby buildings.

The gas-fired CHP plant scheduled for FY 2015 construction is anticipated to provide 5.8 MW of electric power. Although the capacity is insufficient to fully offset the anticipated spike in electricity consumption from a new high performance computing pre-exascale facility, it will contribute significantly to the laboratory's GHG emissions reduction.

Wind Turbine Systems

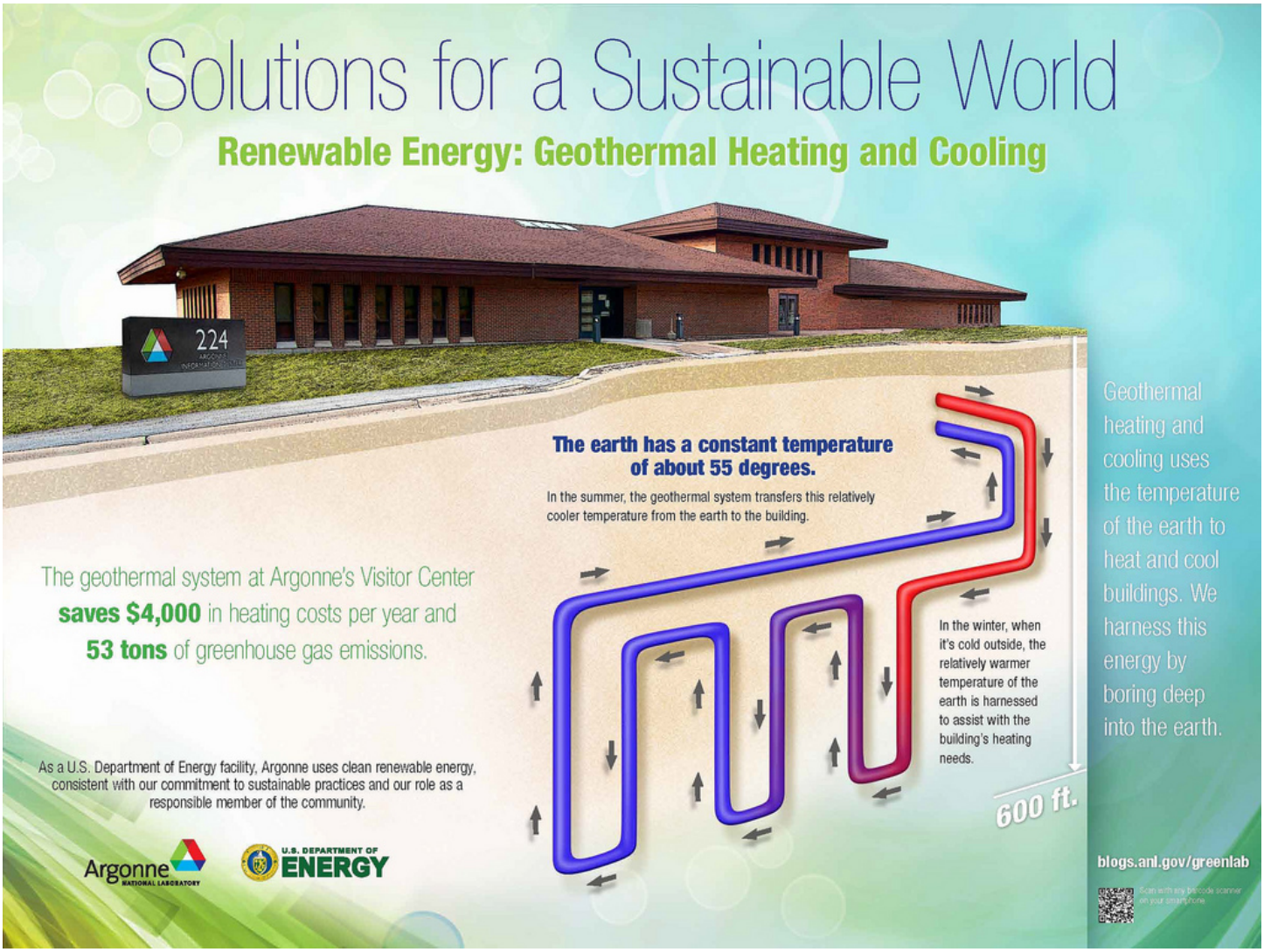
In FY 2012, a 10 kW wind turbine was installed in the east area of Argonne's site. The system sits atop a 100-foot tower that provides electricity for the laboratory's shipping, receiving, and vehicle maintenance facility. It generates

about 20,000 kW-hours per year and avoids about 20 MT of CO_2e per year.

Argonne scientists and engineers are using the wind turbine to study the interaction of wind energy, electric vehicle charging, the electric grid, tribology, and energy storage. In addition to other benefits, generating and using this zero-carbon electricity on site reduces distribution losses, as compared to purchased electricity.

Geothermal Heat Pump System

Installation of a geothermal heat pump system in the Building 224 Visitors Center was completed in FY 2012. The smart geothermal system eliminated on-site fossil fuel combustion of approximately about 668 million Btu of natural gas per year. This is roughly equivalent to 78,100 lbm of CO_2 per year.



Renewable Energy Credits

Argonne supplements a portion of renewable electricity consumption not generated on site by purchasing Renewable Energy Credits (RECs). Power demands are expected to almost double with the FY 2015 and FY 2018 installation of pre-exascale computing system facilities. Although the preferred choice would be to offset GHG emissions through on-site production of renewable energy, REC purchases will likely be pursued as the GHG offset mechanism, since they are much more affordable compared to construction of wind or solar systems.

To assist DOE in meeting its renewable energy goals, Argonne purchased RECs based on electricity generation from biomass (Table 8). These 24,000 MWh represent 8% of FY 2013 site electricity consumption.

Table 8: Renewable Energy Credit Purchases

FY	Purchased RECs (MWh)	Unit Cost ($/MWh)	Total Cost ($k)
FY11 (actual)	21,000	$0.45	$9.5
FY12 (actual)	21,000	$0.43	$9.0
FY13 (actual)	24,000	$0.44	$10.6

9.0 CLIMATE CHANGE ADAPTATION

Climate change adaptation differs from climate change mitigation. Specifically, climate change adaptation can be described as “measures to improve our ability to cope with or avoid harmful impacts and take advantage of beneficial ones, now and in the future” (source: U.S. Global Change Research Project - USGCRP).

Argonne is addressing climate change adaptation in a multifaceted manner as described in the following goals and objectives:

9.1 Goal 1: Improve the Understanding of Climate Change Effects and Impacts

Argonne’s Joint Center for Energy Storage Research brings together scientists and engineers from academia, national laboratories, and private industry, and provides them with the tools and institutional backing they need to discover new materials, accelerate technology development, and commercialize revolutionary new energy storage technologies a key component to increased use of renewables.

Another energy storage project being led by Argonne in collaboration with four partners is improvement of the high-resolution computer modeling and simulation of advanced pumped-storage (PS) hydropower facilities. Advanced PS designs have the flexibility and technical capabilities to integrate clean energy into the electric grid. PS plants work somewhat like a large battery: to "charge" the plant, relatively low-cost electricity is used to pump water uphill from a lower reservoir to a higher one, generating power to satisfy peak demand on the grid.

In the area of solar photovoltaic power generation, one of several avenues of solar energy research are currently underway as part of the ***Argonne-Northwestern Solar Energy Research Center*** (ANSER), a collaborative enterprise that seeks to investigate a number of possible improvements to the current generation of photovoltaic devices. At ANSER, an Energy Frontier Research Centers established by DOE’s Office of Science, organic solar cells are of particular interest.

Argonne and the ***Illinois Tollway*** are conducting a fleet research study aimed at identifying fuel cost savings and efficiencies that will make the tollway more sustainable. Argonne researchers are looking for ways to improve fuel economy, reduce vehicle idling, and study vehicle aerodynamics.

9.2 Goal 2: Improve Understanding of Climate Change Vulnerabilities and Risk

Argonne operations teams regularly evaluate risks to the site’s critical systems. In FY 2012, a risk-based reliability assessment was completed to evaluate vulnerabilities of the central chilled water system and electrical system. In FY 2013, a Feasibility Study of Redundancy Options for Industrial Water Supply was conducted, determining a methodology to increase the stability of supply for industrial cooling water using wastewater and municipal water.

Integrating renewable, distributed generation sources presents a different challenge. Demand and production

patterns are being altered radically by the advent of smart grids, renewable generation, hybrid electric vehicles, and storage technologies. To address these challenges, Argonne is working on developing, analyzing, and integrating predictive models of system behavior, new optimization-based sampling approaches, and scalable algorithms with a ***goal to ensure the efficiency and resiliency of critical energy systems***. The findings will be applied to DOE mission-critical problems: next-generation architectures for electricity generation, storage, and distribution; predictive control of cascading blackouts; and real-time contingency analysis.

NOTE: Goal 3 of the DOE Climate Change Adaptation Plan has been excluded from this section as it is not applicable to individual sites.

9.3 Goal 4: Improve the Climate Resiliency of all DOE Sites

In addition to the SSP, Argonne plans to update its other related plans and strategies to address climate change adaptation considerations (e.g., its site modernization plan, as well as infrastructure and construction specifications).

At a research level, in order to determine the complex interconnectedness between factors that influence climate, Argonne is working with partners to develop next-generation high performance pre-exascale computing.

The existing supercomputing facility Mira is being used at Argonne for various simulations, including climate change-related projects. For example, the ***Mira computing facility is used to understand the role of clouds in climate***. The goal of this project is to explore the frontier of weather prediction and climate modeling with the newly developed Geophysical Fluid Dynamics Laboratory's global cloud-resolving model, and to validate the global cloud-resolving climate models via hurricane hindcasts.

The existing supercomputing facility Mira is being used at Argonne for various simulations, including climate change-related projects.

Site Innovation

Argonne has long been an innovator in clean energy technology and climate change evaluation. Research divisions throughout Argonne are currently working in many areas of sustainability, including energy storage, resource efficiency, electric transportation systems, alternative fuels, and solar energy.

The intent is to work with and share ideas with other organizations – national laboratories, government agencies, universities, and industry – to expand the benefits of sustainability innovation to the Argonne site and elsewhere. Where appropriate, Argonne would license new technologies to firms for deployment through their customers.

Continuing sustainability projects include:

1. Energy Storage Research
2. Renewable Power Production Optimized Through Weather Forecasting
3. Generation of Biofuels Using Household Bioreactors
4. Aquifer Thermal Storage
5. Midwest Photovoltaics Analysis
6. Fuel Cell Applications with Waste Heat Recovery, Thermal Storage, and Renewable Fuels
7. Advanced Building Controls through Predictive Modeling

Management and Funding

Management Structure and Staffing

Figure 12 depicts the organization of Argonne's sustainability program team.

Budget/Funding

Funding is prioritized to achieve goals in the areas of greenhouse gas reductions (all three scopes), water, energy (for buildings, data centers), high performance sustainable buildings, advanced metering, cool roofs, renewable energy, and more. In addition to indirect funding, other avenues are explored as well, including alternative financing mechanisms and reinvestment programs. Funding for FY 2013-15 is summarized in Table 9.

Other sources of funding include Institutional General Plant Projects and major repair funding. Often, funding from different sources is combined for implementation. Sustainability project funding in FY 2013 was $2.9 million, but was dropped to $2.5 million in FY 2014 due to budget constraints.

Reinvestment Program

Argonne created an in-house energy savings reinvestment program in late FY 2008. The energy/water savings from each project are re-paid annually until the project pays back the initial capital investment cost. Received funds are reinvested in new energy/water savings projects. Over the last four-year period (FY 2009-FY 2013), about 62,000 million Btu, 51 million gallons of potable water, and over 12 million gallons of industrial water have been saved annually as a result of implemented energy and water conservation measures. This translates into $861,000 that has been requested for reinvestment into energy and water savings measures. A measurement and verification engineer is assigned to verify savings.

Table 9. Funding Summary, FY 2013 - FY 2015*

Task	FY 2013 Actual ($K)	FY 2014 Budgeted ($K)	FY 2015 Projected ($K)
Metering	554	400	400
HPSB Upgrades	337	175	250
Energy & Water Reduction	935	950	890
CHP Program	114	145	200
Scope 3 Reduction Efforts	615	85	85
Industrial Water Conservation	39	90	50
Outreach	72	150	125
Administration Effort	209	415	400
Research Support	0	40	50
Renewables	0	0	0
Other Scope 1 & 2 Reduction Efforts	41	0	0
TOTALS	**$ 2,915**	**$ 2,450**	**$ 2,450**

* Note: Funding Summary includes both sustainability program funds as well as energy savings reinvestment funds.

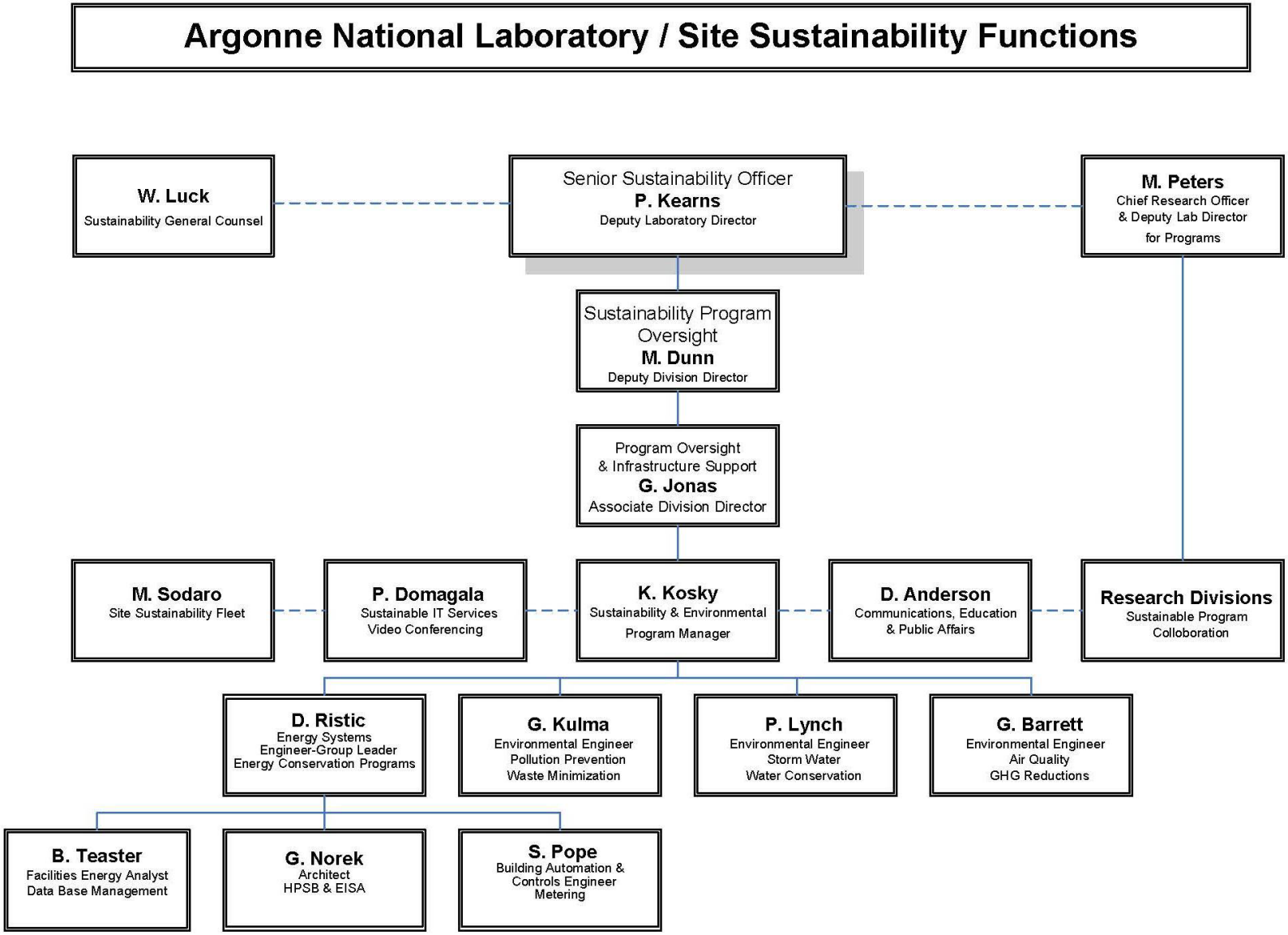


Figure 12: Argonne Sustainability Organizational Chart

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

Argonne has four scientific user facilities (HEMSFs) listed in the DOE Office of Science database. Figure 13 identifies the location of Argonne HEMSFs: APS/CNM, ATLAS, and ALCF BG/P, and TCS (ALCF BG/Q).

Cumulatively, the total HEMSF and HEMSF-related annual electricity consumption is approximately 190,000 MWh, comprising about 64% of total site electricity consumption. The HEMSF impact to electricity consumption is detailed in Figure 14.

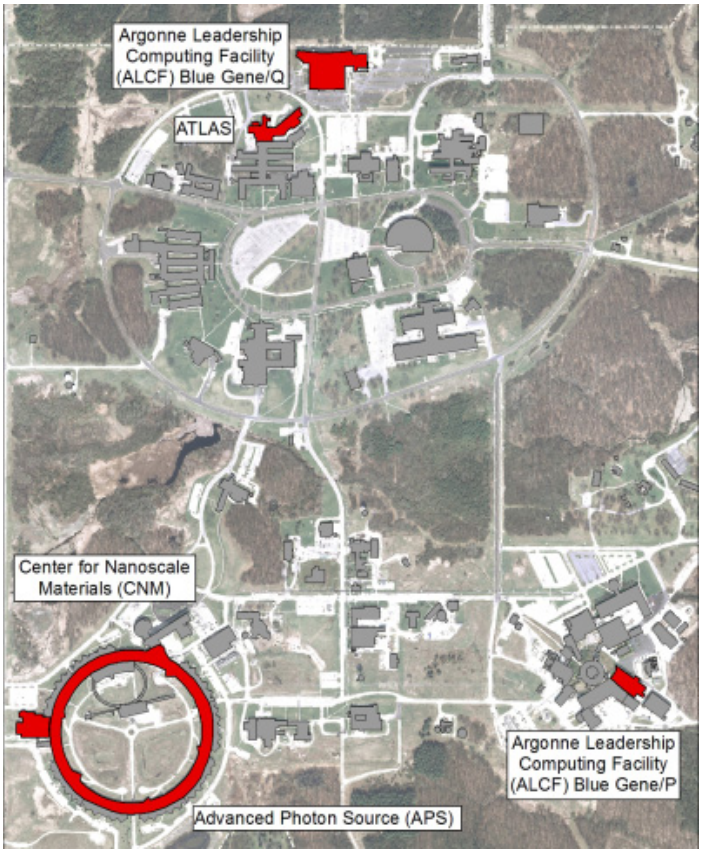
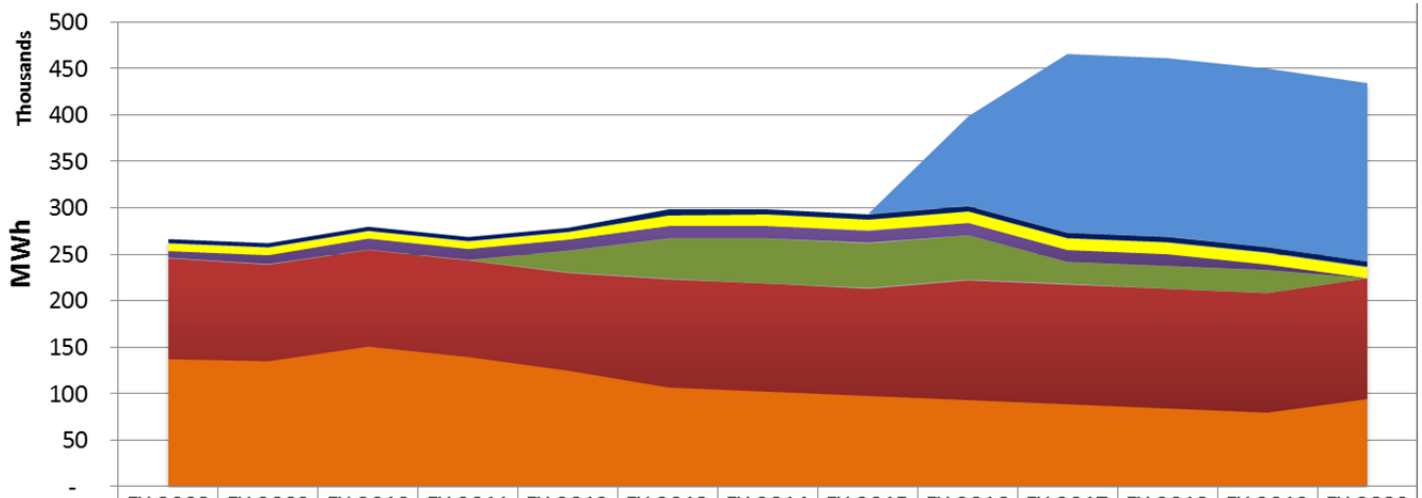


Figure 13: Location of Argonne HEMSFs



	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
LCF-3 (TCS 240, pre-exascale)	-	-	-	-	-	-	-	-	96,360	192,720	192,720	192,720	192,720
CNM (440)	3,878	4,448	4,368	4,526	4,542	5,677	5,677	5,677	5,677	5,677	5,677	5,677	5,677
ATLAS (203)	7,966	7,465	7,969	7,528	7,321	12,257	12,257	12,257	12,257	12,257	12,257	12,257	12,257
LCF - BG/P (369)	7,653	10,355	12,669	12,216	12,320	13,322	13,322	13,322	13,322	13,322	13,322	6,661	-
LCF - BG/Q (TCS 240, Mira, Intrepid)	-	-	-	-	23,348	43,520	48,500	48,500	48,500	24,250	24,250	24,250	-
APS Area (incl. upgrade and Bld 450)	108,261	102,942	102,920	103,522	104,727	115,252	115,000	115,000	128,140	128,140	128,140	128,140	128,140
Base (Site less HEMSFs)	138,123	136,664	152,106	140,429	125,967	108,335	103,668	99,002	94,335	89,668	85,002	80,335	96,123

Figure 14: Site Electricity Consumption with HEMSFs (excluding PUE for HPC), FY 2008-2020

Advanced Photon Source and Center for Nanoscale Materials

The APS is an accelerator that creates high-energy X-ray beams that allow scientists to pursue new knowledge about the structure and function of materials.

Based on four findings listed in the National Energy Conservation Policy Act (NECPA), the APS is considered an excluded building under criterion G ("metered intensive load"). The APS storage ring has an annual electricity consumption of 55,000 MWh, and the dedicated APS utility facility (Building 450) has an annual ring-related consumption of 49,000 MWh. Thus, total annual APS-related electricity exceeds 100,000 MWh.

The CNM (Building 440) is connected to the APS. It is a facility for interdisciplinary nanoscience and nanotechnology research. Based on four findings listed in NECPA, CNM is considered an excluded building under criterion G ("metered intensive load"). CNM-related annual consumption is approximately 4,600 MWh.

CNM is a LEED Silver Certified building.

Argonne Leadership Computing Facility

The ALCF provides leadership-class computing resources. The ALCF (Building 369) houses one of the fastest open-science supercomputers in the world, the IBM Blue Gene/P Intrepid. Based on four findings listed in the NECPA, the ALCF is considered an excluded building under criterion G ("metered intensive load"). Annual ALCF-related electricity consumption is about 12,500 MWh.

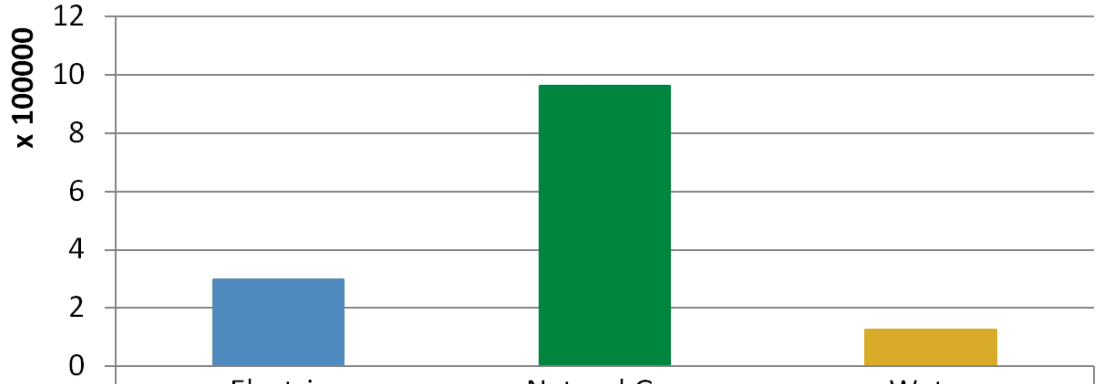
Argonne Tandem Linear Accelerator System

The ATLAS is a facility for fundamental nuclear physics research and provides a wide range of beams for nuclear reaction and structure research. ATLAS is located in Building 203. Based on four findings listed in the NECPA, ATLAS could be considered an excluded facility. However, electric power is supplied to ATLAS through six substations, which also supply electric power to Building 203. Since ATLAS-related consumption is not an overwhelming portion of Building 203 consumption, the entirety of Building 203 (including ATLAS) is considered goal-subject.

Argonne Leadership Computing Facility BG/Q

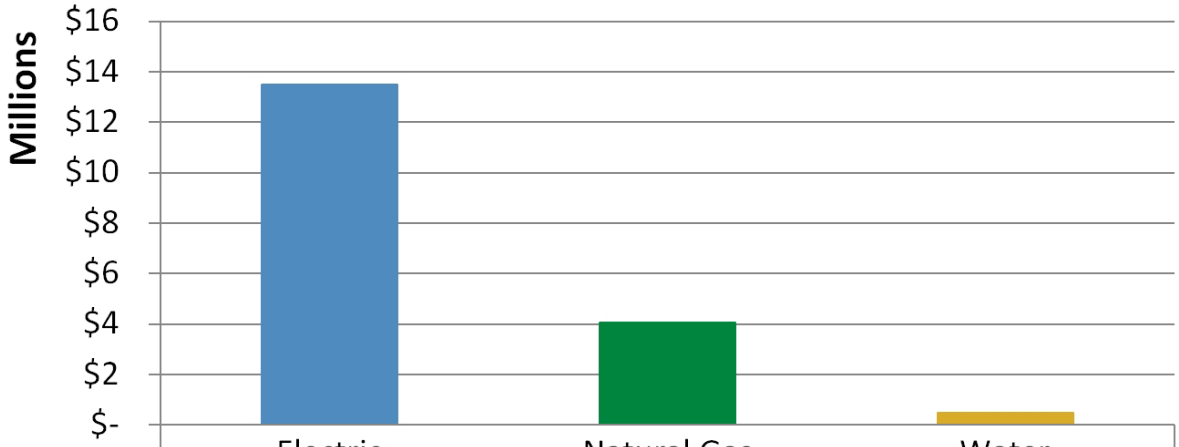
ALCF BG/Q, a high performance computing facility, is the newest operating HEMSF at Argonne. Located in Building 240, the TCS building is a world-class research center that supports large-scale computation. The building provides a much-needed infrastructure for large-scale computers, computational laboratories, a digital conference and meeting area, and a consolidated Argonne library. The high performance computing facility is a 25,000 square-foot wing in which the ALCF and other key computing projects conduct research on state-of-the-art computing systems that include the IBM Blue Gene/Q, named Mira, one of fastest computers in the world.

Utility Costs



	Electric	Natural Gas	Water
Consumption	298,363	963,477	127,095
Units	MWh	Dth	kGal

Figure 15: Utility Consumption, FY 2013



	Electric	Natural Gas	Water
Cost	$13,492,361	$4,045,784	$496,741

Figure 16: Utility Costs, FY 2013

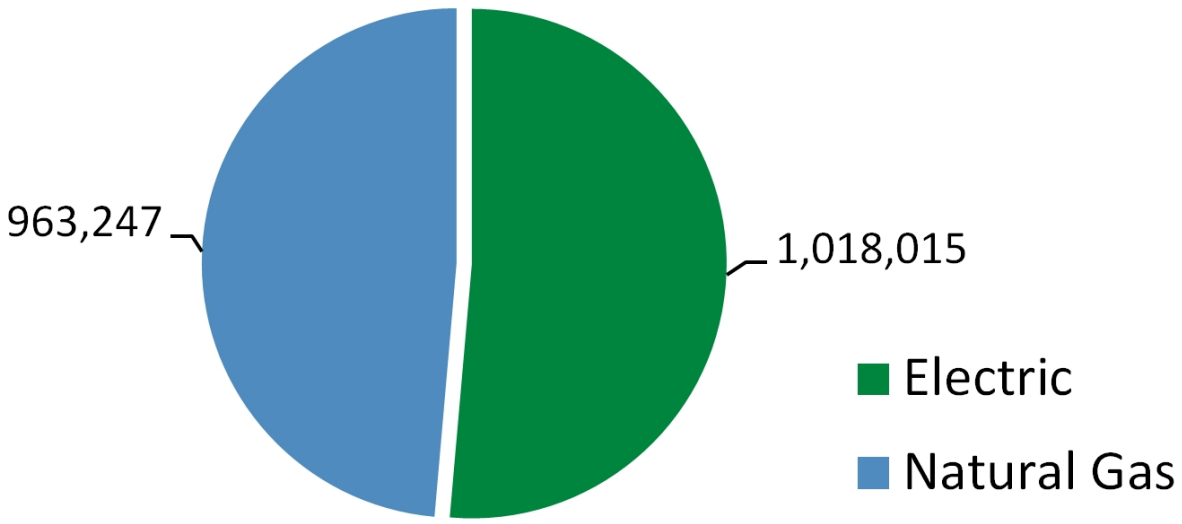


Figure 17: Energy Breakdown, FY 2013 (MBtu)

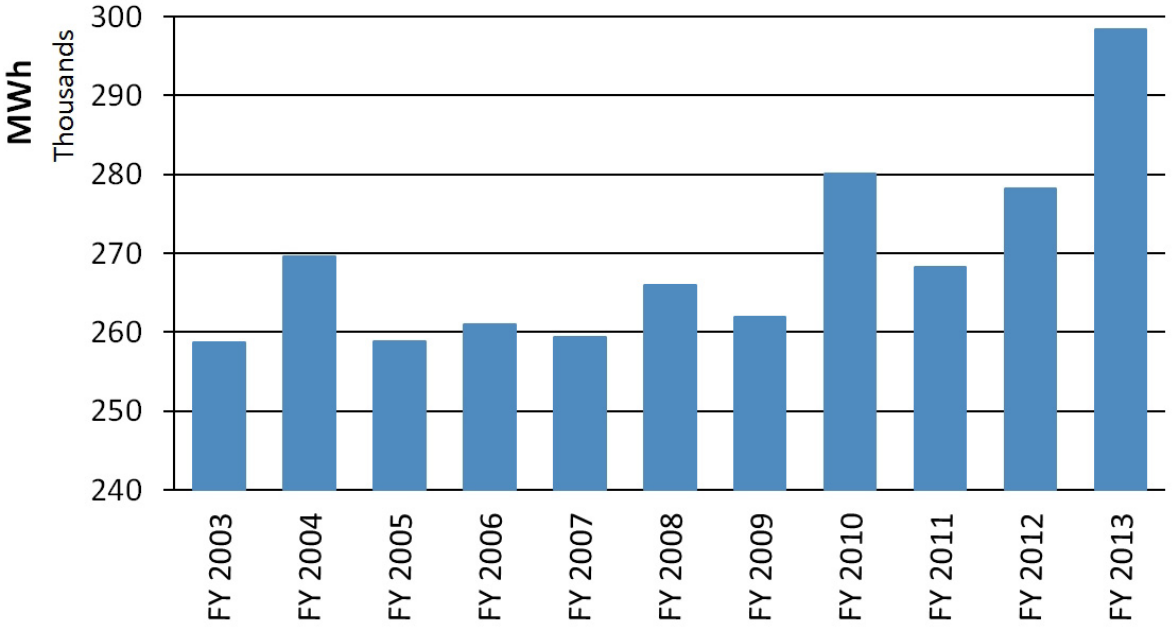


Figure 18: Site Electricity Consumption FY 2003-2013

blogs.anl.gov/greenlab

Printed on 30% post-consumer recycled content paper

ARGONNE NATIONAL LABORATORY

SITE SUSTAINABILITY PLAN

FOR MORE INFORMATION
Argonne Sustainability Program Office
9700 S. Cass Avenue | Argonne, IL 60439
630.252.2000 | **sustainability@anl.gov**

U.S. DEPARTMENT OF ENERGY

Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

Argonne NATIONAL LABORATORY