

SITE SUSTAINABILITY PLAN

Fiscal Year 2020



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Acronyms

AFV	alternative fuel vehicle
AHU	air handling unit
ALCF	Argonne Leadership Computing Facility
AMOS	Argonne Materials Ordering System
APS	Advanced Photon Source
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ATLAS	Argonne Tandem Linac Accelerator System
BAS	building automation system
BB	Better Buildings (program)
CEQ	Council on Environmental Quality
CHP	combined heat and power
CFCs	chlorofluorocarbons
CORAL	Chemical Ordering, Reporting and Attributes Library
DC	direct current
DOE	U.S. Department of Energy
DEAR	Department of Energy Acquisition Regulations
EEP	environmentally preferable
ECM	energy and water conservation measure
EDC	Enterprise Data Center
EISA	Energy Independence and Security Act
E-bikes	electric assist bicycles
E.O.	Executive Order
EPEAT	Electronic Product Environmental Assessment Tool
ESPC	energy savings performance contract
EUV	electric utility vehicle
EV	electric vehicle
FAR	Federal Acquisition Regulations
FDD	fault detection, data analytics, and visualization
FY	fiscal year
GEM	Global Electric Motorcars
GHG	greenhouse gas
GPS	global positioning system
GSA	General Services Administration
GSF	gross square foot (feet)
HEMSF	High-Energy Mission-Specific Facility
HPC	high-performance computing
HPSB	High-Performance Sustainability Building
HVAC	heating, ventilation, and air conditioning
ILA	industrial, landscaping, and agricultural
IPM	integrated pest management
ISO	International Organization for Standardization
ISTC	Illinois Sustainable Technology Center
LBB	Long Beamline Building
LED	light-emitting diode
LEED	Leadership in Energy and Environmental Design

LMS	Laboratory Management System
LOM	laboratory office module
MABAS	Mutual Aid Box Alarm System
MAG	Mobility Advisory Group
MDL	Materials Design Laboratory
MSW	municipal solid waste
M&V	measurement and verification
NEPA	National Environmental Policy Act of 1969
PARIS	Procurement and Requisition Integrated System
PPA	power purchase agreement
PUE	power usage effectiveness
PV	solar photovoltaic
R2	Responsible Recycling
RCx	retrocommissioning
REC	renewable energy credit
SLA	Smart Labs Accelerator
SPO	U.S. Department of Energy Sustainability Program Office
T&D	transmission and distribution
TCS	Theory and Computing Science
UESC	utility energy services contract
USGS	U.S. Geological Survey
VFD	variable frequency drive
WWT	wastewater treatment

Executive Summary

Argonne National Laboratory's (Argonne's) Sustainability Program supports world-class science and engineering breakthroughs, addresses deferred maintenance, and improves operations. This delivers cost savings and reduces Argonne's environmental impacts. Across energy, water, waste, and green buildings, Argonne has significantly reduced resource use and increased efficiency.

The Fiscal Year (FY) 2020 Site Sustainability Plan (SSP) documents Argonne's plans and current progress toward meeting federal sustainability requirements. The SSP is designed to meet sustainability requirements outlined in the U.S. Department of Energy (DOE) Order 436.1, "Departmental Sustainability," relevant Executive Orders (E.O.s), and other statutory requirements. Performance data and progress is tracked using the DOE's online Sustainability Dashboard tool and through Argonne's International Organization for Standardization (ISO) 14001 certified Environmental Management System.

The FY 2020 SSP builds upon Argonne's long-term site planning and infrastructure modernization efforts. Although mission priorities will result in an increase in site-wide energy use, annual tracking of energy and water use for goal-subject buildings will help demonstrate an increase in efficiency of Argonne's buildings and infrastructure. Table ES-1 outlines Argonne's current progress, compared to sustainability goals set forth in E.O. 13834, "Planning for Federal Sustainability in the Next Decade." Plans and projected performance for the next 2, 5, and 10 years are also provided in this table.

For more than a decade, Argonne has been implementing a dynamic Sustainability Program that has resulted in measurable progress toward optimizing energy and environmental performance, reducing waste, and cutting costs. The sustainability accomplishments Argonne achieved during FY 2019 included the following:

- **Increased efficiency and promoted safety with Smart Labs Program:** Formalized Argonne's Smart Labs Program to optimize Laboratory facilities focusing on energy efficiency, safe ventilation, and enhanced operations; completed assessments at Buildings 401 and 362, while completing improvements at Building 200. *More information is provided in Section 1, Energy Management.*
- **Improved stormwater drainage and increased green infrastructure with Coal Yard Restoration Project:** Restored 5 acres of land and established it as a green infrastructure asset for the Argonne campus; provided natural drainage and native plants that will divert 16 million gallons of stormwater annually, resulting in approximately \$13,000 of cost savings annually. *More information is provided in Section 2, Water Management.*
- **Increased waste diversion and reduced energy use through Green Action Team:** Partnered with Building 362 occupants to create the Green Action Team (GAT) to develop building specific projects that advance site-wide sustainability goals; implemented projects including compost collection in break rooms, addition of no-idling signs, and improved recycling containers. *More information is provided in Section 3, Waste Management.*
- **Improved resilience through comprehensive planning and maintenance:** Completed master plan for solar photovoltaics across the campus and improved reliability, resilience, and efficiency of the site-wide steam system with a two-week maintenance effort. *More information is provided in Section 5, Clean and Renewable Energy, and Section 12, Resilience.*
- **Improved safety and reduced waste with green cleaning program:** Added green window washing equipment to portfolio of green cleaning products, building on a 10-year initiative to improve safety and save money across all custodial activities; recognized by the DOE Federal GreenBuy Program for use of green cleaning products. *More information is provided in Section 7, Acquisition and Procurement.*
- **Reduced cost of operating and maintaining facilities:** Completed performance period for two Energy Savings Performance Contracts (ESPCs) that improved facilities and utility systems to ensure reliable and efficient operations at the Laboratory, saving Argonne \$20,620,690 over the life of the two contracts; implemented 24 energy and water savings projects, adding \$90,177 in annual savings to Argonne's portfolio of projects implemented under the In-House Energy and Water Reinvestment Program. *More information is provided in Section 8, Measures, Funding, and Training.*
- **Identified stakeholder value and needed investments for Green Ride Program:** Collected input from 826 occupants during the Laboratory-wide Green Ride Program survey to inform investments in Bike Share, Ride Share, and Electric Vehicle Charging Programs. *More information is provided in Section 9, Travel and Commute.*

Argonne's Sustainability Program continues to align SSP activities with the overall Laboratory strategy and to embed sustainability strategies within day-to-day operations. This integrated approach efficiently uses limited resources to achieve bold sustainability goals and support Argonne's scientific and engineering research mission. As a result, Argonne's Sustainability Program drives impacts that reach every corner of the Laboratory.

In FY 2019, the U.S. Environmental Protection Agency (EPA) recognized Argonne for its lab-wide sustainability impacts with a 2019 Federal Green Challenge Award. (Figure ES-1).



Figure ES-1: Argonne Team Recognized by EPA for the 2019 Federal Green Challenge Award

The award, administered by EPA Region 5, encourages federal agencies to lead by example in reducing the federal government's environmental impact. Argonne won a regional Federal Green Challenge award in FY 2019 for conserving resources and saving taxpayers' money in the following categories:

- **Electronics:** 99% increase in EPEAT-registered electronics purchased
- **Transportation:** 57% increase in miles not traveled due to teleworking
- **Waste:** 285% increase in municipal solid waste recycling from Disposal Days and construction material
- **Water:** 16% increase in stormwater captured by converting 3.5 acres from turf grass to prairie grasses
- **Innovation:** Disposal Days Project helped staff clean out offices and lab spaces and recycle or properly dispose of materials

The Disposal Days Project delivered impact across the Laboratory. Thirty-five buildings participated and over 90 tons of material were collected. More than 70% of the material was recycled, including 30 metric tons of electronics and 36 metric tons of scrap metal. Argonne leveraged a wide team from across its operations and research divisions to help identify and prepare materials for collection. Disposal Days helped to free up space for additional research and made the Laboratory safer overall.

Argonne will continue to make the Laboratory campus more sustainable and create new opportunities for employees and visitors to participate in solutions. The Sustainability Program will develop new partnerships to leverage campus infrastructure as a living laboratory and promote research in energy and the environment.

Table ES-1: Executive Summary Table of DOE Sustainability Goals based on the SSP and E.O. 13834

Prior DOE Goal	Current Performance Status	2 Year Performance & Plans	5 Year Performance & Plans	10 Year Performance & Plans
Energy Management				
30% energy intensity (Btu per gross square foot [GSF]) reduction in goal-subject buildings by FY 2015 from a FY 2003 baseline and 1.0% year over year (YOY) thereafter.	<p>Current Performance: -8% (202,869 Btu/GSF)</p> <p>Note current performance assigned chilled water to non-goal-subject (non-GS) buildings due to metering issues. Plan to include energy from chilled water use at buildings starting in FY 2021 after metering inventory and update.</p> <p>Refer to Table 1 for energy and water impacts of high-performance computing (HPC).</p>	<p>FY 2021 Projection: -5% (207,142 Btu/GSF)</p> <p>Planned 1% annual reduction YOY; projection includes energy from chilled water use at buildings.</p> <p>Implement Retrocommissioning (RCx) Program with Smart Labs strategies; implement Fault Detection and Diagnostics (FDD) platform at two buildings, incorporate Guiding Principles for HPSB across all projects based on complexity and extent of scope.</p>	<p>FY 2024 Projection: -8% (200,801 Btu/GSF)</p> <p>Planned 1% annual reduction YOY; projection includes energy from chilled water use at buildings.</p> <p>Continue Smart Labs strategies; identify energy efficiency strategies through ongoing commissioning with FDD platform.</p>	<p>FY 2029 Projection: 13% (190,232 Btu/GSF)</p> <p>Planned 1% annual reduction YOY; projection includes energy from chilled water use at buildings.</p> <p>Continue Smart Labs strategies; identify energy efficiency strategies through ongoing commissioning with FDD platform.</p>
EISA Section 432 continuous (4-year cycle) energy and water evaluations.	<p>Current Performance: On target</p>	<p>FY 2021 Projection: On target</p> <p>Leverage RCx program for EISA evaluations and continue as required.</p>	<p>FY 2024 Projection: On target</p> <p>Leverage RCx program for EISA evaluations and continue as required.</p>	<p>FY 2029 Projection: On target</p> <p>Leverage RCx program for EISA evaluations and continue as required.</p>
Meter all individual buildings for electricity, natural gas, steam, and water, where cost-effective and appropriate.	<p>Current Performance: 100% of facilities metered for electricity, steam, natural gas, and chilled water where cost-effective</p>	<p>FY 2021 Projection: 100% of facilities metered</p> <p>Continue installing advanced metering; add chilled water meters at buildings, implement FDD platform at two buildings. Planned project to address issues with chilled water meters.</p>	<p>FY 2024 Projection: 100% of facilities metered</p> <p>Continue installing advanced metering; add chilled water meters at buildings, implement FDD platform at additional buildings.</p>	<p>FY 2029 Projection: 100% of facilities metered</p> <p>Continue installing advanced metering; add chilled water meters at buildings, full implementation of FDD platform complete.</p>

Prior DOE Goal	Current Performance Status	2 Year Performance & Plans	5 Year Performance & Plans	10 Year Performance & Plans
Water Management				
20% potable water intensity (million gallons [MG] per GSF) reduction by FY 2015 from a FY 2007 baseline and 0.5% YOY thereafter.	Current Performance: -40%	FY 2021 Projection: -43% (21.87 MG/GSF) Planned 0.5% annual reduction below 2019 levels. Evaluate water efficiency in RCx and Smart Labs programs; retrofit and decommission bathrooms, continue once-through to closed-loop conversions.	FY 2024 Projection: -43.9% (21.4 MG/GSF) Planned 0.5% annual reduction below 2019 levels. Evaluate water efficiency in RCx and Smart Labs programs; retrofit and decommission bathrooms, continue once-through to closed-loop conversions.	FY 2029 Projection: -45.3% (20.8 MG/GSF) Planned 0.5% annual reduction below 2019 levels. Evaluate water efficiency in RCx and Smart Labs programs; retrofit and decommission bathrooms, continue once-through to closed-loop conversions.
Non-potable freshwater consumption (MG) reduction of industrial, landscaping, and agricultural (ILA). YOY reduction; no set target.	Current Performance: -6.9% (176.1 MG) Recommend tracking canal water attributed to HPC facilities separate from other site-wide use. Refer to Table 1 for energy and water impacts of HPC.	FY 2021 Projection: -4% Baseline Use: -6% (165.9 MG) HPC Use: 22.4 MG Implement integrated energy and water management strategy; implement chilled water efficiency project at Bldg. 202 and complete planning for chilled water efficiency at next target building.	FY 2024 Projection: 17% Baseline Use: -7% (164.2 MG) HPC Use: 56.7 MG Implement integrated energy and water management strategy; extend central chilled water system to 200 area to improve energy and water efficiency and reliability of cooling system.	FY 2029 Projection: 16% Baseline Use: -8% (162.1 MG) HPC Use: 56.7 MG Implement integrated energy and water management strategy; extend central chilled water system to 200 area to improve energy and water efficiency and reliability of cooling system.
Waste Management				
Reduce at least 50% of nonhazardous solid waste, excluding construction and demolition debris, sent to treatment and disposal facilities.	Current Performance: 62% (861 tons)	FY 2021 Projection: 60% (844 tons) Continue composting program implementation, adding break rooms and kitchenettes in 20 buildings; continue pollution-prevention outreach and education campaigns.	FY 2024 Projection: 57% (819 tons) Expand composting program to all buildings; develop and implement green meeting toolkit.	FY 2029 Projection: 52% (778 tons) Continue composting program; increase focus on waste reduction and sustainable materials management.
Reduce construction and demolition materials and debris sent to treatment and disposal facilities. YOY reduction; no set target.	Current Performance: 63%	FY 2021 Projection: 80% Continue to divert construction and demolition materials and debris from municipal landfills.	FY 2024 Projection: 80% Continue to divert construction and demolition materials and debris from municipal landfills.	FY 2029 Projection: 80% Continue to divert construction and demolition materials and debris from municipal landfills.

Prior DOE Goal	Current Performance Status	2 Year Performance & Plans	5 Year Performance & Plans	10 Year Performance & Plans
Fleet Management				
20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline and 2.0% YOY thereafter.		FY 2021 Projection: Maintain 30–40% reduction	FY 2024 Projection: Maintain 30–40% reduction or better	FY 2029 Projection: Maintain 30–40% reduction
10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter.		FY 2021 Projection: Continue to use biofuel as primary source of alternative fuel	FY 2024 Projection: Continue to use biofuel as primary source of alternative fuel	FY 2029 Projection: Continue to use biofuel as primary source of alternative fuel
75% of light-duty vehicle acquisitions must consist of alternative fuel vehicles (AFVs).		FY 2021 Projection: 100% Continue acquisition of AFVs for light duty	FY 2024 Projection: 100% Continue acquisition of AFVs for light duty	FY 2029 Projection: 100% Continue acquisition of AFVs for light duty
Clean & Renewable Energy				
“Renewable Electric Energy” requires that renewable electric energy account for not less than 7.5% of an agency’s total electric consumption by FY 2013 and each year thereafter.	Current Performance: 10.5% Purchased renewable energy certificates (RECs) to meet 7.5% based on FY 2019 expected electricity use plus 2-year contract for Building 242 LEED credits.	FY 2021 Projection: 65,000 MWh at \$40k–50k for RECs to continue working toward 30% by FY 2025 Continue to purchase RECs to meet required renewable electric goals; increase onsite renewable electric energy with projects that are lifecycle cost-effective. Refer to Section 5 for capacity of potential onsite solar PV systems.	FY 2024 Projection: 168,000 MWh at \$120k–130k for RECs to continue working toward 30% by FY 2025 Continue to purchase RECs to meet required renewable electric goals; increase onsite renewable electric energy with projects that are lifecycle cost-effective. Refer to Section 5 for capacity of potential onsite solar PV systems.	FY 2029 Projection: 184,000 MWh at \$135k–150k for RECs to continue working toward 30% by FY 2025 Continue to purchase RECs to meet required renewable electric goals; increase onsite renewable electric energy with projects that are lifecycle cost-effective. Refer to Section 5 for capacity of potential onsite solar PV systems.
Continue to increase nonelectric thermal usage. YOY increase; no set target, but an indicator in the Office of Management and Budget (OMB) scorecard.	Current Performance: 5%	FY 2021 Projection: Maintain current levels of performance Work with DOE to calculate benefits of combined heat and power (CHP); RECs continue to account for largest portion of clean energy.	FY 2024 Projection: Maintain current levels of performance Work with DOE to calculate benefits of CHP; RECs continue to account for largest portion of clean energy.	FY 2029 Projection: Maintain current levels of performance Work with DOE to calculate benefits of CHP; RECs continue to account for largest portion of clean energy.

Prior DOE Goal	Current Performance Status	2 Year Performance & Plans	5 Year Performance & Plans	10 Year Performance & Plans
Green Buildings				
At least 15% (by count) of owned existing buildings to be compliant with the revised Guiding Principles for HPSB by FY 2020, with annual progress thereafter.	Current Performance: 19.8% (16 out of 83)	FY 2021 Projection: 21% (17 out of 83) Document the new Materials Design Laboratory as compliant. Incorporate Guiding Principles into all building improvement projects based on planned scope and complexity; use RCx program to assess buildings for Guiding Principle compliance.	FY 2024 Projection: 23% (19 out of 83) Document two additional buildings as compliant. Incorporate Guiding Principles into all building improvement projects based on planned scope and complexity; use RCx program to assess buildings for Guiding Principle compliance.	FY 2029 Projection: 26% (21 out of 83) Document two additional buildings as compliant. Incorporate Guiding Principles into all building improvement projects based on planned scope and complexity; use RCx program to assess buildings for Guiding Principle compliance.
Net Zero Buildings: All new buildings (>5,000 GSF) entering the planning process designed to achieve energy net-zero beginning in FY 2020.	Current Performance: 0%	FY 2021 Projection: Work with DOE to address future requirements for Net-Zero Buildings	FY 2024 Projection: Work with DOE to address future requirements for Net-Zero Buildings	FY 2029 Projection: Work with DOE to address future requirements for Net-Zero Buildings
Increase regional and local planning coordination and involvement.	Current Performance: On target	FY 2021 Projection: Continue efforts to coordinate onsite and offsite transportation planning and collaborate with regional stakeholders	FY 2024 Projection: Continue efforts to coordinate onsite and offsite transportation planning and collaborate with regional stakeholders	FY 2029 Projection: Continue efforts to coordinate onsite and offsite transportation planning and collaborate with regional stakeholders
Acquisition & Procurement				
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions and clauses are included in all applicable contracts.	Current Performance: 100% Contracts were updated in May 2019 with most current federal sustainable acquisition clauses and were incorporated into all contracts thereafter.	FY 2021 Projection: 100% Improve sustainable acquisition tracking, develop acquisition guide, and conduct outreach to suppliers.	FY 2024 Projection: 100% Improve sustainable acquisition tracking, develop acquisition guide, and conduct outreach to suppliers.	FY 2029 Projection: 100% Improve sustainable acquisition tracking, develop acquisition guide, and conduct outreach to suppliers.
Measures, Funding, & Training				
Annual targets for sustainability investment with appropriated funds and/or financed contracts to be implemented in FY 2019 and annually thereafter.	Current Performance: Ongoing acquisition planning activities for partnership with utility to implement energy management services	FY 2021 Projection: Explore partnership with local utility to leverage performance contract for implementing RCx and Smart Labs programs and to achieve deep energy retrofits	FY 2024 Projection: Explore partnership with local utility to leverage performance contract for implementing RCx and Smart Labs programs and to achieve deep energy retrofits	FY 2029 Projection: Explore partnership with local utility to leverage performance contract for implementing RCx and Smart Labs programs and to achieve deep energy retrofits

Prior DOE Goal	Current Performance Status	2 Year Performance & Plans	5 Year Performance & Plans	10 Year Performance & Plans
Electronic Stewardship				
Purchases: 95% of eligible acquisitions each year are EPEAT-registered products.	Current Performance: 80%	FY 20210 Projection: 100% Increase communication and outreach to AMOS vendors for electronics to support compliance with requirements.	FY 2024 Projection: 100% Increase communication and outreach to AMOS vendors for electronics to support compliance with requirements.	FY 2029 Projection: 100% Increase communication and outreach to AMOS vendors for electronics to support compliance with requirements.
Power management: 100% of eligible personal computers, laptops, and monitors have power management enabled.	Current Performance: 100%	FY 2021 Projection: 100% Expand power management into non-centrally managed systems (currently exempt).	FY 2024 Projection: 100% Expand power management into non-centrally managed systems (currently exempt).	FY 2029 Projection: 100% Expand power management into non-centrally managed systems (currently exempt).
Automatic duplexing: 100% of eligible computers and imaging equipment have automatic duplexing enabled.	Current Performance: 100%	FY 2021 Projection: 100% Continue deployment of automatic duplexing enabled equipment; reduce non-centrally managed printers and imaging equipment.	FY 2024 Projection: 100% Continue deployment of automatic duplexing enabled equipment; implement tracking system to summarize printing by employee and division.	FY 2029 Projection: 100% Continue deployment of automatic duplexing enabled equipment
End of Life: 100% of used electronics are reused or recycled using environmentally sound disposition options each year.	Current Performance: 100%	FY 2021 Projection: 100% Continue recycling e-waste with an R2-certified recycler; leverage Disposal Days and other programs to recycle backlog of e-waste.	FY 2024 Projection: 100% Continue recycling e-waste with an R2-certified recycler; leverage Disposal Days and other programs to recycle backlog of e-waste.	FY 2029 Projection: 100% Continue recycling e-waste with an R2-certified recycler; leverage Disposal Days and other programs to recycle backlog of e-waste.
Data Center Efficiency: Establish a power usage effectiveness target for new and existing data centers; discuss efforts to meet targets.	Current Performance: 1.4 Power Usage Effectiveness (PUE) for new data centers and 1.9 PUE for existing data centers	FY 2021 Projection: Continue making progress toward DOE power effectiveness targets Work with Business Information Systems (BIS) to consolidate closet data centers and meter remaining data centers.	FY 2024 Projection: Continue making progress toward DOE power effectiveness targets Work with BIS to consolidate closet data centers and meter remaining data centers.	FY 20298 Projection: Continue making progress toward DOE power effectiveness targets Work with BIS to consolidate closet data centers and meter remaining data centers.

Prior DOE Goal	Current Performance Status	2 Year Performance & Plans	5 Year Performance & Plans	10 Year Performance & Plans
Organizational Resilience				
Discuss overall integration of climate resilience in emergency response, workforce, and operations procedures and protocols.	Current Performance: Completed planning activities for two projects to improve organizational resilience, such as upgrades to the high-voltage electrical system and improvements to the canal water system	FY 2021 Projection: Incorporate resilience measures into planned projects for next 2 years	FY 2024 Projection: Complete potable water, canal water, chilled water, and sewer system improvements to increase resilience of these utilities with newly established modernization project	FY 2029 Projection: Complete high-voltage electrical system upgrade and utility system upgrades to increase site resilience; incorporate climate-related hazards of extreme amounts of precipitation and temperature into design guide and infrastructure projects
Multiple Categories				
YOY scope 1 & 2 GHG emissions reduction from a FY 2008 baseline.		FY 2021 Projection: -26% in emissions (229,737 Mt CO2e)	FY 2024 Projection: 23% increase in emissions (381,600 Mt CO2e)	FY 2029 Projection: 21% increase in emissions (374,500 Mt CO2e)
		Implement energy efficiency measures under RCx and Smart Labs programs and as identified by FDD Platform; increase renewable energy onsite where cost-effective; improve refrigerant management; work with DOE to calculate GHG benefits from CHP plant.	New HPC system operating at full capacity, increasing site electricity use by 2x.	New HPC system operating at full capacity, increasing site electricity use by 2x.
YOY scope 3 GHG emissions reduction from a FY 2008 baseline.		FY 2021 Projection: Maintain current levels at -20% below FY 2008 levels.	FY 2024 Projection: Air and ground travel to remain level; employee commuting to decrease due to low- and zero-emission vehicles and increase in telecommuting.	FY 2029 Projection: Air and ground travel to remain level; employee commuting to decrease due to low- and zero-emission vehicles and increase in telecommuting.
		Increase participation in green commuting and telecommuting programs with outreach, new rideshare tool, and more electric vehicle charging stations; work with DOE to calculate GHG benefits from CHP plant.	Continue promotion and investment in green commuting programs and infrastructure.	Continue promotion and investment in green commuting programs and infrastructure.

Mission Change

Argonne's work spans the research spectrum end to end, from discovery to application. Our diverse and dynamic research agenda includes 16 programmatic divisions, 12 centers, and 5 national user facilities. Together, these user facilities serve one of the largest user communities in the U.S. Department of Energy (DOE) complex.

Argonne's multidisciplinary science strategy focuses on five specific major initiatives, which cut across the 18 DOE core capabilities and seek to advance fundamental and applied research in science. All initiatives support our strength and expertise in imaging and advanced computing, fundamental science, and applied science and engineering. The five initiatives are as follows:

- Hard x-ray sciences
- Advanced computing
- Universe as our laboratory (ULab)
- Materials and chemistry
- Manufacturing science and engineering

Emerging major initiatives include Artificial Intelligence for science and Quantum Information Science. Future funding in these programs would affect several programs and user facilities. Research capabilities provided by the Advanced Photon Source (APS) and Argonne Leadership Computing Facility (ALCF), both of which are user facilities, are foundational to Argonne's seven major and emerging initiatives. Electrical reliability is critical to achieving ideal user facility operational metrics for the DOE-Basic Energy Sciences program's upgrade to the APS, and support of the Advanced Scientific Computing Research program and the ALCF.

Argonne's mission to support ALCF is expected to have a significant impact on the Laboratory's ability to meet energy and water reduction goals. The DOE tasked Argonne to deploy Aurora, the next-generation exascale computing platform, by 2021. Aurora is the key science facility at Argonne that will increase the projected site energy load. Aurora will also require reliable electric supply upgrades and chilled-water upgrades for system cooling. ALCF's need for extreme amounts of power and cooling (industrial) water will make it difficult for Argonne to reduce industrial, agricultural, and landscape (ILA) water and site-wide electricity use.

Revitalization and reuse of existing facilities, combined with modernization of aging support infrastructure, is necessary to support Argonne's scientific mission. This approach provides modern, flexible spaces to support today's research while providing the ability to adjust to changing needs as science evolves. Space build out and renovations are required to support the hard x-ray sciences, manufacturing science, and engineering initiatives to prepare space for clean assembly of equipment. Planned facility renovation projects will support Argonne's efforts to meet the Guiding Principles for High-Performance Sustainable Buildings (HPSBs) in all existing buildings and will further support Argonne's performance in achieving sustainability goals.

Over the next 5 years, Argonne plans to remove legacy contaminated waste from the site, thereby reducing the hazard category of the Laboratory. This consolidates or eliminates the need for several radiological facilities, and the unnecessary facilities can be prepared for decommissioning and demolition. The facility reduction strategy allows for existing space renovations and realignment of operations and maintenance costs to new facilities.

Argonne's 10-year plan for site-wide improvements is outlined in the *Facility & Infrastructure Strategic Investment Plan*. Ongoing facility and infrastructure improvements will continue to meet the needs of major initiatives to support 21st-century science. Sustainability is embedded into the *Facility & Infrastructure Strategic Investment Plan* and the *Annual Laboratory Plan*, with opportunities for energy, water, and waste reduction incorporated into planned projects through an integrated design strategy. Argonne will strive to meet the mission needs of multidisciplinary science and engineering research while using natural resources efficiently.

1. Energy Management

1.1 Performance Status

Argonne’s energy management activities are designed to meet the mission needs of the Laboratory while managing costs, increasing resiliency, and supporting safe and efficient facility operations. Activities are strategically selected to reduce energy use intensity, improve metering and benchmarking outcomes, and reduce non-fleet fuel use.

Argonne continues to implement an integrated approach to reduce the Laboratory’s energy consumption. This approach focuses on high-impact infrastructure projects and leverages the energy-water nexus that is inherent to many projects appropriate for Argonne’s campus. Specific strategies include the following:

- Pursue waste heat recovery projects at High-Energy Mission-Specific Facilities (HEMSFs) and other buildings, as appropriate
- Complete traditional energy and water conservation measures such as lighting retrofits and reducing once-through cooling
- Implement a Smart Labs Program that seeks to enhance safe ventilation, improve operations, and increase energy efficiency
- Improve chilled-water system to meet cooling needs and maximize energy efficiency and water conservation opportunities
- Implement advanced metering to improve data collection and energy management
- Decommission all or portions of buildings to reduce unnecessary utility usage
- Use alternative fuels and management practices to reduce non-fleet fuel

A summary of energy management activities completed in Fiscal Year (FY) 2019 are provided in the following sections.

1.1.1 Energy Intensity

In FY 2019, Argonne achieved a 40 percent reduction in energy use intensity (EUI) over the FY 2003 baseline, as shown in Figure 1. Attachment A lists buildings with an energy use intensity greater than 150 KBTU/GSF. Energy use intensity is calculated based on data collected from the Laboratory’s network of advanced and standard meters. Argonne maintains its own campus utility infrastructure and provides 15-minute through monthly data to its analysts and engineers to support operations and energy efficiency activities. Because Argonne owns and maintains meters across the laboratory campus, the public site GreenButtonData.org is not a viable tool to monitor the lab’s end-point energy uses.

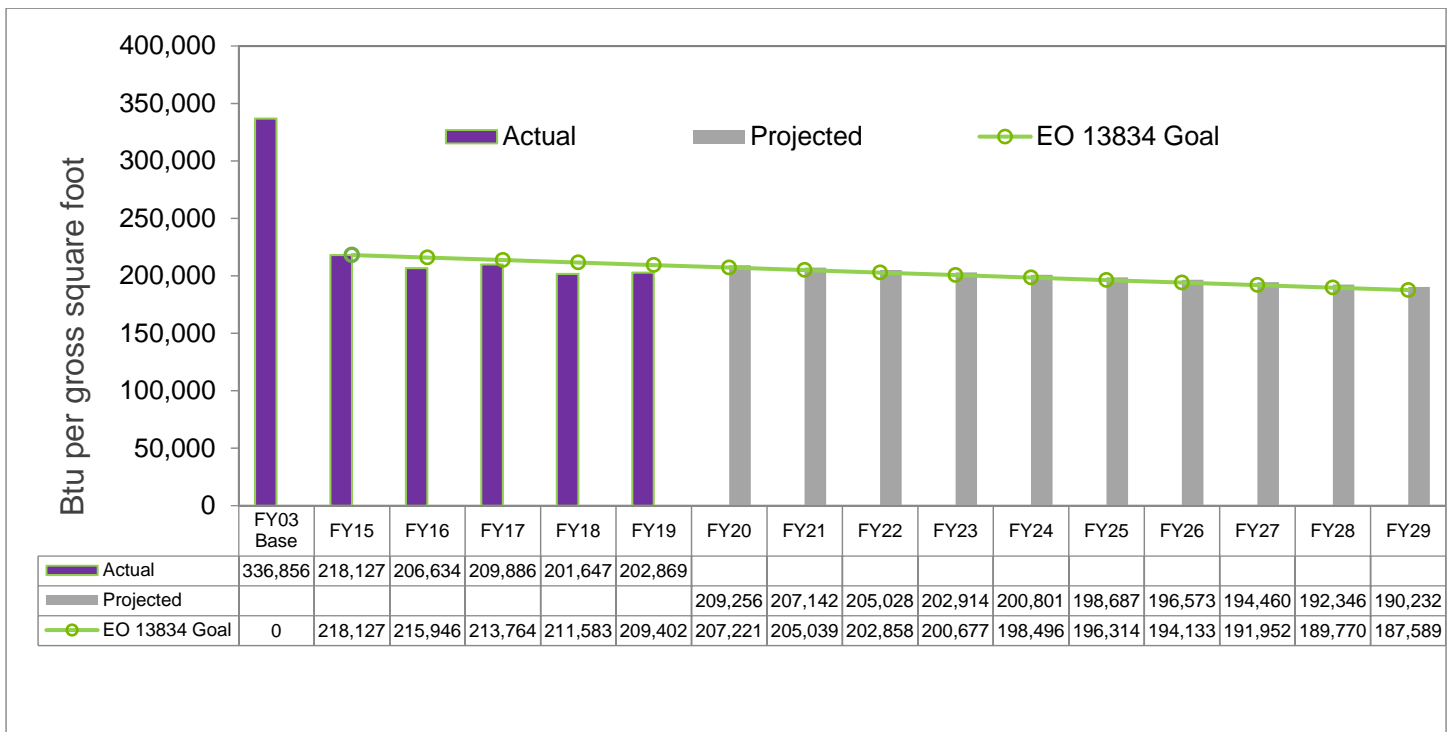


Figure 1: Energy Intensity Progress and Forecast, FY 2019 (BTU/GSF)

Energy conservation and energy retrofits continue to be vital components of energy management at Argonne. Argonne completed 24 energy- and water-savings projects across 20 buildings at the Laboratory in the last fiscal year. Building managers, facility engineers, maintenance staff, and building occupants identified projects based on their knowledge of the facilities and interest in improving the performance and efficiency of their buildings. When combined, these projects will save an estimated \$150,118 annually, and have a simple payback period of 5.3 years. More information on energy and water conservation measures appears in Section 8.

Argonne completed a large lighting retrofit of 476 fixtures in the Experiment Hall of the APS, representing two-thirds of the full project. Existing 400-W metal halide fixtures were replaced with new 240-W light-emitting diode (LED) high bay fixtures. Overall, the project will produce an estimated \$50,000 in energy cost savings per year, while improving the light quality in the space for occupants and reducing the maintenance costs of maintaining the old lighting.

Argonne also utilizes space management and alternative workplace arrangements to reduce energy loads. Argonne offers alternative workplace arrangements to employees whose work and management allow for regular or occasional teleworking. Argonne maintains workspaces in the most environmentally efficient manner possible and attempts to fully occupy space in the most efficient buildings before moving to less-efficient buildings. The space planning activities also strive to co-locate groups that collaborate frequently to reduce onsite commuting.

In FY 2019, Argonne's decommissioning team worked to reduce energy use and operations costs through temporary and permanent decommissioning of unoccupied spaces. Decommissioning was initiated at the 600 Lodging Area in the spring, when Argonne decided it was cost prohibitive to maintain the seven facilities for continued use as short-term housing (Buildings 614, 615, 617, 618, 619, 620, 621). The decommissioning team met over several months to determine a process for taking 38,000 square feet of space out of service and disconnecting utilities serving the area. The space is now vacant and utility service has been discontinued, saving the Laboratory costs associated with providing heat, air-conditioning, water, and electricity to the buildings.

1.1.2 Smart Labs Program

Argonne's Smart Labs Program takes an integrated approach to improving operations, achieving energy efficiency, and supporting safe ventilation systems in laboratory buildings. The Smart Labs Program is a critical energy-management strategy because laboratory buildings consume three to four times more energy than a typical office building. In FY 2019, Argonne formalized its Smart Labs Program through participation in the DOE Better Buildings Smart Labs Accelerator (DOE BB SLA), which seeks to achieve a 20 percent reduction in energy usage over 10 years. Figure 2 summarizes the laboratory buildings that are the initial focus of Argonne's Smart Labs Program.

Under the DOE BB SLA, Argonne staff participated in monthly webinars and learned best practices from other program participants. Argonne leveraged best practices from other facilities and convened stakeholders to begin developing a laboratory ventilation management program (LVMP) to support the full lifecycle of Smart Lab activities. Argonne also held a day-long workshop on Smart Labs best practices with the consultant 3 Flow and an extended team of stakeholders from the Infrastructure Services and Environment, Safety, Health & Quality Directorates. More information about Argonne's Smart Labs Program is provided in the Energy Management Success Story at the end of this section.

Argonne's Smart Labs Program incorporates retrocommissioning (RCx) activities, such as baselining energy use and testing equipment. This project began in FY 2017 with the goal of enhancing operations and efficiency of the top 40 energy-consuming buildings at the Laboratory. The Smart Labs Program now includes a full suite of building optimization assessments that the Sustainability Program uses to identify efficiency and safe ventilation improvements at any given building.

Argonne completed a baseline energy, ventilation, and building envelope assessment in Building 401. Functional testing was completed for building heating, ventilation, and air conditioning (HVAC) and laboratory exposure control devices. Analysis and testing of Building 401 identified \$620,000 of projects that promote energy efficiency and enhance safety. These projects would generate an estimated \$39,000 in energy savings annually. In addition, Argonne completed a ventilation assessment in Building 362 as a follow-on to the energy and RCx assessment completed in FY 2018. The revised Building 362 report identified \$314,325 of projects with \$73,992 in annual energy savings potential.



Figure 2: Laboratory Buildings Identified for Focused Safety and Efficiency Improvements in Smart Labs Program (Baseline Year FY 2017)

In FY 2019, Argonne completed four RCx measures in Building 200. The RCx measures included lighting controls in private offices, reduction in simultaneously heating/cooling throughout the building, schedule changes to allow for unoccupied space temperature setbacks, and space-heating lockouts when the outdoor air temperature is above 60°F. The functional testing of equipment during the RCx process uncovered four additional energy savings items that maintenance staff were able to fix immediately at no cost. The completed measures have an annual savings of \$56,000. Argonne also completed design documents for energy efficiency measures identified in Buildings 201 and 221 based on the RCx assessment completed in FY 2018. Energy efficiency improvements in Buildings 201 and 221 have an estimated \$73,000 in annual energy savings.

1.1.3 Energy Independence and Security Act (EISA) Section 432 Evaluations and Benchmarking

Each year, Argonne evaluates energy usage in all of its buildings to determine which facilities consume the most energy. The top 75 percent of buildings are placed on the 4-year evaluation cycle for energy and water usage efficiency. In FY 2019, Argonne began its third year of the second 4-year evaluation cycle. Argonne also continues to use the Energy STAR Portfolio Manager to benchmark facilities and identify opportunities for future improvement. Where possible, Argonne uses the detailed assessments completed under the RCx program to meet the Laboratory's EISA obligations. Building 200 was covered by the RCx EISA evaluations in FY 2018.

1.1.4 Metering and Continuous Commissioning

Argonne meters its facilities at the building level at 100 percent of feasible locations. Argonne continues to upgrade existing standard meters to advanced meters. The updated *Argonne Design Guide* continues to be the guiding document for new construction and renovation projects with regard to metering. It ensures that all design projects incorporate building-level meters to meet the DOE's goals.

Argonne's automated meter-reading program uses the Laboratory's existing Computerized Maintenance Management System (CMMS) [Assetworks AiM](#) operations and maintenance software for all network-connected meters across campus. The system also performs regular data validation checks to flag erroneous or suspect readings. In FY 2019, Argonne completed several activities to enhance metering capabilities around the site. Branch circuit monitoring of switchgear breakers in Building 241 (the Center for Nanoscale Materials) was established, providing granular evaluation capabilities

within the building. The main switchgear in Building 203, which serves equipment for the ATLAS accelerator, was upgraded to an advanced meter, allowing analysis for expanded transformer usage and promoting real-time data analysis.

In the fourth quarter of FY 2019, Argonne awarded a contract to the company Iconics for its Genesis64 web-based software package. Genesis64 is a fault detection, data analytics, and visualization (FDD) software platform that will automatically weather-normalize meter data, and aggregate, analyze, and provide reports to Argonne engineers on potential areas for further investigation. Argonne’s long-term goal is to deploy the software on a large portion of the Laboratory’s largest energy using facilities to maintain optimal operating conditions in real time and identify repair and efficiency measures on a continual basis.

1.1.5 High-Energy, Mission-Specific Facilities (HEMSFs)

The Laboratory Chief Research Officers define HEMSFs as constructed, mission-specific facilities, such as accelerators (particle and light sources), reactors (fusion and fission), high-performance computers, high-performance lasers and similar facilities, and the closely coupled conventional facilities necessary for their operations. HEMSFs are necessary to achieve the DOE’s mission goals. HEMSFs reduce energy use primarily through increased waste heat recovery.

Argonne’s three HEMSFs are the APS, the Argonne Tandem Linac Accelerator System (ATLAS), and the ALCF. 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. ATLAS is a facility for fundamental nuclear physics research and provides a wide range of beams for nuclear reaction and structure research. ALCF is a high-performance computing (HPC) facility and is the newest HEMSf at Argonne. Cumulatively, the FY 2019 total annual electricity consumption of the three HEMSFs and HEMSf-related consumption was 219,895 MWh, comprising 75 percent of total site electricity consumption. Attachments B and C break down the electricity consumption of HEMSFs and other newer facilities.

As shown in Attachment B, site electricity use is expected to increase dramatically over the next few years due to upgrades at the APS and ALCF. These planned increases in electricity use will make it challenging for Argonne reduce its overall greenhouse gas (GHG) emissions.

The increase in electricity and water consumption at the ALCF is due Argonne’s mission to serve as the home of the next generation of exascale computing platforms. Aurora, a next-generation supercomputer, is expected to come online in Building 240, Theory and Computing Sciences (TCS), in 2021. Aurora is two orders of magnitude more powerful than the current ALCF supercomputers and will therefore require higher levels of power and cooling (ILA) water to support it. The operation of these supercomputers must overlap to provide continuity of use for the science community they serve. Table 1 overviews the existing and planned energy and water use at ALCF over the next 10 years.

The chilled-water plant expansion that will serve Aurora was designed to operate as efficiently as possible. The system utilizes a water-side economizer to provide a large portion of its cooling capacity. The economizer cooling will operate year-round and is made possible by the fact that Aurora can operate at water temperatures up to 80°F. The economizer system also uses industrial canal water rather than treated domestic water to save water. Additional details about the Argonne canal water system are highlighted in the Water Management Success Story and discussed in Section 2.

Table 1: Energy and Water Use—HPC Facilities, Actual and Projected

Fiscal Year	Domestic (Potable) Water Usage	Canal (ILA) Water Usage	Chilled-Water Usage	Electricity Usage
	Million gallons/year	Million gallons/year	Million BTUs/year	MWh/year
FY 2018 act.	3.1	6.7	78,510	62,880
FY 2019 act.	1.6	9.4	110,888	62,667
FY 2020 est.	3.0	14.3	168,402	66,839
FY 2021 est.	3.5	22.4	263,812	100,740
FY 2022 est.	3.5	49.1	577,666	350,400
FY 2023 est.	3.5	56.7	667,339	386,316
FY 2024 est.	3.5	56.7	667,339	386,316
FY 2025 est.	3.5	56.7	667,339	386,316
FY 2026 est.	3.5	56.7	667,339	386,316
FY 2027 est.	3.5	56.7	667,339	386,316
FY 2028 est.	3.5	56.7	667,339	386,316
FY 2029 est.	3.5	56.7	667,339	386,316

1.1.6 Non-Fleet Vehicles and Equipment

Fuel use from non-fleet vehicles and equipment has decreased by 28 percent from the 2005 baseline. This is due to Argonne’s efforts to replace older, inefficient equipment with newer, fuel-efficient equipment, as well as increased use of alternate fuels.

Argonne continues to investigate the use of local electric vehicles (EVs) for on-campus commuting and non-fleet vehicles. In FY 2018, Argonne added two Polaris Global Electric Motorcars (GEM) utility vehicles to the intra-Lab fleet. GEMs are multipurpose, 100 percent all-electric transportation and utility vehicles. Argonne piloted these two vehicles in FY 2019 with two different work teams. More information about the pilot results are presented in Section 4, Fleet Management.

1.2 Plans and Projected Performance

Table ES-1 in the Executive Summary summarizes planned performance over the 2-, 5- and 10-year horizons for energy management goals. Based on planned activities, Argonne projects an annual reduction of 1 percent in EUI for goal-subject buildings. Table 2 provides projected energy and water use, broken down by goal and non-goal subject buildings, across the 10-year planning horizon.

Projected performance (shown in Figure 1 and Table 2) also incorporates embedded energy in the chilled water that individual buildings use, which the central chilled-water system provides. Argonne recently added metering for chilled water at the individual buildings, which allows the embedded energy to be calculated and associated with the appropriate buildings based on actual use.

Table 2: Energy and Water Use—Actual and Projected for Goal Subject and Non-Goal Subject Buildings

Fiscal Year	Goal Subject		Excluded		Total	
	Electricity	Natural Gas	Electricity	Natural Gas	Potable Water	Non-Potable Fresh Water
	MWh/year	1000 CuFt/year	MWh/year	1000 CuFt/year	Mgal/year	Mgal/year
FY 2018 act.	88,713	327,718	213,216	742,922	121	177
FY 2019 act.	93,339	315,742	199,503	850,280	115	176
FY 2020 est.	96,278	325,682	196,088	892,579	116	181
FY 2021 est.	95,306	322,392	230,914	937,208	115	188
FY 2022 est.	94,333	319,103	481,505	984,068	114	214
FY 2023 est.	93,361	315,813	518,360	1,033,272	114	221
FY 2024 est.	92,388	312,523	519,306	1,084,935	113	221
FY 2025 est.	91,416	309,233	520,260	1,139,182	112	220
FY 2029 est.	87,526	296,075	524,153	1,384,683	110	219

1.2.1 Energy Use Reduction

In FY 2020, Argonne will continue to implement energy and water efficiency projects through the In-House Reinvestment Program and through projects identified during the annual EISA evaluations. The remaining one-third of the APS Experiment Hall lighting upgrade will be completed in December and January, during the winter APS maintenance shutdown.

Argonne will continue to convene the decommissioning team in FY 2020 and complete demolition activities to disconnect utilities serving the 600 Area. The Sustainability Program will also support the Facilities Planning Group to formalize decommissioning and demolition activities by developing a formal excess facilities plan focused on legacy facilities.

Argonne plans to combine EISA evaluations as part of the larger Smart Labs Program while maintaining the 4-year cycle requirement. The Smart Labs program gives Argonne the ability to perform deeper evaluations than EISA 2007 requires. Specially trained in-house engineers and technicians will work with consultants to perform these evaluations.

The Sustainability Program will continue to explore energy savings projects to address the energy consumption associated with HEMSFs and the expected increase over the next 10 years. In FY 2020, Argonne will complete a detailed

design for a waste heat recovery project at the APS. Annual operational savings for this project are expected to total approximately \$580,000 per year, based on the final equipment selection. This heat recovery project was identified in the FY 2018 *APS Master Plan* and will provide additional resilience to APS by supplementing the heating system when the beamline is operational. Argonne also plans to complete a study to identify other opportunities for waste heat recovery across the Laboratory, looking at HEMSFs and other waste heat sources.



Figure 3: Project Team Reviewing Portion of Completed APS Experiment Hall Lighting Improvements

1.2.2 Smart Labs Program

In FY 2020, Argonne will complete the remaining Smart Labs improvements at Building 200. These will include improved airflow measurement, rebalancing airflow, and construction of a chilled-water bridge to improve the efficiency of the chilled-water system. Implementation of these final two measures was delayed because additional design and analysis was required following the study phase completed in FY 2018. Argonne also plans to complete RCx measures at Building 201 in the first quarter and at Building 221 by the end of the fiscal year.

The Sustainability Program will focus on reviewing the study results and developing a strategy to implement the identified Smart Labs measures at Buildings 362 and 401. The implementation strategy will take into consideration required staffing resources, available funding, stakeholder engagement, and logistic coordination need to adjust airflow and building operations.

Argonne will also focus on developing a LVMP, which is a key best practice from the SLA program. The LVMP will ensure best practices are applied in the Laboratory's operations and facilities, as well as putting a formal change management process in place to address occupant/space ever-changing requirements. The Sustainability Program will convene key stakeholders from Project Management, Facilities, and Environment, Health Safety & Quality to develop a draft LVMP. Argonne will also develop a 10-year roadmap for achieving a 20 percent reduction in the target Smart Labs buildings (Figure 2), which is a deliverable required for participation in the SLA program.

1.2.3 Metering and Continuous Commissioning

In FY 2020, Argonne plans to begin implementing the FDD platform in Buildings 200 and 401. The FDD software (see Section 1.1.3) will allow Argonne to visualize advanced energy analytics and benchmarking. The FDD software will support Argonne's Smart Labs Program and ensure continued energy performance of recently completed energy efficiency projects and RCx activities.

Argonne continues to use multiple energy-tracking systems to monitor the Laboratory's energy and water use. In FY 2020, the Sustainability Program will focus metering efforts on this chilled-water system. Argonne will complete a building-by-building assessment to audit inventory, verify equipment statistics in the CMMS, confirm reporting connections, evaluate calibration requirements and calibrate where possible, and ultimately confirm readings for building-level chilled-water meters. This will include buildings on the central chilled-water system and those with individual building chillers. The analysis will start with goal subject buildings and buildings in Argonne's Smart Labs Program.

In FY 2020, Argonne will continue to install advanced metering on electrical loads where economically feasible. In addition, first-generation smart meters installed within the last 22 years are beginning to degrade. Argonne will begin developing a business case to document the need for the next investment in metering replacements or upgrades to meet sustainability goals and operational requirements. Argonne will continue to work with a cross-disciplinary team to coordinate meter installation schedules with previously planned shutdowns and take advantage of short-notice, emergency shutdowns to perform meter installations.



ARGONNE TAKES STRIDES TO INCREASE EFFICIENCY AND PROMOTE SAFETY WITH **SMART LABS PROGRAM**

Argonne’s Smart Labs Program seeks to optimize laboratory facilities to improve energy efficiency, provide safe ventilation levels, and enhance operations.

In FY 2019, the Sustainability Program formalized the Smart Labs Program by establishing a core, multidisciplinary team and standard process that is repeatable and scalable across Argonne. The Smart Labs core team includes staff from Facilities Engineering, Building Controls and Analytics, Worker Safety and Health, Project Management, and the Sustainability Program. To ensure each building is assessed and optimized with a consistent approach, the Smart Labs team began developing and testing the Smart Labs framework, which can be used to evaluate all buildings within Argonne’s campus.

The Smart Labs Program took important strides in FY 2019 by selecting and benchmarking a set of focus buildings for optimizing laboratory ventilation in addition to improving energy efficiency and operations.

ARGONNE’S SMART LABS PROGRAM FOCUS BUILDINGS

BUILDING NUMBER AND NAME	SIZE
200 Chemistry	356,889 ft ²
241 Energy Sciences Building	172,311 ft ²
362 ES, HEP, TD, and Auditorium	184,621 ft ²
401 Advanced Photon Source Central Lab & Office Building	191,336 ft ²
440 Center For Nanoscale Technology	99,057 ft ²
446 Advanced Protein Crystallization Facility	66,705 ft ²



Building 401, one of six buildings included in Argonne's Smart Labs Program

FOR MORE INFORMATION
PLEASE EMAIL

Sustainability Program Manager
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A key accomplishment in FY 2019 was completing the laboratory ventilation risk assessment (LVRA) and demand for ventilation assessment (DVA) at Buildings 362 and 401 with the help of consultants 3Flow, Grumman/Butkus Associates and Burns & McDonnell. During the LVRA, Argonne staff and the consultants surveyed the lab spaces to evaluate exposure risk levels and the protective capabilities of the exposure control devices within the building. The LVRA included surveying of all laboratory spaces, and interviewing laboratory area leads to help understand the laboratory processes, daily operation, and chemical use.

During the DVA, a series of onsite testing and measurement was completed in a sampling of labs. The process included measuring room supply airflow, measuring room exhaust airflow, measuring the air-handling unit supply and recording its operational status, and lastly assessing a sample of the Exposure Control Devices (ECDs) per the industry standard. The information from the LVRA and the DVA is used to determine appropriate operation specifications—such as air change rate, minimum airflow, and exhaust duct and stack discharge rates—for each lab within the building.

Focusing on laboratory buildings for reducing energy use is a key strategy to meet DOE's sustainability goals for Argonne. According to the DOE

Better Buildings Program, a typical laboratory is three to four times more energy intensive than an average commercial building. Argonne has 48 buildings with laboratory space, 23 of which are in the top 40 energy-consuming buildings at the Lab, and together represent an area of 820,000 square feet.

Argonne's Smart Labs Program is leveraging best practices from universities, federal agencies, national laboratories, and hospitals by participating in the DOE Smart Labs Accelerator. Under the Accelerator program, Argonne participated in technical webinars, received technical assistance, and joined peer-learning sessions throughout the last year. Argonne will work to achieve an energy savings of 20% or more in the initial six buildings where this program is being implemented.

Argonne's Smart Lab Program also builds upon the retrocommissioning activities started in FYs 2017 and 2018. In FY 2018, energy-using systems for Building 362, such as the heating, ventilation, and air conditioning equipment, were evaluated and tested using an outside consultant, Burns & McDonnell. Results from the LVRA will be used to finalize the recommended improvements to Building 362 to provide safe laboratory ventilation and optimize energy-using systems to save Argonne money.

2. Water Management

2.1 Performance Status

Argonne’s location southwest of the City of Chicago provides ready access to high-quality potable water from Lake Michigan. Argonne obtains treated potable water from Lake Michigan via the City of Chicago and the DuPage Water Commission distribution system. The Lab utilizes non-potable water from the Chicago Sanitary and Ship Canal (“the Canal”) for cooling towers and for Argonne’s other ILA uses. Argonne does not use potable or ILA water for irrigation, except to establish newly planted areas. Table 3 illustrates the main sources of water consumption (excluding losses) at Argonne.

Table 3: Summary of Water Sources and Uses

Type	Source	Use	Activities
Potable	Lake Michigan	Domestic	Steam generation Chilled water Sanitation (food service) Sanitation (general) Fire protection Wastewater treatment
		Laboratory	Research (programmatic) Waste management Sanitation (programmatic)
Non-potable	Chicago Sanitary and Ship Canal	Industrial	Cooling tower makeup water Other industrial uses

2.1.1 Potable Water

Argonne’s water management strategy takes advantage of campus-wide upgrades to reduce water use in older, more inefficient buildings by requiring the addition of low-flow fixtures and proactively implementing water conservation and efficiency projects. As a result, Argonne has achieved a 43 percent reduction in potable water use below a FY 2007 baseline, as shown in Figure 4. Argonne meters water at the individual building level for 100 percent of buildings onsite. Overall, 95 percent of Argonne’s water meters have been upgraded to smart meters. Argonne completes an annual water analysis to ensure the accuracy of the potable water main from the DuPage Water Commission that serves the Laboratory. Attachments D and E provide information about facilities that have high potable water use intensity (in gallons per GSF) and those that account for 75 percent of the site’s potable water use.

Argonne continues to implement projects to reduce potable water use at the Laboratory. In FY 2019, Argonne completed a full remodeling of the Building 200 women’s washroom, which included upgrading showers, toilets, and sink faucets to high-performing, water-efficient fixtures. The project also included reducing the size of the washroom to reflect current building occupancy and decreasing the number of sinks, toilets and showers.

In addition, Argonne completed a site-wide steam shutdown between August 23 and September 9, 2019, to perform maintenance and restoration activities at the Lab’s steam plant. Potable water is used as makeup water for Argonne’s six boilers within the central steam plant. The improvements completed during the steam shutdown will contribute to the safety and efficiency of campus buildings and contribute directly to potable water savings. Highlights of the steam system repairs include rework of all 9 steam isolation valves in the steam plant, repairs in all 12 steam vaults, maintenance on more than 150 steam valves, and repairing a steam leak at the valve serving Building 350. Argonne’s building maintenance staff were also able to complete various steam-related repairs within numerous building across the site during the shutdown. More information on this sustainability strategy is highlighted in the Resilience Success Story.

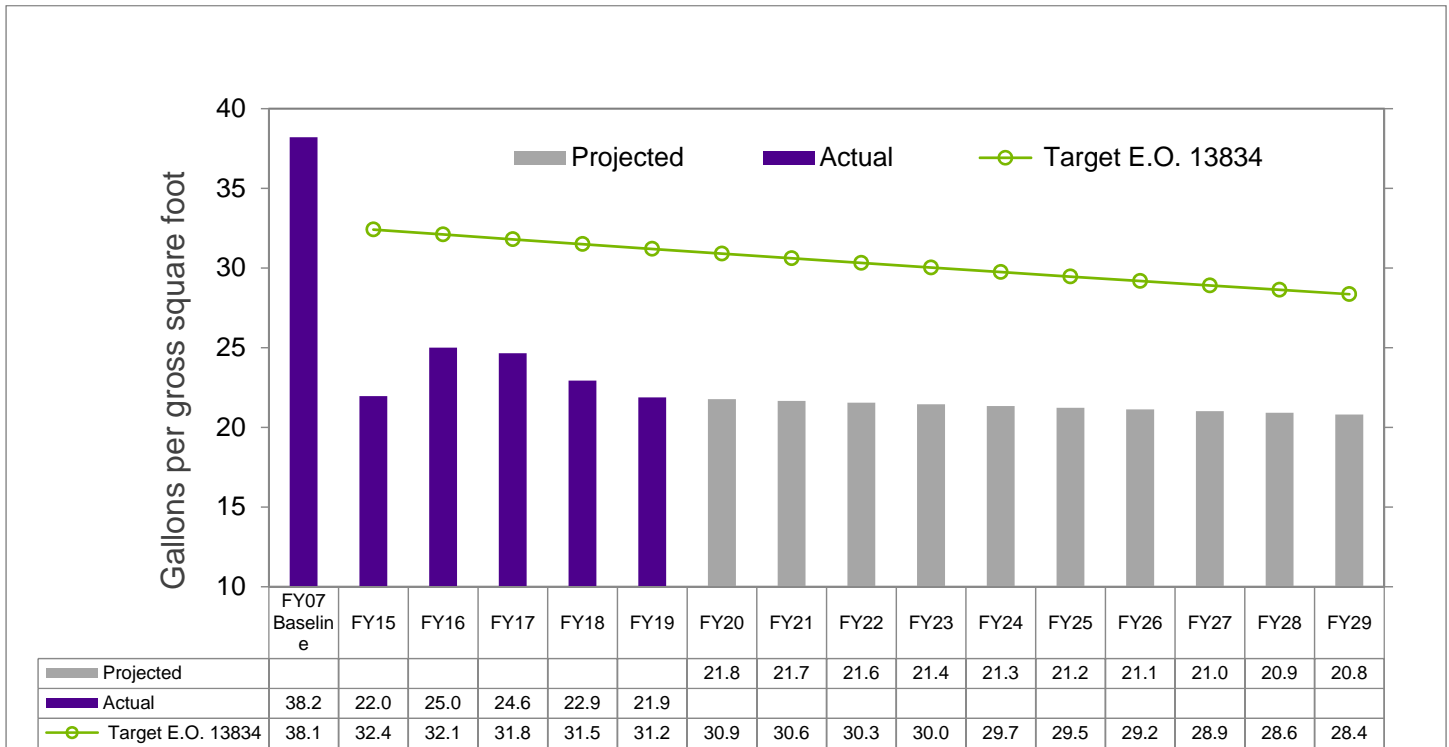


Figure 4: Potable Water Intensity Reduction—Progress and Forecast, FY 2019 (gallons/GSF)

2.1.2 Industrial, Landscape, and Agricultural Use

Figure 5 presents Argonne’s current and projected ILA water use. Efficiencies in chilled-water plants and summer temperatures closer to annual averages resulted in FY 2019 ILA water use continuing the downward trend seen over the last few years. Argonne projects significant energy and ILA water use at the ALCF over the next 10 years to support the Laboratory’s Exascale Computing initiative. As shown in Table 1, Argonne’s ILA water associated with Exascale Computing at the ALCF will grow to 40 percent of the Lab’s annual total by FY 2022.

Argonne continues to implement an integrated water and energy management approach that uses a holistic approach to drive reductions in Argonne’s use of energy, potable water, and ILA water. The Sustainability Program focuses on energy-reduction strategies to reduce cooling tower makeup water, chilled water, steam, and domestic hot water across office and laboratory buildings because they simultaneously impact potable and ILA water use.

In FY 2019, Argonne completed several activities to increase the efficiency of the central chilled-water system and thereby reduce cooling tower makeup water (ILA water). Under the Smart Labs Program, Argonne hired an engineering consultant to complete a detailed design for a chilled-water bridge in Building 200. This project will increase the efficiency of chilled water used within Building 200 by decreasing the amount of water that is sent back to the chilled-water plant. The water will be returned at a higher temperature, which will allow the central chilled-water plant chillers to operate more efficiently and reduce the amount of pumping energy required to circulate the water across the site. In addition, Argonne completed chiller overhauls in Buildings 450 and 208 that will increase system performance, save energy, and improve redundancy.

Argonne also constructed a new chilled-water line that connected Building 203 to the central chilled-water system. Connecting Building 203 to the central chilled-water system provides a more reliable source of chilled water to Building 203 and allows Argonne to decommission the aging and inefficient chiller within the building.

In FY 2019, Argonne continued to evaluate the poor performance of the chilled-water system at Building 202. In Building 202 there have been numerous complaints about the building’s inability to meet design cooling temperatures during warm periods. This points to an inefficiency in the way the building uses the central chilled-water loop to cool the building. Argonne monitored differential pressure sensors that were installed in FY 2018 on the chilled-water system to better understand the existing conditions in the building. Pressure monitoring and additional investigation are being performed to help guide the redesign of this bidirectionally fed chilled-water system, which may be causing system inefficiencies.

Switching to ILA water is also an important part of Argonne’s strategy to reduce potable water consumption. The Canal is an impaired, non-potable waterway, and its water consists primarily of regional wastewater discharges. Argonne obtains the Canal water from the Metropolitan Water Reclamation District, the Chicagoland wastewater utility, at no cost. To reduce potable water use, Argonne has proactively identified opportunities to replace potable water with Canal water, leading to cost savings and reduced reliance on freshwater sources for industrial uses. After use, Argonne treats both Canal water and other Laboratory wastewater to a higher water quality than the raw Canal water and then discharges it to a different waterway downstream of the Canal. Using Canal water to support the Laboratory’s cooling demands saves approximately 750,000 gallons of Lake Michigan water annually.

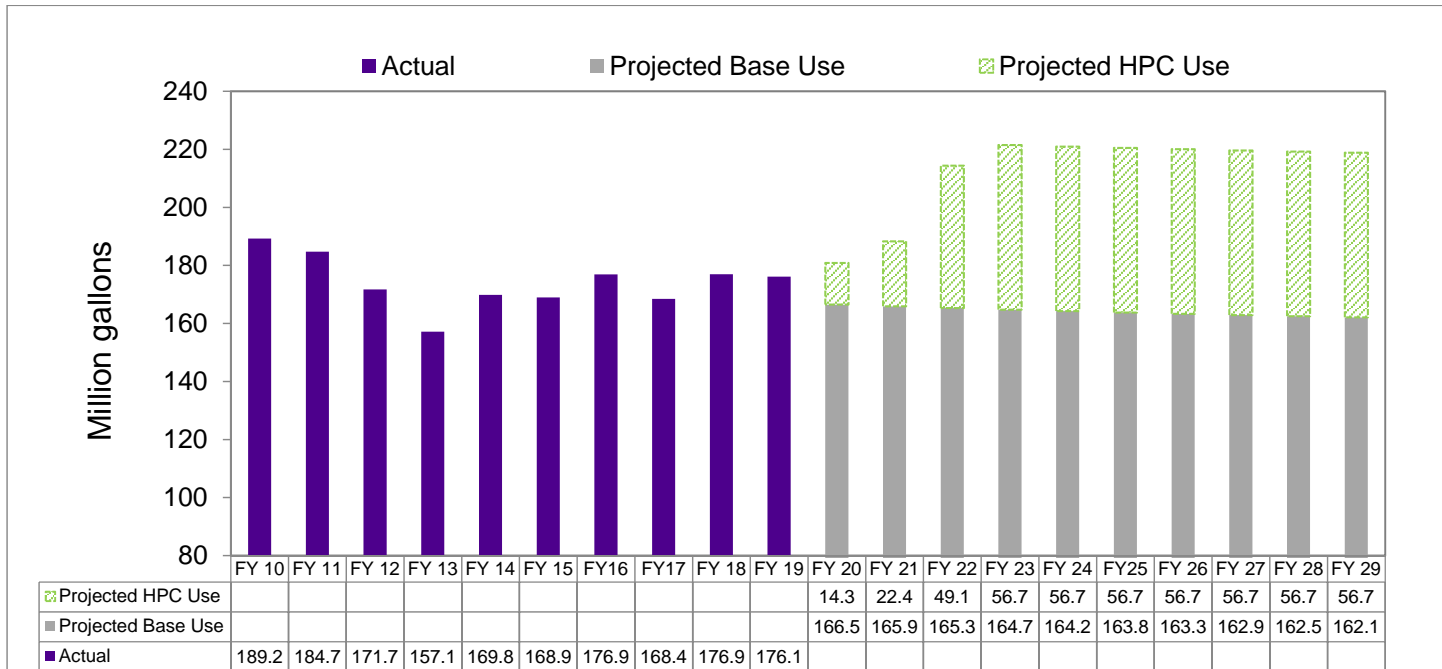


Figure 5: Industrial Water Reduction—Progress and Forecast, FY 2019 (million gallons)

2.1.3 Stormwater

Argonne’s water management strategies include adding green infrastructure to increase stormwater infiltration and mimic natural systems to manage and clean water as it runs off paved surfaces. In FY 2019, Argonne completed the Coal Yard Restoration Project. This project successfully restored approximately 5 acres of land, which were previously used to store coal for the onsite central steam plant prior to the switching to use natural gas in 2011, and established the restored area as a green infrastructure asset. The restoration project will divert 16 million gallons of stormwater annually, resulting in approximately \$13,000 of cost savings each year. More information on this sustainability strategy is highlighted in the Water Management Success Story.

As part of a FY 2019 Earth Day Team Challenge event, groups of two or more employees were encouraged to come up with an idea for improving sustainability at the Laboratory, and Argonne identified three new locations for green infrastructure improvements. The winning idea was to convert some of the Laboratory’s unused asphalt and parking lots to green space to promote stormwater infiltration, reduce urban heat island effects, and promote wildlife habitat. Over the summer, the Sustainability Program convened members of the winning team and other stakeholders to begin developing an implementation plan to complete the project.

2.2 Plans and Projected Performance

Argonne plans to continue implementing an integrated energy and water management strategy as outlined in the Sustainability Strategic Plan. The Laboratory is pursuing projects from the strategic plan that would lead to a reduction of approximately 16 million gallons of stormwater and approximately 1.3 million gallons of process water or cooling tower makeup water. Table ES-1 in the Executive Summary summarizes planned performance over 2-, 5- and 10-year horizons.

2.2.1 Potable Water

Argonne continues to institutionalize potable water reductions as the Lab implements HPSBs and purchases WaterSense-certified and other low-flow fixtures and fittings to make plumbing repairs. Argonne also will continue large-scale upgrades of water fixtures and fittings as part of the ongoing Site-Wide Bathroom Renovation Program. With 400 bathrooms across the Laboratory, this program provides an ongoing opportunity for additional potable water savings. In FY 2020, Argonne plans to renovate two washrooms in Building 203. Argonne anticipates a continued annual reduction of 1.5 percent in potable water, based on planned efforts and funding levels.

Argonne also expects to see potable water reduction as the result of planned decommissioning efforts over the next few years. Argonne plans to finalize decommissioning of the 600 Area housing by disconnecting utilities from the 38,000 square foot set of facilities. Some visitors will relocate to the Argonne Guest House Building 460, but overall potable water use is expected to decrease because the Guest House facility is newer and has more efficient plumbing fixtures and fewer leaks. This project is planned to reduce potable water consumption by 1 million gallons/year.

In FY 2020, Argonne plans to complete a feasibility study and cost estimate for a project to use Canal water instead of potable water at the Laboratory's central steam plant. Potable water is used as makeup water for the six boilers at the steam plant and in FY 2019, 13 million gallons of potable water were used. The Sustainability Program and the Utilities Department have identified this opportunity and estimated that this water-switching project would save the Laboratory approximately \$60,000 per year in water costs and further leverage Canal water for non-potable uses.

2.2.2 Industrial, Landscape, and Agricultural Use

Argonne continues to implement projects to reduce ILA water and increase the efficiency of the Laboratory's cooling system and other equipment that is using ILA water. However, long-term reductions will be difficult given the increases in energy and water due to ALCF and the success of Argonne's potable water strategy to switch to Canal water when possible.

Argonne's strategy for decreasing ILA water includes efforts to address chilled-water utilization efficiencies for individual buildings and equipment. This includes implementing projects to increase the efficiency of existing systems and replacing old equipment with equipment that is more efficient. A long-term goal is to explore implementing a demand response program for chilled water. Argonne estimates that chilled-water efficiency projects will result in an annual reduction of approximately 1.3 million gallons of makeup water, 600,000 kWh in electricity use, and \$29,000 in costs.

In FY 2020, Argonne will complete chilled-water optimization activities at Building 200. This includes closing three-way valves; shutting down an auxiliary chiller; and bidding, construction and commissioning of a new chilled-water bridge in the building. The chilled-water optimization is expected to save \$11,000 in costs annually and contribute significantly to increasing cooling efficiency in Building 200. Argonne intends to replicate this design across many of the buildings that have high chilled-water usage and low differential chilled-water temperature, which is expected to have a high impact on total energy consumption. Next, Argonne will focus on Building 202 complete an energy analysis and detailed design to add a chilled-water bridge there to address that building's chilled-water system inefficiencies. Based on an assessment of the costs and energy savings, Argonne plans to construct the bridge in late FY 2020 or early FY 2021.

Argonne also plans to re-commission the Building 371 Cooling Tower to optimize equipment performance, which should result in energy and cost savings compared to existing conditions. This activity will be coordinated with the addition of a side-stream filtration system to address issues with water quality that are impacting current operation of the cooling tower.

The largest projected increase in ILA water will support cooling at ALCF (see Figure 5 and Table 1). This HEMSf is a key priority to Argonne's mission, as discussed in the Mission Change section. Argonne's plans and funding will result in efficiencies across the site, but those will be overshadowed by the increases expected due to the ALCF. Therefore, Argonne plans to track and measure reductions in ILA water for ALCF separately from the site-wide cooling load, similar to how EUI is monitored for goal-subject facilities separate from HEMSf. Without separating the ILA water due to cooling needs at ALCF, Argonne will be unable to show ILA water reduction starting in FY 2020.

2.2.3 Stormwater

Argonne's Sustainability Program will complete a preliminary design and cost estimate for implementing green infrastructure at the three locations identified during the Earth Day Team Challenge project: the Building 362 parking lot and pedestrian pathway, Building 212 parking lot and pedestrian pathway, and Building 205 remote lot. The project team will include diverse stakeholders from across the Laboratory so the projects developed to incorporate details that benefit the diverse needs of Argonne including pedestrian travel, natural habitat, stormwater management, and safety.

In FY 2020, Argonne will monitor the plant establishment at the coal yard restoration project (Figure 6). The Natural Resources manager will assess the progress through FY 2020 and complete additional seeding, planting, and invasive species control as needed. Argonne also plans to continue converting turf grass to native, prairie grasses, which is a regular part of the Natural Resources Program.



Figure 6: Native Plants Take Root at Coal Yard Restoration Project Site

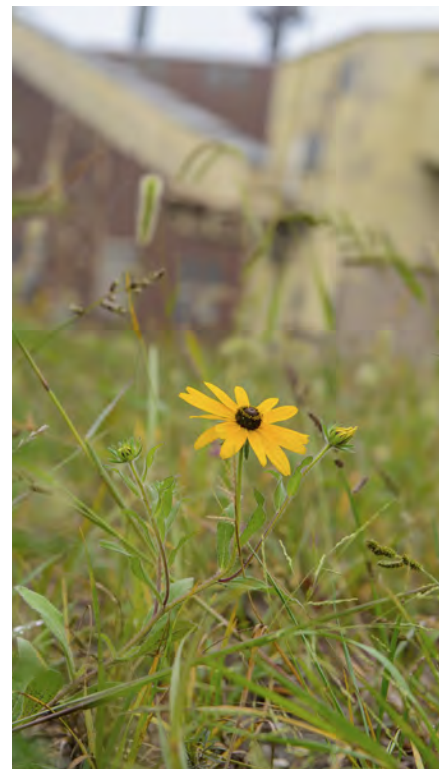


RESTORATION PROJECT IMPROVES STORMWATER DRAINAGE AND INCREASES GREEN INFRASTRUCTURE AT ARGONNE

The Coal Yard Restoration Project successfully restored approximately 5 acres of land and established it as a green infrastructure asset for the Argonne campus.

For over 60 years, Argonne's central steam plant used coal as a fuel source for generating steam needed to provide heat across the Laboratory. The space adjacent to the central steam plant was used as a coal yard until the steam plant was retrofitted to use only natural gas as the fuel for the boilers in 2011. Although coal use was eliminated, the coal yard was left in place, including infrastructure to support collection and pumping of stormwater runoff for treatment at the Canal Water Treatment Plant.

The Sustainability Program collaborated with the Utilities Department to complete the Coal Yard Restoration Project in FY 2019. The project was divided into two phases. Phase 1 was completed in FY 2018 and included design and demolition tasks such as removal of remaining coal debris, decommissioning of the drainage pumps, and leveling of the earthen berms. Phase 2 included final grading of the site, application of a native plant and prairie grass seed mixture and development of an access road, which were completed in FY 2019. A key component of the Phase 2 work was the site grading, which adjusted the elevations of the soil across the coal yard to return the area to a natural drainage pattern to Sawmill Creek.



Black-eyed Susan (*Rudbeckia hirta*)



Remediation of the coal yard added 5 acres to the Laboratory's inventory of green infrastructure assets. The addition of natural drainage, native plants, and prairie grasses will divert 16 million gallons of stormwater annually, resulting in approximately \$13,000 of cost savings each year to Argonne. The project has also improved stormwater drainage and increased the quality of the habitat in this area. The project also properly disposed of the coal deposits left behind from the old operations and removed pumping equipment, both of which will eliminate the need to expend energy to manage stormwater in the area.

The transformation at the coal yard is part of Argonne's water management strategy to use green infrastructure across the site. Green infrastructure is a method of stormwater management that mimics natural systems to infiltrate and clean stormwater at its source.

Argonne has implemented green infrastructure by building rain gardens and bioswales and converting turf grass to prairie grass. These assets complement Argonne's wetland, woodland, and prairie habitats.

Native plants and prairie grasses are key ingredients in the Coal Yard Restoration Project. Native plants have deep roots that condition soils for rapid stormwater absorption and are efficient at adsorbing atmospheric carbon. Prairie grasses adsorb carbon at an even higher rate than many other plants, thereby building organic soils. They also help to prevent erosion because they create plant cover that can resist water and wind. Key native plants used in the Coal Yard Restoration Project include black-eyed Susan (*Rudbeckia hirta*, pictured), big blue-stem grass (*Andropogon gerardii*), and purple cone flower (*Echinacea purpurea*).

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3. Waste Management

3.1 Performance Status

Argonne has a long history of successfully operating programs to support waste prevention and recycling. Key initiatives at the Laboratory include all-in-one recycling, food scrap and paper towel composting, scrap metal recycling, electronics recycling, and battery recycling. Figure 7 presents historical and projected nonhazardous solid waste generation and diversion rates, excluding construction and demolition debris. Solid waste generation varies based on activities at the Laboratory, but Argonne continues to work to decrease the amount of waste sent to the landfill, which was 62 percent in FY 2019. Argonne does not use a waste-to-energy system at this time.

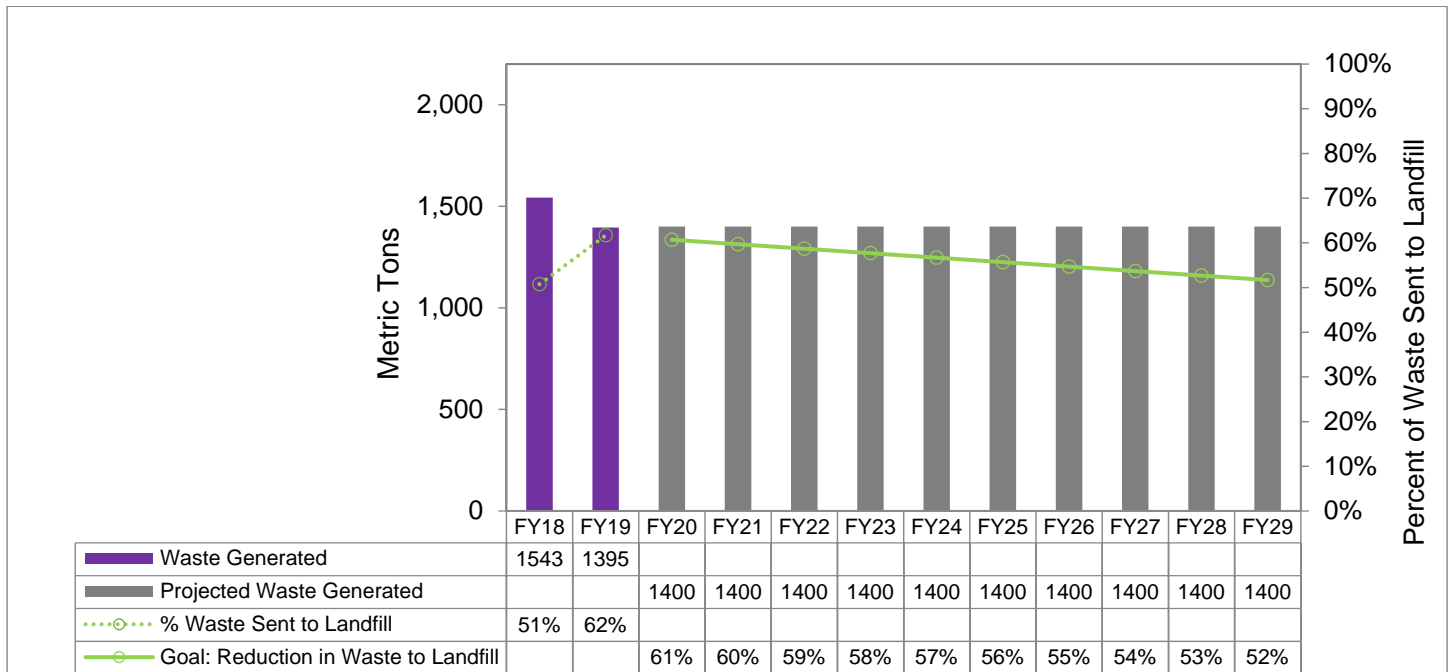


Figure 7: Municipal Solid Waste Diversion—Progress and Projected Performance, FY 2018

3.1.1 Municipal Solid Waste Diversion

Argonne’s food scrap and paper towel composting program (composting program) is a key waste diversion strategy employed by the Laboratory. A 2015 solid waste characterization study completed by the Illinois Sustainable Technology Center (ISTC), showed 40 percent of Argonne’s municipal waste stream as compostable. Once fully implemented, composting and other pollution prevention and recycling program improvements will help the Laboratory achieve a 68 percent diversion rate.

In FY 2019, Argonne implemented phase 2 of the composting program. During phase 2, Argonne added 19 buildings to the collection program and updated the composting signage for the paper towel collection in washrooms. Table provides a cumulative list of buildings covered in the composting program. The Sustainability Program worked closely with several key groups to carefully plan and implement phase 2 of the composting program: Custodial Services, building managers, Amenities, Safety, Argonne’s food service contractor Sodexo, and ISTC.

As of September 30, 2019, the composting program had diverted 45.6 metric tons of compostable materials from landfills since the program’s launch in July of 2018. In FY 2019, the composting program diverted 35 metric tons of compostable materials. A privately contracted waste hauler delivers the compostable materials collected at Argonne to the Willow Ranch Commercial Composting Facility in Romeoville, Illinois. The Willow Ranch facility produces approximately 70,000.00 cubic yards of compost per year from yard and food waste collected in the greater Chicago area.

Table 4: Summary of Buildings Participating in Composting Program

Food Scrap Collection	Paper Towel Collection	
Building 213 Bistro	Phase 1	Phase 2
Building 362 breakroom, coffee station	Building 201	Building 200
Building 401 Grill	Building 203	Building 205
Building 460 Guest House	Building 213	Building 221
	Building 214	Building 241
	Building 362	Building 302
	Building 401	Building 306
	Building 436	Building 333
	Building 440	Building 360
	Building 446	Building 402
	Building 460	LOMs (10 in total)

Argonne also completed an expansion of the composting program at Building 362 to pilot the addition of breakrooms and coffee stations to the program. Argonne upgraded recycling and landfill bins within the lobby and service floor of Building 362 (Figure 8). In addition, composting containers and signage were added to the first-floor coffee station and third-floor lunchroom to increase the collection of organic material for composting. The composting expansion was launched in Building 362 on July 29 and is ongoing.



Figure 8: Composting Pilot Program in Building 362 Coffee Station

The composting program expansion in Building 362 was one of several projects implemented in the building as part of Argonne's new Building 362 Green Action Team (GAT). In FY 2019, the Sustainability Program created the Building 362 GAT to help engage building occupants and implement projects within their work areas that help advance site-wide sustainability goals. The Sustainability Program staff met regularly with the Building 362 GAT. They worked closely together on the composting program expansion and other sustainability projects. More information on this sustainability strategy is highlighted in the Waste Management Success Story.

The Sustainability Program continues to engage Laboratory occupants to help develop and implement waste prevention and recycling activities. In FY 2019, Argonne launched the Earth Day Team Challenge and 20 groups submitted ideas for improving sustainability at the Laboratory. Two ideas directly related to waste management activities: reducing cigarette litter outside Building 201 and increasing recycling in Building 401. The Sustainability Program worked with the two teams following Earth Day to develop a plan for implementing these ideas. The Building 401 team collaborated with Sustainability Program staff to add recycling containers to 21 conference rooms and other locations within the 191,000 square foot building (Figure 9). The 401 team was also able to remove trash and recycling cans from individual offices and consolidate to single-point collection, effectively preventing 24 plastic trashcan liners per week from being sent to landfill. The Building 401 team continues to pursue additional sustainability projects within the building and will formalize their efforts as a new GAT for in FY 2020.



Figure 9: Team Challenge Group Adds Recycling Containers to Building 401

In FY 2019, Argonne launched a shoe recycling program as part of the Laboratory's Earth Day celebration. Laboratory occupants can recycle their own shoes from home or work-related shoes. USAgain, a company focused on diverting shoes and textiles from landfills, provided collection bins at no cost to the Laboratory. Shoes in wearable condition are sent for resale to thrift stores, consignment shops, and other secondhand clothing markets in the United States and abroad. Shoes that are unwearable are repurposed as furniture stuffing, home insulation, padding, and other products. The shoe recycling program was launched on April 2, and 2,160 pounds of shoes were collected during the initial 1-month window. By the end of FY 2019, 3,226 pounds of shoes had been collected. Feedback on the program was very positive, with a key benefit being the convenience of the bins located across the laboratory. The Sustainability Program extended the recycling program through the end of calendar year 2019.

Argonne also continued efforts to upgrade water fountains to combination water fountain–water bottle filling stations and reduce single-use disposable products. An additional 5 water fountains were installed in FY 2019. Argonne distributed 120 reusable coffee tumblers at the 2019 Earth Day Celebration to reduce pollution from single-use coffee cups.

3.1.2 Construction and Demolition Debris

Diversion of clean construction and demolition debris (CCDD) is another focus of Argonne's waste reduction and management program. In FY 2019, Argonne diverted 63 percent of its construction and demolition debris.

Argonne diverts CCDD from three primary sources: maintenance of existing infrastructure (buildings and roads), demolition of existing buildings, and construction of new buildings. CCDD from Argonne's construction sites included brick, concrete, ceiling tile, paper, corrugated cardboard, drywall, glass, metal, plastic, and wood. The quantity of CCDD each year varies depending on the amount of construction Argonne implements.

Municipal solid waste contracts and construction contracts are used to accomplish CCDD. Argonne's Division 1 specifications require all contractors to divert at least 50 percent of CCDD on any given project from the landfill and complete an annual reporting form. Due to the robust CCDD recycling program in the greater Chicagoland area, Argonne has consistently exceeded the 50 percent diversion goal. The Sustainability Program continues to work with project managers to keep detailed records of construction and demolition material and debris generated during construction projects to ensure that material is diverted from landfills.

Argonne also collects and separates scrap metal generated onsite during small construction projects and clearing out obsolete equipment and materials from laboratory facilities. Argonne has a robust scrap-metal recycling program that provides a centralized location for collecting scrap metal and a contractor that hauls the scrap metal to a recycling facility. In FY 2019, Argonne collected and recycled 158 tons of scrap metal.

3.1.3 Chemical, Legacy, and Universal Waste

In FY 2019, Argonne continued to improve the sustainability of chemical management at the Laboratory. The Sustainability Program led a working group that defined chemical sustainability as "a chemical management system that looks at the lifecycle of chemicals at Argonne (purchase, use, storage, disposal) and works to meet the mission needs in a way that maximizes safety, minimizes waste, and manages lifecycle cost."

Based on stakeholder feedback and opportunities analysis, Argonne implemented a pilot program to centralize chemical management activities within Building 241. For the pilot, a Deployed Material Specialist (DMS) was assigned to Building 241 to support the scientific community by reducing the time spent performing administrative tasks associated with the chemical lifecycle. Administrative tasks taken over by the DMS include chemical purchase, receipt, storage, and disposal, allowing researchers to focus on science. A 6-month pilot was completed in FY 2019 in Building 241, where the DMS position successfully reduced attribute errors within Argonne's Chemical Management System, CORAL, while providing time and cost savings to the scientific community. This pilot also assessed the integrity of chemical containers of aging chemicals (>10 years old), which led to safely disposing of 83 aging chemicals.

In FY 2019, Argonne collected chemical and legacy waste that was identified for disposal during Disposal Days in 2018. The goal of the program was to improve safety and housekeeping in active work areas and common spaces by reducing clutter and properly disposing of unwanted or unused material. The response from building occupants was very strong; 355 requests were made for chemical waste disposal, representing over 7,200 items, and 6,896 requests were made for non-chemical waste, representing 192 items. Argonne's Nuclear and Waste Management staff worked through the first 9 months of FY 2019 to complete waste requisition paperwork and pick up the material.

Argonne's Rigging team collected scrap metal, obsolete electronics, and other equipment for recycling and disposal between October and June 2019 to address original Disposal Days program requests. All eligible requests for waste

collected under the 2018 Disposal Days program have been addressed. A key to the success of the program was the free pick up of materials and the support provided across multiple divisions to help identify, package, and oversee collection.

Batteries are generated primarily from office and other administrative tasks and are also found during the demolition of small or large facilities and infrastructure projects. Argonne maintains a lab-wide battery recycling program that meets the EPA's requirements for disposition of universal waste. In FY 2019, Argonne assessed the battery recycling program to identify opportunities for enhancements. Based on the assessment, Argonne upgraded containers and signage used at the 10 battery collection sites (Figure 10). Argonne also developed new signage to advertise the location of battery recycling stations and posted the signs in copy areas and breakrooms within each building that has a recycling station. These efforts are designed to create awareness of the program and communicate requirements to building occupants.



Figure 10: Battery Recycling Program Signage and Container Upgrade

3.2 Plans and Projected Performance

Argonne plans to continue existing activities that support waste prevention and recycling measures, and implement the resource conservation strategy outlined in the 2017 Sustainability Strategic Plan. The Laboratory expects to achieve its goals of reducing municipal solid waste generation, reducing the percentage of solid waste sent to landfill, and increasing the quantity of construction demolition debris recycled, based on current plans and funding levels. Details of expected performance are summarized in Table ES-1 in the Executive Summary.

In FY 2020, Argonne plans to expand the composting program to collect food scraps in breakrooms and coffee stations across the Laboratory. This Phase 3 implementation of the composting program will focus on buildings where there is strong support from building managers; Environment, Safety and Health (ES&H) Coordinators; and building occupants. Planning for the Phase 3 implementation will begin at the start of the fiscal year, and will incorporate best practices learned in the Building 362 pilot program for breakroom and coffee station composting. Argonne plans to engage composting ambassadors throughout phase 3 and will organize a second round of training so new volunteers can join the program.

Argonne will continue efforts to conduct education and outreach for employees and visitors on recycling, waste reduction, and other sustainability topics. In FY 2020, Argonne will work with internal Communications and Public Affairs staff to update site-wide signage for landfill, recycling, and composting containers. The Sustainability Program will also evaluate results from three “Green in Action” Brown-Bag Lunch and Learn events held in FY 2019 to determine next steps for FY 2020. Argonne also plans to continue the shoe recycling program and will work to establish an annual contract that allows for shoe collation and recycling.

Argonne plans to continue working with the Building 362 and Building 401 GATs. The Building 362 GAT plans to implement several projects with the Sustainability Program staff, including replacement of large fiberglass panels in the Building 362 High Bay with water-tight, insulated panels and pursuing energy lighting retrofits. The Building 401 GAT plans to focus on signage and communications to building occupants to reinforce the Laboratory’s recycling program (Figure 11).



Figure 11: Building 362 Green Action Team (GAT) Group Photo

The Sustainability Program plans to develop a GAT toolkit that includes templates and additional resources so staff in other buildings can start additional GATs in the future. Based on the lessons learned from these two GAT in FY 2019, the Sustainability Program plans to work closely with building managers to identify potential other buildings in which to establish GATs in FY 2020 and beyond.

Argonne plans to recycle large quantities of scrap metal, mainly in the form of electromagnets, during the APS Upgrade planned for FY 2022. The site population is not expected to change significantly, but large construction projects like the APS Upgrade will continue to influence Argonne's waste management activities.

Argonne plans to develop a project in FY 2020 to focus on disposing of legacy chemicals through a targeted, risk-based approach. The Sustainability Program will participate in this project by working closely with Nuclear & Waste Management and ES&H staff. Addressing legacy chemicals connects to the Smart Labs Program that the Sustainability Program is leading to improve operations, achieve energy efficiency, and support safe ventilation systems. Disposal of higher-risk chemicals helps to reduce demand for ventilation that is driven by the generating potential of chemicals present in a laboratory space. The Sustainability Program will incorporate the target SLA buildings into the FY 2020 planning process for addressing legacy chemical waste.



GREEN ACTION TEAMS LAUNCHED TO ACCELERATE BUILDING SPECIFIC POLLUTION PREVENTION, WASTE MINIMIZATION, AND SUSTAINABILITY PROJECTS

Green Action Teams generate sustainability strategies that fully tap into the ingenuity of Argonne’s talented and unique community.

In FY 2019, Argonne created a Green Action Team (GAT) in Building 362 to help advance site-wide sustainability goals with strategies and projects that meet the specific needs of the building. The GAT is open to all occupants of the building and provides a structured process to help drive sustainability results within their specific workspaces and building.

The Sustainability Program collaborated with the Building 362 Building Manager; Environmental, Health & Safety (ESH) Coordinators; Facility Engineers; Maintenance Staff; and Custodians to establish the GAT and implement a first round of projects. The Building Manager and an ESH Coordinator volunteered to serve as the GAT Champions and helped organize a kickoff meeting open to all building occupants.

To help support the GAT, the Sustainability Program created a Guidance Document to serve as a resource to support the GAT kickoff, planning, implementation, and continuous improvement process. Included are step-by-step instructions for brainstorming and prioritizing project ideas, a business case template to use in documenting project ideas and requesting funding, and sample language that can be used to recruit team members and communicate with the building occupants.



Anti-Idling sign installed by the Building 362 Green Action Team.





Adjustable fiberglass window shades installed in the corridor connecting Building 362 to the adjacent Building 360

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The Building 362 GAT and Sustainability Program staff met regularly and worked closely to brainstorm ideas and develop details for the initial projects. Ideas focused on pollution prevention and waste diversion, as well as energy efficiency throughout the building.

In FY 2019, the Building 362 GAT completed three projects from their initial list. Anti-idling signs were installed in front of the building along the drop-off area where delivery trucks routinely park. These signs reinforce Argonne's commitment to improving local air quality and reducing greenhouse gas emissions associated with unnecessary idling of vehicles.

To support Argonne's waste diversion and composting program, the Building 362 GAT helped upgrade recycling and landfill bins within the lobby, hallway, and service floor of Building 362. In addition, composting containers and signage were added to the first floor coffee station and third-floor lunchroom to increase the collection of organic material for composting. This GAT led effort resulted in Building 362 being

designated as the official site for piloting Phase 3 of the Composting Program, which aims to bring compost collection to break areas, coffee stations, and lunchrooms across Argonne.

The GAT also implemented a project to improve occupant comfort and avoid adding space cooling to the corridor connecting Building 362 to the adjacent Building 360. Adjustable fiberglass window shades were installed to reflect the sunlight during spring, summer, and fall months when temperatures would otherwise regularly exceed 100 degrees Fahrenheit inside the corridor during the workday.

The Building 362 GAT developed business case documents to request support for several other projects that will be completed in FY 2020. These include a project to reduce heat loss and water infiltration by replacing panels in the highbay, sensors to automatically switch off lights in several conference rooms when they are unoccupied, lighting upgrades, and radiator cleaning to improve efficiency and output of office heating.

4. Fleet Management

4.1 Performance Status

Argonne continues to implement Sustainability Strategic Plan, which includes an integrated approach to address the Laboratory's fleet, travel, and commuting needs. The Sustainability Program's efforts complement Argonne's Fleet Management Plan (Appendix 1), implemented by the Facilities Department. By implementing both plans, the Laboratory will continue to reduce the environmental impacts of fleet and mobility services by using a combination of strategies for procurement, alternate fuel infrastructure, zero-emission onsite mobility solutions, and use policies.

To date, these efforts have resulted in Argonne meeting or exceeding fleet management goals for reduction in petroleum consumption and increase in alternate fuel use.

Argonne's fleet is comprised of 119 vehicles, 111 of which are leased through the General Services Administration (GSA) and 8 of which Argonne owns. Argonne's policy of ordering only alternative fuel vehicles (AFVs) from the GSA leasing program has resulted in over 90 percent of fleet vehicles operating on ethanol (E85), biodiesel (B20), or electricity. Older, less-efficient unleaded fuel vehicles have been replaced with newer AFVs. All replacement light-duty vehicles during FY 2019 were AFVs. In addition, Argonne downgraded, in vehicle class, two security vehicles from pickup trucks to hybrid sedans. Argonne's fleet continues to include two plug-in hybrid EVs, Chevy Volts, which GSA provided as part of the Green Fleet Pilot Program.

Argonne continues to advance zero-emissions mobility solutions on campus by increasing the number of zero-emission vehicles and EV charging stations. Argonne has added three Polaris GEM utility vehicles to the intra-lab fleet since FY 2018. The Project Management Organization, Maintenance Planning, and Worker Safety and Health groups are piloting these GEM utility vehicles to determine how they perform in Argonne's Midwestern climate and site terrain. The pilot program was a partial success. Employees' views of the vehicles are more positive than they were regarding previous local-use electrical vehicles. There were problems, initially, with the dependability of the vehicles. Argonne's Vehicle Maintenance group addressed the dependability issue by switching authorized service centers and securing manufacturer support, and GEM vehicles proved more reliable following these changes. Argonne will continue to investigate and evaluate multiple types of local-use EVs for viability.

In FY 2019, the Argonne Sustainability team completed a full year of the Fleet Share program to further reduce the number of fleet vehicles at the Laboratory. Staff working across multiple divisions in Building 214 shared one of the GEM vehicles and used the Laboratory's e-mail system calendar feature as a digital reservation tool to coordinate use of the shared vehicle. In FY 2019, Building 214 staff reserved the GEM vehicle on a daily basis and with 10 different users. The Fleet Share participants provided positive feedback about the program, noting that the reservation system was convenient and that the shared vehicle increased the group's likelihood to carpool to meetings.

As part of the construction of the Materials Design Laboratory (MDL), Argonne added four dual-port EV charging stations to the Laboratory's EV charging infrastructure in FY 2019. Underground infrastructure was also added at the MDL so that two additional dual-port EV charging stations can be added in the future as demand for EV charging increases. Fleet vehicles are allowed to charge at the site-wide EV charging infrastructure, which is also open to employees and researchers. To support dedicated fleet managed EVs, the Sustainability Program installed two new level 1, 120-volt EV charging outlets at Building 200 to accommodate the Custodial Manager in that building who uses one of the GSA-provided Chevy Volts.



Figure 12: Key Members of the Polaris GEM Utility Vehicle Pilot Program

4.2 Plans and Projected Performance

Argonne will continue to implement strategies initiated in FY 2019 to improve the environmental performance of the fleet and provide more mobility solutions to the Laboratory population. Strategies include the topics of fleet efficiency, fleet sharing, and zero-emission campus mobility. Based on current plans and funding levels, Argonne expects to maintain the current reductions in annual petroleum consumption and percentage of alternate fuel consumption.

Because the majority of Argonne's fleet vehicles are leased, the Laboratory will continue to work with GSA to select replacement vehicles that support the Laboratory's fleet sustainability goals. Argonne has a successful track record working with GSA, and the Laboratory continues to use t EVs funded by a previous GSA pilot. With a robust network of level-2 EV charging stations, Argonne is well positioned to take advantage of additional plug-in electric and hybrid EVs as they become available from GSA.

The Sustainability Program and Fleet Manager will continue to proactively engage stakeholders to better understand their needs and to provide recommendations on vehicle options that both meet user needs and address sustainability goals. Details of expected performance for fleet management are summarized in Table ES-1 in the Executive Summary.

In FY 2020, Argonne will continue to support the Polaris GEM utility vehicles project by understanding how the current Kubota vehicles are being used and suggesting the GEM as an alternative where viable. The Sustainability Program also plans to support a fleet utilization study that will help right-size vehicles and fleet size based on fleet utilization and needs.

Based on the positive feedback on the Fleet Share pilot, Argonne plans to formalize this approach and expand it to other work groups. Key steps in this process will include developing a Fleet Share best practices guide, promoting the concept to fleet users, and supporting groups in on-boarding. The Sustainability Program and Fleet Manager will look for opportunities to promote the Fleet Share program, including the Earth Day Celebration held annually in April, and in discussions with vehicle custodians as they evaluate their vehicle needs.

Argonne will continue to support zero-emissions mobility solutions on campus and enhance EV charging station infrastructure. In FY 2020, Argonne plans to improve the Employee Electric Vehicle Charging Program. Improvements include increasing the number of time slots when employees can reserve for a charging session, and creating a way for short-term employees to participate. In FY 2020, Argonne also plans to develop a multiyear investment strategy to address the projected increase in demand for EV charging for site occupants within the next few years.

5. Clean and Renewable Energy

5.1 Performance Status

Argonne has invested in onsite infrastructure to provide clean and renewable energy in partnership with onsite research and operational programs. The campus includes solar photovoltaic (PV), wind, geothermal, and CHP facilities. Figure 13 presents a summary of Argonne’s renewable electric energy consumption broken down by location and attribute.

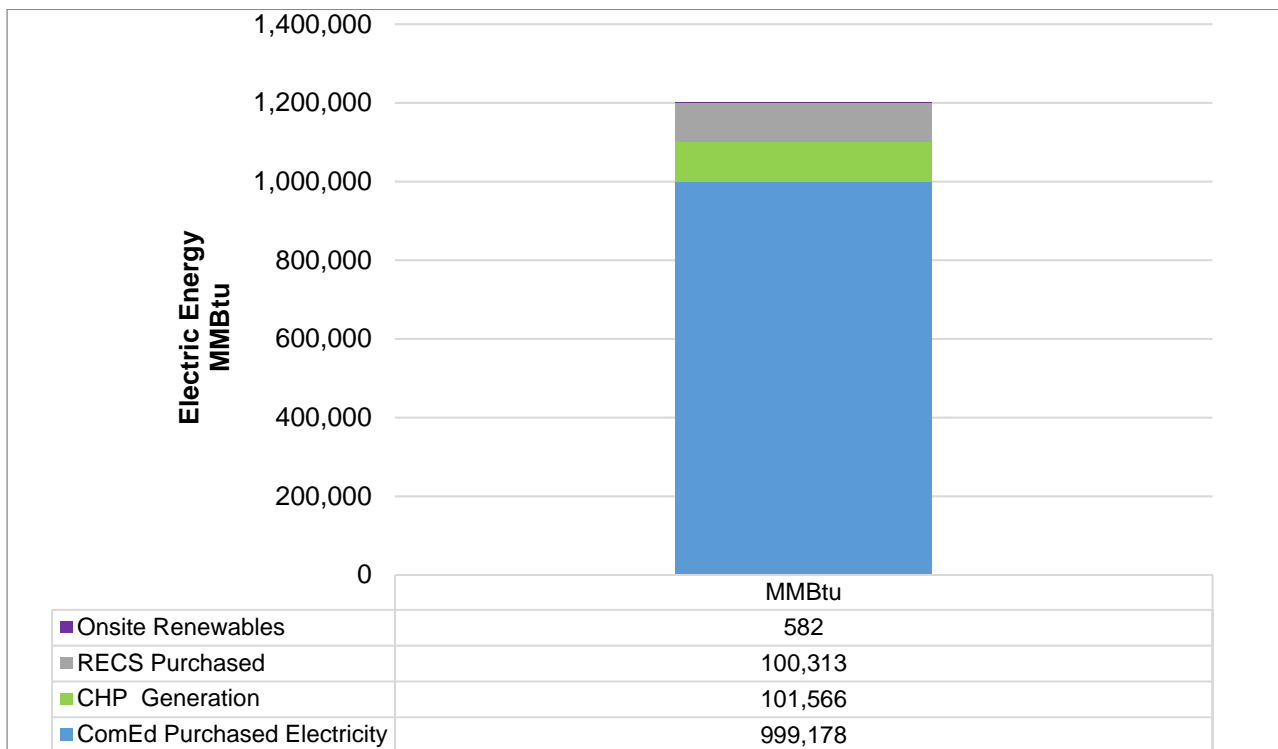


Figure 13: Total Renewable Electric Energy Consumption by Type (in MMBTUs), FY 2019

Onsite renewable energy provides a small portion of Argonne’s electricity supply. These assets demonstrate techniques for incorporating renewable energy into existing buildings and sites. The Sustainability Program actively promotes the Laboratory’s clean and renewable energy infrastructure through tours and by providing information on the Laboratory’s website.

As a federal facility, Argonne must meet statutory requirements related to the consumption of renewable energy and electricity. Current statutory requirements are to achieve 7.5 percent of total electric consumption from renewable sources. Argonne primarily meets this requirement by purchasing renewable energy certificates (RECs). In FY 2019, Argonne purchased 29,400 MWh of Green-e certified RECs. This quantity is significantly less than Argonne purchased over the previous 3 years, because EO 13834 reduced the requirement. Table 5 summarizes Argonne’s REC purchases.

Table 5: Renewable Energy Credit Purchase History, FYs 2011–2019

FY	Purchased RECs (1,000 MWh)	Unit Cost (\$/MWh)	Total Cost (\$k)
2011 (act.)	21	0.45	10
2012 (act.)	21	0.43	9
2013 (act.)	24	0.44	11
2014 (act.)	26	0.99	26
2015 (act.)	33	0.60	20
2016 (act.)	40	0.43	17
2017 (act.)	31	0.33	10
2018 (act.)	46	0.69	32
2019 (act.)	29	0.73	21
2020 (est.)	60	0.70	42

5.1.1 Solar Photovoltaic

Argonne maintains several PV systems onsite that provide clean, renewable energy. The newest system, located at the Building 300 Smart Energy Plaza, includes two 40-kW solar arrays and fixed canopies. The Sustainability Program collaborated with Energy Systems division researchers to develop this facility, which generates more than 100 MWh of energy annually. The facility includes EV charging stations and an active research laboratory for Argonne’s Center for Transportation Research.

Argonne also maintains a ground-mounted 109-kW solar array adjacent to Building 372/373. This system consists of more than 700 PV panels and provides electricity for the Laboratory’s emergency operations center. Every year, it generates about 120,000 kWh of energy, saves about \$6,000, and helps avoid emission of 110 metric tons of CO_{2e}. The 109-kW project started as a collaboration between the Sustainability Program and Argonne researchers who were using the system to study the performance of panel types in a Midwestern environment. High-resolution sensor monitor components train machine-learned algorithms to forecast the power production of Argonne’s PV plant.

Two additional small solar installations provide power to EV charging stations and are grid-tied to provide energy to building systems when not charging vehicles. A 3.8-kW PV array uses a powered dual-axis tracker to increase energy yield by keeping the array pointed at the Sun. It can produce enough power to charge four EVs simultaneously. The second, a fixed-axis, 9-kW PV array, is connected to a bank of charging stations used for research and employee EV charging.

In FY 2019, Argonne focused on maintenance to support the Laboratory’s existing solar PV infrastructure and began planning for future solar PV investments. Argonne inspected and performed preventative maintenance on the 109-kW solar PV system, with the help of a contractor, Hardt Electric, Inc. The contractor thoroughly assessed the condition and performance of key system components and documented recommended repairs in a report to Argonne.

Argonne also completed the Solar Energy Feasibility Study (Solar Study) to serve as a masterplan and roadmap toward achieving Argonne’s clean and renewable energy goals through onsite solar energy generation at a significant scale. The goal was to identify viable locations and system size for Argonne to further investigate expanding onsite solar PV generation. The Solar Study shows Argonne could install enough PV to meet the current renewable electric energy goal of 7.5 percent through onsite infrastructure. The Renewable Energy Success Story summarizes this project and next steps.

The Solar Study also included an analysis to incorporate Extreme Fast Charging for EVs and an additional PV system at the Building 300 Smart Energy Plaza. These improvements at Building 300 support current research by the Energy Systems division and will result in a change to electrical demand, supply, and storage capacity at the facility. The Solar Study recommended a range of battery size for a PV array that could match the expected demand from EV charging.

5.1.2 Wind

Argonne's 10-kW wind turbine provides electricity for the Laboratory's shipping, receiving, and vehicle maintenance facility. It generates about 6,000 kWh annually and helps Argonne avoid producing about 6 metric tons of CO₂e per year. In FY 2019, Argonne focused on maintenance of the wind turbine. In parallel to the maintenance activities on the 109-kW PV system, Argonne inspected the wind turbine, with the help of a contractor, Hardt Electric, Inc. The contractor provided a summary report to Argonne with the results of the inspection and recommended repairs.

5.1.3 Geothermal

The geothermal heat pump system at Argonne's Visitor Reception Center eliminates approximately 668 million Btu of natural gas combustion per year. This system continues to operate as designed and provides a sustainable heating source for the Visitors Center.

5.1.4 Combined Heat and Power Plant

Argonne's Combined Heating and Power Plant (CHP) is a 6.3-MW facility that is designed to provide 20 percent of Argonne's electricity needs and 80 percent of its steam heat. It replaced aging equipment and modernized critical infrastructure. In FY 2018, the CHP experienced an operational limitation, resulting in operation for only 7 months throughout the year. As a result, the CHP produced 26,860 MWh of energy rather than the planned 49,358 MWh. Therefore, Argonne purchased more electricity from the local utility than planned. The operational limitation is being addressed and the CHP is expected to run at full capacity during FY 2020.

5.2 Plans and Projected Performance

Argonne's strategy for clean and renewable energy is outlined in the Sustainability Strategic Plan. It calls for Argonne to continue to leverage onsite, distributed renewable energy to improve campus resiliency. Details of expected performance are summarized in Table ES-1 in the Executive Summary. In FY 2020, Argonne will continue building on recent success with onsite PV projects and begin next steps

5.2.1 Existing System Maintenance

Based on results from the preventative maintenance activities completed in FY 2019, Argonne will develop an implementation plan in FY 2020 to address repair and replacement needs at the Building 372/373 PV array (Figure 14). The Sustainability Program will continue to work with qualified contractors to provide maintenance services on the Laboratory's renewable energy assets and will explore working with building maintenance and utilities staff to complete maintenance. Argonne plans to integrate these assets into the Laboratory's asset management system and develop a maintenance program for them to ensure they operate effectively over their expected service life.

Argonne plans to address broken PV-wind lights that are exterior of Building 201 by replacing them with a more mature and proven technology. Building Maintenance and Engineering Departments made several repairs efforts in the past to these pole-mounted fixtures and issues have persisted. The Sustainability Program worked with the maintenance contractor to identify a reliable replacement, and this solution will be implemented in FY 2020.



Figure 14: Building 372/373 Solar PV Array

5.2.2 New Infrastructure and Green Energy Procurement

In FY 2020, Argonne will take the next step to implement the recommendations of the Solar Study by convening key stakeholders across operations and research divisions to review the study's results and prioritize locations for further analysis and design. Argonne will also explore options for funding, procurement, and operations of future PV systems. The Sustainability Program will also collaborate with Energy Systems researchers to help implement the battery energy storage and PV project at Building 300. Argonne plans to implement the battery energy storage system in FY 2020 and continue with primary design activities for the PV array.

In FY 2020, Argonne plans to build a new guardhouse at the North Gate entrance to the Laboratory. A PV system was included during design and the north guardhouse was confirmed to be a viable location for roof-top PV. The Sustainability Program will work closely with the project manager to ensure the PV system is included in the bidding process and funding is available to complete the work.

Argonne will continue evaluating the feasibility of renewable and clean energy technologies at specific buildings during the Smart Labs Program baseline evaluation and during all new construction projects, where appropriate. Argonne will also continue to leverage RECs to meet the majority of Argonne's clean electric energy requirements until funding and contracting details are developed to develop more onsite solar PV infrastructure. Because site-wide electricity usage is expected to increase due to exascale computing, Argonne expects to see a sharp increase in quantity and cost to purchase RECs over the next 2–5 years, depending on the amount required.



LONG-TERM SOLAR PV MASTER PLAN CHARTS PATH FOR **FUTURE SOLAR ENERGY PROJECTS AT ARGONNE**

The Solar Energy Feasibility Study provides a masterplan and roadmap toward achieving Argonne’s clean and renewable energy goals through onsite solar energy generation at a significant scale.

Federal authority requires Argonne to obtain a minimum of 7.5% of the site’s total electrical usage from renewable sources by FY 2013 and every year thereafter. Currently, Argonne primarily purchases renewable energy credits (RECs) to meet this goal, in addition to using energy from a small number of onsite solar photovoltaic (PV) systems. Based on FY 2018 utility meter data, Argonne must generate 22,645 MWh to meet its goal of 7.5% renewable electric energy.

To support long-term planning and inform future infrastructure investments, the Sustainability Program led a feasibility study in FY 2019 to understand the site impact, costs, and benefits associated with meeting the federal renewable energy goal exclusively through onsite solar PV systems. Stakeholders from a broad set of disciplines were involved in the study, including environmental compliance, civil engineering, facilities and campus planning, project management, facility engineering, utilities, project management, electrical safety, and sustainability, as well as consultants from Cannon Design.

SOLAR PV ENERGY BASELINE ANALYSIS FY 2018

- Total campus electricity consumption: 301,929 MWh in FY 2018
- Baseline electricity consumption: 77,654 MWh (25% of total)
- High Energy Mission Specific Facility use: 224,275 MWh
- Federal requirements for renewable electric energy:
 - 22,645 MWh annual energy generation
 - 7.5% of total electric energy



SUCCESS STORY: **CLEAN & RENEWABLE ENERGY**

The Solar Energy Feasibility Study analyzed the existing PV marketplace to determine what specific technologies and arrangements would most effectively meet Argonne renewable electricity goals. To account for limited annual funding, the study evaluated how the different technologies could be deployed on the Argonne campus in an incremental fashion. The analysis sought to:

- Quantify how much electricity PV arrays could produce or offset and the physical space they would require.
- Understand the costs associated with PV arrays of various sizes that utilize various technologies.
- Assess the economic feasibility of various options with a credible life-cycle cost analysis, according to federal procedures.

The Solar Energy Feasibility Study also took into consideration available solar resources on Argonne's campus, as well as potential space constraints

and other factors that would affect implementation, energy rates, interconnection of PV arrays with the Argonne power grid, and impacts on Argonne's long-term operations and maintenance.

The stakeholder team reviewed available information to determine suitable areas for PV array installation. The team excluded areas that contained wetlands, protected habitat, and/or landfill or other similar uses, as well as those shadowed by nearby buildings. Argonne's rooftops were not considered because they have limited clear roof area for PV arrays due to the abundance of laboratory exhaust stacks. Finally, the stakeholder team limited their search to areas large enough to support at least a 250 kW array; this was determined to be the size at which systems become more cost effective and their output can contribute sufficiently to the large quantity of renewable energy Argonne is seeking to generate onsite.

A total of 20 sites were identified as viable locations for solar PV installations across the Laboratory over the long term. Viable sites are distributed across Argonne's campus, with the largest available sites on the east and west periphery of the Laboratory.

Based on the current analysis of the available area for PV generation, Argonne can support approximately 81,800 solar PV modules and generate roughly 53,600 MWh of solar energy. This exceeds the initial goal of roughly 22,645 MWh that would be necessary to meet the requirement of 7.5% of total electricity consumption from renewable sources.

Argonne's next steps include continued engagement with stakeholders and an analysis of procurement models and funding strategies for PV implementation.



Existing solar PV array

**FOR MORE INFORMATION
PLEASE EMAIL**

**Sustainability Program Manager
sustainability@anl.gov**

6. Green Buildings

6.1 Performance Status

6.1.1 Guiding Principles

Argonne has successfully documented 19.8 percent of the Laboratory’s buildings as meeting the HPSB Guiding Principles, achieving the previous goal set for 2025. In FY 2019, Argonne did not certify any new buildings as compliant with HPSB Guiding Principles. Table 6 inventories Argonne’s compliance with these principles.

Table 6: Inventory of Compliance with Guiding Principles for HPSBs

Building	New/Existing	Certification	FY
46: Shipping and Receiving	Existing	LEED Silver	<2011
216: Sub-Angstrom Microscopy	New	LEED Gold	<2011
214: Facilities Management	Existing	HPSB	2012
302: Security	Existing	HPSB	2012
438: APS Laboratory Office Module (LOM)	Existing	HPSB	2012
440: Center for Nanoscale Materials	New	LEED Silver	2012
435: APS LOM	Existing	HPSB	2013
241: Energy Sciences Building	New	LEED Gold	2015
446: Advanced Protein Characterization Facility	New	LEED Gold	2015
436: APS LOM	Existing	HPSB	2015
224: Visitor Reception Center	Existing	HPSB	2015
434: APS LOM	Existing	HPSB	2016
431: APS LOM	Existing	HPSB	2017
432: APS LOM	Existing	HPSB	2017
433: APS LOM	Existing	HPSB	2017
386: Enterprise Data Center	Existing	HPSB	2017
242: MDL	New	LEED Gold	2020
4XX: Long Beamline Building	Future	HPSB	2021
4XX: Sensing and Imaging Building	Future	HPSB	TBA

Argonne leverages an integrated design approach to include HPSB Guiding Principles early in the design process. For new buildings, the Sustainability Program is involved early in the project development and the project team documents the process to show compliance with HPSB Guiding Principles. All new buildings whose designs began at or after the beginning of FY 2007 meet or exceed Federal building efficiency standards. For all other facility projects, Argonne takes a graded approach to incorporate HPSB Guiding Principles into the project, where the size and complexity of the design is used to determine the way HPSB Guiding Principles are incorporated.

Argonne uses design guidelines and design reviews to ensure that all buildings meet these requirements. The Sustainability Program is an integral part of Argonne’s Project Management Organization and takes an active role in all construction projects. Argonne’s Facilities Design Guide also requires compliance with these standards. The Reinvestment Program also supports compliance with HPSB Guiding Principles by implementing energy efficiency projects using products and strategies consistent with HPSBs.

In FY 2019, Argonne substantially completed construction on the laboratory’s newest green building, the MDL. This new building is expected to receive certification as a LEED Gold building when the project is completed in FY 2020. The MDL will house 112 lab modules and have a net 51,788 square feet focused on materials design. The MDL embraces maintainability, energy efficiency, and environmental sustainability to optimize economy of operation and energy

utilization. Argonne selected LEED certification as the path for achieving compliance with the guiding principles for HPSBs. The Green Buildings Success Story highlights sustainability features of the MDL project.

Argonne also completed a thorough review of compliance with HPSB Guiding Principles as part of the Smart Labs Program. In FY 2019, Argonne evaluated Building 401 during the baseline assessment phase. Building 401 is not in compliance with two of the required metrics, energy use reduction and thermal comfort. Energy usage data for chilled water and steam are not available, making it difficult for Argonne to document the 20 percent reduction compared to the FY 2015 baseline to meet the Guiding Principle. In addition, compliance with thermal comfort criteria cannot be demonstrated based on a survey that was completed during the Building 401 Smart Labs assessment.

In FY 2019, the Sustainability Program developed a checklist to incorporate sustainability strategies within horizontal and vertical non-occupied building projects, such as cooling towers, water tanks, and underground sewer mains. Argonne used this checklist in two sustainability reviews of the Electricity Capacity and Distribution Capability (ECDC) project, which will bring two new 138-kV circuits onto Laboratory property to connect to Argonne's existing high-voltage electric distribution system.

Argonne plans to construct two new buildings at the Laboratory in the next few years: the Long Beamline Building (LBB) and the Sensing and Imaging at Argonne Facility (Sensing & Imaging). Summaries of each building are provided below.

- The LBB will house two long beamlines as part of the APS Upgrade project. LBB will be approximately 26,000 square feet in area and will house associated shielded enclosures. Construction is expected to start in June 2020 and to take approximately 16 months to complete.
- Sensing & Imaging will provide a state-of-the-art laboratory to support the most advanced levels of electron microscopy in the international research community. The core of the facility will include high-performance instrument suites that provide stable environments meeting the exceptionally stringent vibration, acoustic, and thermal humidity and electromagnetic interference requirements. The facility will be either 7,500 or 19,500 square feet, depending on funding levels. Currently the project is tasked with the design only; there is, as yet, no planned construction start date.

6.1.2 Increase Local and Regional Planning and Coordination

Argonne is the nation's oldest national laboratory and has existed as part of the Chicago suburbs since its inception in 1946. All new construction and facility renovations occur within the 1,500-acre Laboratory site. Argonne's planning efforts advance the Laboratory's scientific mission by integrating the needs of stakeholders through ongoing outreach to site occupants and meeting legal and other requirements. Argonne's development plans incorporate elements of the Council on Environmental Quality's (CEQ's) Principles for Sustainable Federal Location Decision.

Argonne's natural resources staff coordinate with ecosystem, watershed, and environmental management efforts outside the Laboratory. Argonne representatives attend monthly meetings at Fermi National Accelerator Laboratory to discuss land management strategies and issues. Argonne also actively coordinates with the U.S. Fish and Wildlife Service (USFWS). In FY 2019, Argonne concluded a study to identify amphibian and reptiles present at the Laboratory.

For the second year in a row, Argonne hosted a bumblebee "blitz," where USFWS staff provided training to Argonne employees on identifying the rusty patch bumblebee, which is also on the endangered species list in Illinois. Documenting the presence of threatened and endangered species is critical for Argonne so the Laboratory can take the necessary steps during planning and construction to limit environmental impacts during energy and water improvement projects.

Argonne is a driver in regional planning initiatives. The Laboratory leads by example onsite and in collaboration with regional partners. In FY 2019, Argonne continued design efforts to develop the ECDC project, which will increase the site's electrical capacity to support the expansion of HEMSFs on campus. The planning process included coordination with the DuPage County Forest Preserve, neighboring residential subdivisions, and local business and community leaders. Argonne adjusted the final location of the infrastructure based on feedback from the local stakeholders and to minimize the project's environmental impact.

Building on the relationship with forest preserve staff and elected officials, Argonne led a roundtable discussion with stakeholders from the Township Highway Department, DuPage County Sheriff's Office, and DOE on traffic and pedestrian safety concerns in the forest preserve surrounding the Laboratory. These relationships will continue to inform planning and coordination with the surrounding community as Argonne develops facility and infrastructure improvements.

6.2 Plans and Projected Performance

6.2.1 Guiding Principles

Argonne's green building initiatives continue working to document all subject buildings as compliant with HPSB Guiding Principles. The Sustainability Program is working with the Facilities Planning group and Project Management Division to incorporate HPSB Guiding Principles into the lifecycle of all infrastructure projects, including planning, design, construction, and closeout.

In FY 2020, the Sustainability Program plans to develop two complementary tools to help inform infrastructure projects and assist staff in completing design reviews to ensure projects incorporate HPSB Guiding Principles. First, subject matter experts within the Sustainability Program will develop a detailed set of technical and performance specifications that will help engineers understand the types of products and design calculations needed to show inclusion of HPSB Guiding Principles. This document will complement the Facilities Design Guide, which provides high-level requirements. Second, Argonne will develop a detailed checklist that the Sustainability Program can use to complete design reviews and confirm HPSB requirements were incorporated as planned. Argonne will continue to preserve each building's HPSB documentation in a centralized file system on the Laboratory's cloud storage system, Box, for ease of access.

In FY 2020, Argonne will complete construction on the MDL and move researchers and support staff into the building (Figure 15). Completion of the MDL marks the final stage in the creation of the Argonne "Energy Quad" on the main campus. The Energy Quad collocates and consolidates science disciplines to improve productivity and foster greater collaboration, while reducing Argonne's overall facilities footprint. Coupled with laboratory and space renovations in Buildings 223 and 222, the Energy Quad creates modern state-of-the-art research facilities, while facilitating the decommissioning of obsolete and contaminated space. In addition to being a LEED building and complying with HSPB Guiding Principles, MDL also improves site mobility through pedestrian improvements, parking lot improvements and the addition of EV charging stations.



Figure 15: Photo Rendering of MDL Planned for Completion in FY 2020

Argonne plans to complete the LBB design and begin construction in FY 2020. Design activities for the Sensing & Imaging facility will continue, although no construction budget has yet been secured. The Sustainability Program will work closely with the project managers for both projects to incorporate HPSB Guiding Principles through project planning, design, and construction.

6.2.2 Local and Regional Planning and Coordination

Argonne will continue to participate in national, regional, and local planning to support the social, environmental, and economic successes of the region and the nation. Sustainability staff will continue to provide and participate in outreach and education with students, teachers, partner organizations, and other groups to develop learning opportunities and strategic planning tactics.

Argonne continues to improve travel to and within the Laboratory by integrating onsite and offsite transportation planning into a Mobility Solutions strategy. Argonne's onsite transportation management interacts extensively with wider regional transportation resources. The Sustainability Program initiated conversations with the Chicago regional commuter rail transportation provider, Metra, seeking methods of accommodating Laboratory staff and visitors on public transit in FY 2019. Based on these information-sharing discussions, the program will continue to investigate regional transportation planning and coordination with other transit providers in FY 2020. Additional plans related to transportation issues are summarized in Section 4, Fleet Management, and Section 9, Travel and Commute.

7. Acquisition and Procurement

7.1 Performance Status

Argonne is working to maximize the number of purchases that incorporate sustainable products by embedding requirements into the Laboratory’s contracting process and providing stakeholder outreach and education. Argonne’s Prime Contract with the DOE directs the site’s procurement efforts to maximize acquisition of sustainable products and includes sustainable acquisition clauses for procurement that meet federal green purchasing requirements, as outlined in the Federal Acquisition Regulations (FAR) and Department of Energy Acquisition Regulations (DEAR). Table 7 summarizes the Sustainable Acquisition Progress for FY 2019.

Table 7: Summary of Sustainable Acquisition Progress

Category	Recycled	Energy Efficient	Biobased	EEP	Statutory +	Total
Number of Eligible Contract Actions	*	*	*	*	*	12,779
Number of Contract Actions w/SA Clauses	*	*	*	*	*	764
Total Eligible Contract Dollars (\$)	*	*	*	*	*	\$657,476,393
Total Contract Dollars (\$) w/SA Clauses	*	*	*	*	*	\$96,310,331
*Note-at this time we are not able to determine which category the contract action is related to but can confirm that all clauses were included in the contracts as shown.						
Biobased Purchasing Values	FY 2019		FY 2020		Notes	
Biobased Product Purchase and Targets (# of actions)	At this time we are unable to separate which contracts were appropriate for biobased product requirements. Improving our procurement system is a key priority for FY 2020 to better track sustainability requirements is a key activity.					
Category	Definition from FPDS Sustainability Report			Alignment with DEAR Clauses		
Recycled	"FAR 52.223-4" + "FAR 52.223.4 & FAR 52.223-9"			DEAR 970.5223-7		
Energy Efficient (EE)	"Energy Efficient"			DEAR 970.5223-7		
Biobased	"Biobased"			DEAR 970.5223-7		
Multi-Statutory	"FAR 52.223-4 & Energy Efficient" + "FAR 52.223-4 & Biobased" + "FAR 52.223-4 & Biobased & Energy Efficient"			DEAR 970.5223-7		
Environmentally Preferable (EPP)	"Environmentally Preferable"			DEAR 970.5223-7		
Statutory+	"FAR 52.223-4 & Environmentally Preferable" + "FAR 52.223-4 & Biobased & Environmentally Preferable" + "FAR 52.223-4 & Biobased & Energy Efficient & Environmentally Preferable"			DEAR 970.5223-7		
For more information, visit the following: Federal Acquisition Regulation Site ; DEAR 970.5223-7						

In FY 2019, Argonne completed all infrastructure project planning, design, and construction with sustainable acquisition requirements embedded in the process. The Sustainability Program provided training to Infrastructure Project Managers on the changes made in FY 2018 to incorporate sustainable acquisition into the Project Implementation Plan, Argonne Facilities Design Guide, and Division 1 Specifications. Argonne also completed a sustainable design project review on the ECDC project and evaluated opportunities for incorporating sustainable acquisition into the \$60 million dollar project.

Argonne continues to use the Earth Day Celebration to educate Lab occupants on sustainable acquisition requirements and opportunities. In FY 2019, Sustainability Program staff promoted greener office products during Earth Day in collaboration with Grainger, one of the Laboratory's vendors for operations and maintenance products. In addition, Sustainability Program staff worked with Sodexo, the Laboratory's food service vendor, to provide samples of a new vegetarian burger and other sustainable products available at the cafeteria.

The Sustainability Program staff continued to work with the Business and Information Services division (BIS) to enhance tracking of sustainable acquisition requirements and products received within the Laboratory's procurement systems. These systems include Argonne Materials Ordering System (AMOS), the Laboratory's "just-in-time" ordering system, and the Procurement and Requisition Integrated System (PARIS). The Sustainability Program formally launched a project with BIS in Q4 to begin modifying AMOS and PARIS to better maximize the procurement of sustainable products.

In FY 2019, the Sustainability Program reviewed three key courses that could be revised to include sustainable acquisition information and developed recommended modifications: training courses for Technical Representatives, training courses for Environmental Compliance Representatives, and the new employee Pollution Prevention overview. The Sustainability Program also provided one-on-one information to individual project managers throughout FY 2019 to provide advice on products that meet sustainable acquisition requirements.

DOE recognized Argonne in FY 2019 with the Green Buy Award for achieving leadership in sustainable acquisition. Argonne's 10-year progress in maximizing the use of green cleaning products was key in the award (Figure 16). The Acquisition and Procurement Success Story describes the award and green cleaning results.



Figure 16: Argonne Staff Recognized for Green Buy Award

7.2 Plans and Projected Performance

In FY 2020, Argonne will continue to make progress toward the sustainable acquisition plan developed in FY 2018. Under this plan, FY 2020 efforts will focus on updating Argonne's procurement systems to improve tracking of sustainable contracts and procurements, and revising training provided to staff involved in procurement activities. Argonne's current funding levels and plans are adequate for the Laboratory to continue achieving acquisition and procurement goals.

Argonne plans to continue FY 2019 activities to enhance tracking of sustainable acquisition requirements and products received within the Laboratory's procurement systems. The project is a collaboration between the Sustainability Program, Financial Management and Procurement Systems division (FMPS) Division and BIS. FMPS plans to do a complete review of the terms and conditions used in all procurement actions greater than \$50,000 and the contracts with the AMOS vendors to ensure the current FAR and DEAR clauses for federal acquisition requirements are included.

In FY 2020, Argonne plans to move forward with updates to three site-wide training courses where sustainable acquisition information is relevant. After the implementation of training, Argonne will complete targeted outreach for specific groups/roles that are responsible for or involved in buying products in their respective areas.

Argonne will also continue outreach to key vendors in AMOS and work to have their systems highlight products with sustainable attributes. Argonne plans to finalize the green purchasing guide to supplement the stakeholder engagement.



CUSTODIAL TEAM RECOGNIZED FOR LEADERSHIP IN GREEN PURCHASING WITH GREEN CLEANING PRODUCTS

For over 10 years, Argonne's Custodial Services team has proactively sought out greener products. They have switched to green products for virtually every cleaning application at the Laboratory.

At the start of Argonne's green cleaning efforts, the initial goal was to address worker safety resulting from the harsh, toxic cleaning chemicals that were the industry standard. During the last decade, the Custodial Manager and Coordinator took the initiative to seek safer and greener cleaning alternatives. Led by the six Custodial Foremen, Argonne's 83 custodians are now using green products and equipment that meet cleaning requirements and support sustainability goals at the same time.

Argonne's leadership in green cleaning products was recognized in FY 2019 by the DOE Federal GreenBuy Program, which awarded Argonne a Gold Level Green Buy Award in large part due to green cleaning. The GreenBuy Program shows that DOE sites can leverage Federal purchasing dollars to achieve mission goals while also reducing the environmental impact of their operations and improving the marketplace for greener products.

The Laboratory has experienced many benefits from switching to greener cleaning products. Custodians have less chemical exposure, in terms of both quantity and toxicity, during their routine cleaning activities. Custodial cleaning activities are performed during the day because the risk of exposure to general building occupants is so low.

Argonne ensures that the green products we use meet industry-established environmental attributes by leveraging third-party by Eco-Labels. Custodial Services uses green products that meet the following Eco-Labels:

- Green Seal Certified
 - Fragrance-free foam hand soap
 - Multi-surface disinfectant
 - Daily neutral cleaner/ auto scrubber
 - Glass and multipurpose cleaner
 - One shot auto soap
 - Neutral floor cleaner
 - Host waterless/dry carpet cleaner
 - Biodegradable industrial hand cleaner
- UL EcoLogo Certified: Degreaser
- Safer Choice: Soy-based stainless steel cleaner



SUCCESS STORY: ACQUISITION & PROCUREMENT

Because many products take advantage of technology and equipment that uses only water or very low hazard chemicals, Argonne has greatly reduced the quantity of hazardous chemicals purchased, as well as the costs associated with their purchase and proper handling. Argonne also uses centralized supply ordering to save money and further reduce quantities purchased.

Green cleaning practices also support recycling and waste reduction. Many products, such as microfiber cloths, are made from recycled content and are very durable. This allows Argonne to reuse products for longer periods of time before replacing them.

Green cleaning products and practices support operation of Argonne's 16 green buildings that require green cleaning.

Argonne's Custodial Manager and team identified several keys to their successful green products program. These include the following:

- Start with pilot projects—Custodial Services staff always start with a pilot project to try out a greener alternative product. The staff can test the product across the full spectrum of applications and building conditions before deciding whether to make the switch permanently. In some cases, a product did not meet the performance criteria and the team continued to look for green alternatives.
- Leverage partnerships—Argonne collaborated with existing vendors and asked that they proactively bring greener products to be tested. Vendors also helped identify

alternatives to existing products, including products that provided reduced hazardous chemical levels to achieve an incremental step to greener products.

- Conduct research to identify new products—The Custodial Manager and Coordinator review industry publications and annually attend a trade show to learn about new products or techniques that reduce environmental impact and deliver results for facility cleaning.
- Switch equipment at end of life—A cost-effective time to switch to green cleaning equipment is when existing equipment comes to the end of its useful life or when an equipment lease expires. Argonne has used the end-of-life strategy to replace all of its commercial floor cleaning machines and switch to a type that uses only ionized water to clean floors.
- Change the cleaning process or technique—Argonne's custodial staff use self-assessments to review how different cleaning approaches reduce the quantity or type of hazardous chemicals needed for a particular cleaning application. For example, Argonne has switched to a practice of stripping and polishing terrazzo floors instead of continuously applying chemical products keep them shiny.

Argonne's Custodial Services staff has developed extensive knowledge and best practices for green cleaning. Their long tenure with the Laboratory has allowed us to retain knowledge and build success over time.



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8. Measures, Funding, and Training

8.1 Performance Status

Argonne developed the Sustainability Program to help the Laboratory meet the goals set forth by the DOE, and is currently aligned to meet the requirements established in E.O. 13834. Argonne leverages a variety of strategies to implement its Sustainability Program, including financial resources, public-private partnerships, and capacity building for the sustainability team. The next section describes Argonne’s progress during FY 2019 to implement and fund efficiency and conservation measures (ECMs) and provide training to staff involved in ECMs.

8.1.1 Efficiency and Conservation Measures

For more than 11 years, Argonne has made significant investments to improve building and utility system efficiency with the In-House Energy and Water Management Reinvestment Program (Reinvestment Program). The Reinvestment Program serves as a critical funding source for ECMs by reinvesting annual savings from avoided water or energy use into the program over the payback period of the ECMs.

Since FY 2008, ECMs that produce energy or water savings have been identified and logged into a database. A separate document summarizes the business case for each ECM and links to the master database. Anyone at Argonne can identify ECMs for consideration under the Reinvestment Program. Most ECMs are identified by the Sustainability Program or submitted by building engineers, building managers, or facilities maintenance staff. The Sustainability Program Manager and Energy Analyst meet twice a month to review the status of ECMs that are in progress, and to evaluate identified ECMs for funding. The program’s goal is for each ECM to pay for itself in 10 years or less, or to fund them using other resources. All ECMs are tracked, even if they do not meet the program goals. Since FY 2008, Argonne has invest \$8.6M to implement ECMs as part of the Reinvestment Program. Figure 17 provides a summary of the annual energy savings of the ECMs that were completed each year since the program started. The average payback of these projects is 5.3 years.

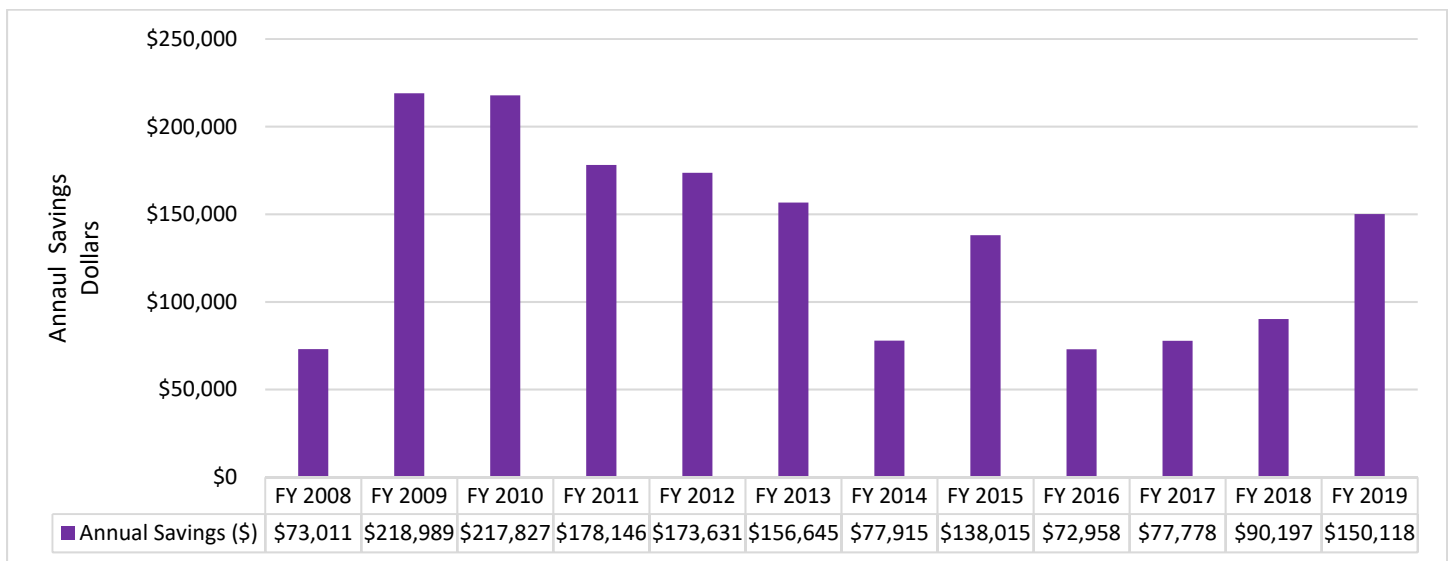


Figure 17: Annual Cost Savings from Completed ECMs in each Fiscal Year

ECM data entered submitted to DOE reflect the most up-to-date information from Argonne’s master Reinvestment Program database. In FY 2019, the Sustainability Program reviewed and approved 24 ECMs, which provided an annual savings of \$150,118. The simple payback for the portfolio of projects funded by the Reinvestment Program in FY 2019 was 5.3 years.

The Reinvestment Program continues to fund ECMs identified as part of the Smart Labs Program. The first four ECMs for Building 200 were successfully completed in FY 2019. In addition, the Smart Labs team completed a business case for ECMs identified for Building 201. Planning and design activities were completed for Building 201 measures and construction will be completed in FY 2020. The Smart Labs team also developed a business case for recommended ECMs in Building 221. Section 1 provides more information about the Smart Labs Program accomplishments in FY 2019.

Once each project is implemented under the Reinvestment Program, the project manager or coordinator provides documentation to verify that the proposed ECM was implemented as planned. Argonne’s Energy Analyst completes additional measurement and verification (M&V) activities, limited to review of building energy and water usage, to document general downward trends typical of a building where ECMs have been implemented. Because many measures are straightforward electric or water savings projects, like LED lighting upgrades or installation of low-flow water fixtures, rigorous M&V with post-installation measurement is not warranted.

Argonne executed a contract for an FDD software package in the fourth quarter of FY 2019 that will support the Laboratory’s continuous asset commissioning strategy. The FDD software will provide help to ensure that completed ECMs continue to perform as intended and provide an ongoing source of potential ECMs that Argonne can explore and implement. More information about the FDD software implementation appears in Section 1, Energy Management.

8.1.2 Energy Performance Contracts

Argonne performed numerous tasks in support of energy savings performance contracts (ESPCs). Table 8 lists the four ESPCs that were active in FY 2019 and produced verified energy savings. Each contract required a number of activities, as outlined below:

- Annual M&V final reports are reviewed and accepted, and raw data and savings are calculated, verified, and validated.
- Quarterly reports are reviewed and meetings conducted with Argonne, DOE, and ESCO representatives.
- M&V activities are completed including steam-pipe measurements, lighting walkthroughs, etc.
- Numerous site visits are completed for equipment condition and functionality checks (air handling units [AHUs], chillers, variable frequency drives [VFDs], insulation, etc.).
- Maintenance work orders are reviewed to ensure equipment is maintained according to or exceeding contract requirements.

Table 8: ESPC Energy Conservation Measures, Energy Savings, and Cost Savings

Energy Conservation Measure	Verified Energy Savings (MMBtu/year)	Cost Savings (\$/year)
ESPC 1: Upgrade controls, reduce unoccupied outside air, lighting upgrades, steam-pipe insulation, VFD installation	45,129	\$401,945
ESPC 2: Chiller replacement, Metasys upgrade, APS heat recovery, lighting improvements, window replacements, condensate return improvements, APS pumps/VFDs	45,115	\$724,243
ESPC 3: APS improvements—free cooling and Metasys upgrade, AHU modifications, AHU heat reclamation, lighting upgrades	35,149	\$596,635
ESPC 4: CHP plant (values represent year 3 verified savings)	216,956	\$2,612,467
Total ESPC annual savings	342,349	\$3,933,345

In the past, projects have been bundled under the ESPC umbrella (ESPCs 1, 2, and 3) in order to achieve cumulative payback of 14 years or less. Individual ECMs that were not funded have been added to the Reinvestment Program master ECM list and are implemented as funding is available. Argonne has largely implemented the ECMs that were previously identified and evaluated for inclusion in an ESPC.

Argonne closed out ESPCs 1 and 2, concluding the performance period and working with the Energy Services Performance Contractor, Johnson Controls, on the final paperwork. Both ESPCs exceeded guaranteed energy savings as outlined in the contract and provided important upgrades to Argonne’s buildings and utility systems. Additional details on EPSCs 1 and 2 are provided in the Measures and Funding Success Story.

Argonne awarded one ESPC in the last 5 years, for the construction and operation of the CHP (ESPC 4). In FY 2019, the CHP continued to experience an operational limitation. This resulted in the CHP operating for only 7 months, producing just 216,956 MMBtu of verified energy savings. Argonne’s Utilities Department is working with the ESCO Noresco to restore the CHP to expected operational levels. Argonne continues to explore upgrading facilities and infrastructure by leveraging technical and financial resources from the private sector through an ESPC or utility energy service contract (UESC). In FY 2019, Argonne continued to collect information on potential projects and engage stakeholders to make progress on the Acquisition Planning Phase. Argonne has engaged with DOE Argonne Site Office and continues to discuss acquisition planning tasks.

One challenge Argonne faced while implementing alternative financing was the lengthy and complex contract development process. Support from the Laboratory’s senior leadership was critical to secure the staff resources needed to complete the necessary workload. DOE-provided training has been valuable in building capacity at all stakeholder levels and is expected to continue. DOE’s Sustainability Performance Office and the Federal Energy Management Program has helped the Laboratory by providing resources to explore the UESC model for implementing infrastructure projects.

An additional challenge for implementing alternative financing projects is the M&V documentation needed to meet contract requirements. During the planning process and contract development, it is important to involve frontline staff who will be involved in regular M&V documentation.

8.1.3 Funding

Argonne completed the second year of the 3-year Sustainability Strategic Plan, which was created to provide an integrated approach to the sustainability goals set forth by the DOE and driven by E.O. 13834. This plan included a multiyear roadmap for proposed projects and funding levels; it recommends leveraging multiple funding sources, including ESPCs and UESCs. Table 8 summarizes Argonne’s sustainability project funding, with FY 2019 actual and FY 2020 planned investments based on the Strategic Plan.

At the planned funding levels shown in Table 9, Argonne will continue making annual progress in addressing sustainability goals across DOE’s focus areas. Reduction in Scope 1 and 2 GHG emissions and ILA water continues to be challenging due to the increase in energy and ILA water use associated with HEMSFs, and specifically ALCF, for HPC.

Table 9: Summary of Sustainability Project Funding (\$K)

Category	FY 2019 Actual	FY 2020 Planned	FY 2021 Projected
Sustainability Projects*	2,687	2,800	3,000
Sustainability Activities Other than Projects**	42	40	40
ESPC Contract Payments	4,335	3641	3,550
Renewable Energy Credit Purchase Costs	31	41	46
Total	7,096	6,522	6,636

* These projects are specifically funded to meet sustainability goals. Funding sources include the annual sustainability program, in-house energy/water savings program, and pollution-prevention/waste-minimization recycling program.

** These activities are indirectly related to sustainability goals, such as annual Site Sustainability Plan preparation, outreach, and education.

8.1.4 Training and Outreach

Argonne staff responsible for implementing the Site Sustainability Program, including Argonne’s facility energy manager, participate in ongoing training to ensure they have the competencies needed to complete their work. During August 2019, Argonne staff members attended the Energy Exchange Conference and participated in a number of webinars on energy management. Argonne’s Facilities division held quarterly cross-disciplinary education sessions that were open to all engineering and project management teams.

As part of the Smart Labs Accelerator, a core team of staff from the Sustainability Program and the Worker Safety & Health department participated in monthly webinars to explore best practices for implementing a Smart Labs Program at the Laboratory. Argonne also hosted a day-long workshop on Smart Lab Best Practices as part of the Building 401 Smart Labs investigation phase. The workshop included a wide diversity of operations staff across the Infrastructure Services and Environment, Health, Safety and Quality directorates to increase knowledge and capacity for Argonne to implement the Smart Labs Program. The workshop material was further reinforced through Laboratory assessments completed in Building 401 during the functional and challenge testing of HV/AC and laboratory equipment (Figure 18).



Figure 18: Staff Learn about Smart Labs Best Practices through On-site Ventilation Assessment in Building 401

In addition to internal training opportunities, Argonne's Sustainability Program also supports external training and outreach to community groups, regional partners, and the public. Argonne produced a variety of publications and participated in a number of outreach activities in FY 2019. These included the following:

- The Argonne Earth Day Celebration connected site occupants and regional partners to share information about environmental stewardship and highlight research activities at the Lab.
- Presentations and site tours for students from surrounding communities, led by Argonne sustainability program staff, introduced students to sustainability ideas and science and highlighted Argonne's Sustainability Program progress.
- Argonne sustainability program staff, working with college interns, gave the next generation of scientists and engineers practical experience with sustainability principles and projects.
- Subject matter experts from the Sustainability Program gave sustainability tours and presentations to community groups, students, teachers, municipalities, government agencies, and educational organizations.
- Argonne sustainability staff members gave presentations to professional organizations.

Argonne's Sustainability Program maintains a comprehensive and forward-looking website presence for the Laboratory's sustainability efforts. Information across the key areas of the Sustainability Program is available online at <https://www.anl.gov/sustainability>, along with success stories written for the public. The website details programs that are important to new employees and visitors, such as Argonne's Bike Share and Employee Electric Vehicle Charging Program. Several new maps were created to highlight green buildings, renewable energy assets, and mobility solutions.

8.2 Plans and Projected Performance

Argonne will enhance its use of existing tools and leverage new ones to fund and implement the Laboratory's Sustainability Program. The sections below provide summaries of activities planned for FY 2020.

8.2.1 Efficiency and Conservation Measures

The Reinvestment Program will continue to support implementation of ECMs identified in the Smart Labs Program and individual projects identified by individuals and teams across the Laboratory. The Smart Labs team will develop an implementation plan for ECMs identified during the study phase at Buildings 362 and 401 in FY 2019. Argonne will also look for opportunities to bundle less-favorable ECMs, such as building envelope improvements and other capital projects, which would otherwise not be attractive based solely on business cases for energy or water savings. Argonne will complete the lighting retrofit in the APS Experiment Hall, which is expected to save approximately \$50,000 per year in energy costs.

Additional energy and water conservation measures will be identified through the FDD software. In FY 2020, Argonne will implement the FDD software for two buildings. The software will integrate existing BAS information and provide ongoing M&V for equipment operability and overall system control stabilization while ensuring energy savings. In the first phase, FDD will be implemented on two buildings that are part of Argonne's Smart Labs Program, Building 200 and Building 401. Argonne will use the FDD software at Building 200 to monitor recently completed ECMs implemented as part of the Smart Labs program, and to identify future efficiency opportunities. At Building 401, Argonne will implement the FDD software before the ECMs are implemented and leverage the software to help prioritize and track energy savings from efficiency measures as they are made over the next 12 months.

The Sustainability Program is also evaluating the costs and benefits of completing additional M&V to track the performance of ECMs beyond straightforward lighting upgrades. In the future, the software can also be used to support M&V of more complex ECMs, such as those identified through the Smart Labs Program. It can track ECMs that take advantage of equipment scheduling, using economizer mode for AHUs and airflow balancing, on an ongoing basis.

8.2.2 Funding

Argonne's goal is to continue leveraging diverse funding sources, including appropriated funds and third-party financing, to implement the annual Site Sustainability Plan and the longer-term Sustainability Strategic Plan. In FY 2020, Argonne will continue to align the Reinvestment Fund to accomplish Smart Labs Program goals, and will use annual local general benefit funds to support efforts that do not have quantifiable energy or water savings. Argonne will also continue to integrate the Sustainability Strategic plan into the Facility and Infrastructure Strategic Investment Plan to better leverage funding and further bundle energy and water ECMs that can help fund deferred maintenance.

8.2.3 Energy Performance Contracts

Argonne will continue acquisition planning to help advance the use of a UESC to support facility modernization and energy efficiency improvements. The goal is to create an integrated project to address deferred maintenance by bundling facility and infrastructure projects with energy- and water-savings ECMs. A key opportunity to leverage a UESC exists in the older buildings in the 200 Area, which have the potential to save energy but require more funding to realize those savings. Smart Labs will help identify and quantify those opportunities and will be valuable in putting together a future UESC project.

8.2.4 Training and Outreach

A key strategy to achieve annual savings through Argonne's implemented ECMs will be to provide training and outreach to building operations personnel and other facility users and occupants. Argonne will continue to involve maintenance personnel throughout Smart Labs projects and during implementation and M&V of ECMs. The Sustainability Program will provide training to maintenance and facilities management personnel as part of the FDD program implementation. This training will include material to explain how ECMs identified by the FDD program will benefit energy savings, facility operations, and safety. In addition, the FDD software vendor will provide detailed training on how to use the web-based tool to track system performance and interpret the software results.

Argonne also plans to complete additional training to support ECM identification and implementation through the GAT program. The Building 362 GAT plans to develop a lighting retrofit project for FY 2020, and the Sustainability Program will support the process. Once specific ECMs are implemented, occupants also will be trained on how to use the implemented ECMs in their work areas and will be engaged on the project through informational e-mails, a presentation, modification to annual building orientation training, and follow-up surveys.

To help build the internal team's capacity, Argonne will also increase training opportunities for staff who lead sustainability efforts. This includes helping additional staff participate training events such as the Energy Exchange Conference, International Society of Sustainable Laboratories local events and conference, and Building Commissioning Association webinars and events.

Argonne plans to host a 2-day Smart Labs Workshop for National Laboratories in November 2020 to further facilitate collaboration across DOE national laboratories. The Sustainability Program and Argonne's Smart Labs team are developing a workshop agenda to focus on accelerating peer learning and sharing best practices across the DOE complex. All DOE national laboratories will be invited to attend, along with an extended list of Argonne stakeholders involved in the Smart Labs Program. Over the two days, participants will share their experience and learn about strategies to optimize laboratory facilities to provide safe ventilation levels, enhance operations, and improve energy efficiency.



LABORATORY COMPLETES TWO ENERGY SAVINGS PERFORMANCE CONTRACTS THAT DELIVER **ENERGY SAVINGS AND EFFICIENCY TO KEY INFRASTRUCTURE**

Argonne successfully completed two Energy Savings Performance Contracts (ESPCs) in 2019 that improved facilities and utility systems to ensure reliable and efficient operations at the Laboratory.

Under the ESPCs, Argonne partnered with an energy services company (ESCO) that pays for the initial cost of identifying, designing, and constructing facility improvement projects that save energy. Argonne paid the ESCO back over time using the annual energy and operations savings generated from the completed projects. The ESPCs enabled Argonne to use third-party funding for projects that have energy savings and reserve funding provided by DOE to address critical infrastructure projects that otherwise could not be justified through energy or water cost savings.

In FY 2019, Argonne closed out its first two ESPCs, which enabled the Laboratory to make critical facility and utility investments at no upfront cost to Argonne. ESPC 1 was awarded on September 30, 2003, and ESPC 2 was awarded on September 29, 2006. Johnson Controls was the ESCO in both ESPC 1 and ESPC 2. The 14-year performance period for ESPC 1 concluded in January 2019, and the 11-year performance period for ESPC 2 concluded in February 2019.

KEY COMPONENTS OF ESPC 1

- ❑ Upgrading Building Controls – Building 201
- ❑ Modify Air Handlers to Reduce Outdoor Air – Building 350
- ❑ Lighting System Upgrade – Buildings 314, 315, 316, and 350
- ❑ Steam Pipe Insulation Upgrade – Site wide

KEY COMPONENTS OF ESPC 2

- ❑ Chiller Replacement – Building 364 Chiller Plant
- ❑ Extended Architecture Upgrade – Site-Wide Building Automation System Network
- ❑ Modify Air Handlers to Reduce Outdoor Air – APS Storage Ring
- ❑ Lighting Improvements – 200 Area Buildings, 300 Area Buildings
- ❑ Window Replacement – Building 200 K-Wing
- ❑ Condensate Return Improvements – Site-wide Steam System
- ❑ Variable Speed Drives – APS Storage Ring





The total verified energy and cost savings results exceeded expectations for ESPC 1 and ESPC 2, as compared with the original guaranteed savings outlined in the contract documents. Total energy savings for ESPC 1 were 635,913 MMBtu and total energy savings for ESPC 2 were 716,629 MMBtu. Total verified cost savings for ESPC 1 were \$5,277,665, which was \$633,962 greater than guaranteed. For ESPC 2, total verified cost savings were \$15,343,025, which was \$1,418,984 greater than guaranteed.

In each contract, a number of individual energy conservation measures (ECMs) were implemented and the total annual cost savings determined the payback period for the full project.

Several key factors contributed to the success of ESPC 1 and EPSC 2. Throughout the performance period of each ESPC, Argonne worked closely with Johnson Controls to implement measurement and verification (M&V) activities that were approved in the contract documents. M&V activities were specific to each ECM within the overall project bundle, and Argonne assigned a Facilities Engineer to oversee the annual process. The M&V plan was successfully carried out, and any necessary adjustments were made during the life of each contract.

Each year of the contracts, the total verified energy and cost savings for ESPC 1 and ESPC 2 were equal to or exceeded the guaranteed savings.

Another key success factor was adjusting the contracts as needed to provide the best value to Argonne. For example, Argonne modified the ESPC 1 contract in FY 2010 to decrease the performance period from 17 to 14 years. This modification allowed the Laboratory to complete its payment commitment sooner, thereby reducing the costs associated with interest. Such changes were made possible by holding regular quarterly Integrated Project Team meetings that included the technical project team that was completing the M&V activities, the Argonne Site Office Contracting Office, and the Federal Project Director.

Argonne's success in implementing ESPC 1 and EPSC 2 marks an important milestone at the Laboratory. This was the first time Argonne successfully leveraged third-party contracts to improve facility and utility systems to increase reliability, eliminate energy waste, optimize performance, and improve the working environment and safety for facility occupants.

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9. Travel and Commute

9.1 Performance Status

Argonne continues to implement a dynamic program aimed at achieving sustainability goals around travel and commuting. Table 10 summarizes key metrics associated with travel and commuting. The downward trend in commuting miles traveled indicates that Argonne's efforts are contributing positively to reducing the impact of the Laboratory's commuting. Argonne updated the calculation methodology for determining the number of commuting miles traveled in FY 2017, which made this values more accurate.

Table 10: Travel- and Commute-Related GHG Emissions (Metric Tons CO_{2e}) and Miles Traveled

Categories	FY 2008 Baseline		FY 2019	
	Miles	GHG	Miles	GHG
Air Travel	23,863,497	6,535	28,886,728	5,472
Ground Travel	N/A	512	1,911,873	688
Commute	31,228,000	11,717	27,676,368	11,901
Total	55,091,497	18,764	58,474,987	18,061

In FY 2019, the Sustainability Program initiated a year-long project with the goal of creating a Mobility Plan to support future investments that encourage green travel and commuting. In the spring of FY 2019, the Sustainability Program created a core project team and Mobility Advisory Group (MAG) to help create and promote an outreach program and develop the Mobility Plan. The core project team includes operations staff who have day-to-day responsibility for the various programs and policies that support green travel and commuting at Argonne. The MAG is made up of representatives from Argonne's research community, including the user facilities, and associate or deputy lab directors and chief operations officers of Argonne's research directorates. MAG members provide feedback and make informed recommendations based on input from their respective stakeholders.

The Sustainability Project Manager leads the core team and the MAG, and held several meetings in FY 2019 to develop the Green Ride Outreach program to help inform the Mobility Plan. The outreach program included several feedback mechanisms, including surveys, an open house, and focus groups designed to collect feedback on the Employee Electric Vehicle Charging Program, Bike Share Program, and Carpool Connect website. The survey and open houses were completed in FY 2019 and the results are highlighted in the Travel and Commute Success Story. Descriptions of the specific outreach activities and progress during FY 2019 are summarized below.

9.1.1 Business Travel

Argonne continues to offer robust videoconferencing services through Blue Jeans as an alternative to business travel. Blue Jeans is a cloud-based video, web, and audio collaboration solution available to all Argonne employees. Argonne actively promotes Blue Jeans through its internal website, Inside Argonne, and through in-person events such as the annual Earth Day Celebration. In FY 2019, Blue Jeans representatives hosted an information station during the Earth Day Celebration and answered questions from employees who wanted to know more about videoconferencing.

In FY 2019, BIS rolled out a new tool for business collaboration with Microsoft Teams. Teams is a collaboration and chat platform for Microsoft Office 365 customers designed to simplify group work. It is integrated with other Microsoft services and allows users access to shared files and calendars, collaborative editing, and easy switching between voice, video, and text chat. Teams is open to all Argonne employees and those with anl.gov domain access. Teams will further support teleworking at Argonne by making it easier to collaborate on projects with people working in different locations.

9.1.2 Commuting

A large portion of the Green Ride Outreach program focused on collecting information related to understanding barriers and solutions to support green commuting at Argonne. The Sustainability Program administered an online survey from July 8 through 26, 2019, using Survey Monkey. This was the first employee commuting survey completed in more than 4 years and more than 826 responses were collected. Although a personal vehicle was the most common method of commuting to the Laboratory, 13 percent of respondents indicated that they utilize an alternative form of transportation including carpooling, bicycle, bus, vanpool, or train. The Sustainability Program conducted open house-style outreach

sessions throughout the survey period to facilitate individual conversations with the Laboratory community on the key themes of commuting, bike share, and EV charging (Figure 19). A key theme from the open house sessions was to increase education and awareness of the programs, as well as the need for additional options for city commuters.



Figure 19: GreenRide Program Open House

Results from the Green Ride Outreach program suggest Argonne will see a significant increase in participation in the Employee EV Charging Program in the next 1–3 years. To help meet this anticipated demand, Argonne installed two new EV charging stations in FY 2019 as part of the new parking lot for the MDL building. The two new EV charging stations are dual-port, level 2, 240-volt stations that will be open to participants in the Employee EV Charging Program in FY 2020 when the MDL construction is completed. Infrastructure was also added during the MDL parking lot construction to allow two additional dual-port EV charging stations to be added in the future. Since the program was developed in FY 2015, Argonne has increased the total onsite capacity for simultaneous EV charging to 37 vehicles. More than 80 Argonne and DOE employees participate in the Employee EV Charging Program.

Argonne actively promotes telecommuting and alternative work schedules through Inside Argonne and update reminders through the Lab's daily e-mail, Argonne Today. Each year, Argonne also uses a seasonal communications campaign to encourage employees to explore telecommuting as a strategy to maintain work activities during weather events, which keeps people safe at home while still allowing them to work.

In FY 2019, Argonne saw an increase in employee telecommuting days and alternative work schedules for the third consecutive year, based on information collected in weekly timesheets. In FY 2019, 1,963 Argonne employees reported a total of 140,343 telecommuting hours. These values represent an increase of 169 percent for the number of employees who telecommute and 211 percent in the number of hours reported, compared to FY 2017 values. This trend reflects the quality of Argonne's telecommuting program and resources provided to support employees who work remotely.

Argonne continues to maintain a web-based carpool and rideshare tool for Argonne, DOE, Fermilab, and University of Chicago employees. In FY 2019, Argonne worked with the Laboratory's existing web-tool provider, TripSpark, to migrate the existing tool to a new and more mobile-friendly interface. The Sustainability Program worked with TripSpark throughout the summer of FY 2019 to migrate registered users to the new tool and populate the new tool with the latest travel and commute information.

9.1.3 Onsite Transportation

In FY 2019, Argonne kicked off the Bike Share program's 11th season. The Bike Share fleet consists of 120 bicycles placed in populated areas around campus. This program provides site users an alternate method of onsite transportation. It serves as the last-mile connection for employees who live within the region and international researchers who come from around the globe to do research at Argonne.

In FY 2019, Argonne overhauled the Bike Share Safety Training (ESH 561, Bicycle Safety), an online video-based training that all Bike Share program users must complete. Over the past few years, the Sustainability Program received numerous comments that the training should be updated to focus on relevant safety information, provide more video footage of safe bicycle riding, and update content to reflect current program details. The Sustainability Program executed a contract with an outside film production company, Lava Inc., and worked over the summer to develop the custom safety training video (Figure 20). The new Bike Share Safety Training video was completed at the end of FY 2019 and consists of a refreshed, 12-minute video filmed at Argonne with current Bike Share program participants.



Figure 20: Employee Participating in Filming for Bike Share Safety Training Video

Argonne is continuing a pilot program to test GEM vehicles as potential replacements for the Kubota RTV utility vehicle fleet. The Kubotas are currently used by Facilities, Project Management, and ESHQ staff as an onsite model of travel between buildings and to construction sites. In FY 2019, Argonne added one all-electric utility vehicle, Polaris GEM, to the intra-Lab fleet. This new GEM joins the two GEMs that were purchased in FY 2018. Additional details about the pilot project appears in Section 4, Fleet Management.

9.2 Plans and Projected Performance

In FY 2020, Argonne will complete the Green Ride Outreach program and develop the Mobility Plan to outline near-term investments for supporting travel to and within the Laboratory. The Mobility Plan will provide specific recommendations for improvements to Argonne's Bike Share, Employee Electric Vehicle Charging, and Carpool programs. Argonne also plans to develop a phase 2 for the Green Ride Outreach program to further explore barriers and solutions to addressing first and last-mile connections for commuters. Current funding levels and plans will allow Argonne to continue offering programs and services that promote greener travel. Telecommuting, alternate work schedules, and virtual meeting tools continue to be the most cost-effective strategies for reducing travel and commuting miles.

9.2.1 Commuting

In FY 2020, Argonne will use results from the Green Ride Outreach program to develop a detailed plan for addressing improvements to the Employee EV Charging Program. Preliminary results from the survey and open house sessions note that program participants would like to see Argonne improve the program's convenience and flexibility. The Sustainability Program plans to continue collaborating with the ES Divisions' Center for Transportation Research to leverage the Employee EV Charging Program to support research priorities. Argonne will also explore expanding the Employee EV Charging Program to additional site occupants who are currently ineligible for the program.

The Sustainability Program will finalize the new, upgraded carpooling tool and relaunch the program in the first quarter of FY 2020. This relaunch will help increase awareness of the web tool and the benefits it provides to the Argonne community. Increasing awareness was a key improvement opportunity identified in the Green Ride survey; 45 percent of survey responses selected lack of familiarity with Argonne's carpooling resources as a barrier to participating in carpooling. The web tool is being rebranded "Carpool Connect" to make it clearer to stakeholders the intention of the program. "Green Ride" is being used as the umbrella communications brand that all mobility programs will fall under.

Argonne plans to continue promoting Blue Jeans and Microsoft Teams as collaboration solutions that can reduce business travel, support employees with telecommuting, and increase the efficiency of virtual team collaboration. In FY 2020, Argonne will continue supporting telecommuting, and alternate work schedules, which helps reduce commuting miles and provides employees with options that support work-life balance. Argonne's annual Earth Day Celebration and the GATs are two venues where the Sustainability Program plans to promote these programs.


Based on feedback from the Green Ride Outreach program, the Sustainability Program will take steps to promote last-mile transportation options for Argonne. This will include working with Pace, the suburban public transit agency, to expand local and regional vanpooling and carpooling options for employees. In FY 2020, Argonne plans to complete a pilot project to expand the current University of Chicago shuttle and allow employees to purchase tickets to ride at their own expense. This would allow employees who live in Chicago near the university to ride the current shuttle for commuting in addition to business purposes. Argonne also plans to upgrade the Laboratory's rideshare tool to better meet employee needs.

9.2.2 Onsite Transportation

Argonne plans launch the new Bike Share Safety Training in the spring of FY 2020 as the program enters its 12th season. All site occupants who wish to use the Bike Share program in FY 2020 will be required to take the training, and new helmets will be provided to anyone who last took the training more than 5 years ago. Argonne will also develop short video clips from the larger training to promote best practices, such as a pre-ride safety checklist, and how to put on a helmet. These video clips will be shared on Inside Argonne.

In FY 2020, the Sustainability Program will develop the Mobility Plan, which will have specific recommendations for the next investments needed for the Bike Share program. A majority of the bicycles in the program are in need of repair. It has been challenging for Argonne to make repairs, because spare parts have not been available since the company that manufactured the bicycles went out of business.

Argonne will continue to look for all-electric vehicles that can be used onsite to offset both personal and government trips. The Sustainability Program plans to continue monitoring the performance of the Polaris GEMs and explore other all-electric utility vehicles to replace Kubota RTVs as they come to the end of their service life.



GREEN RIDE SURVEY IDENTIFIES VALUE AND INVESTMENTS FOR BIKE SHARE, CARPOOLING, AND ELECTRIC VEHICLE CHARGING PROGRAMS

Argonne's Green Ride Program is a dynamic suite of solutions that enable employees, site users, and visitors to travel to and within the Laboratory campus. Key program components include a bike share program, carpooling, and electric vehicle charging, all of which are managed by Argonne's Sustainability Program.

In FY 2019, the Sustainability Program conducted a Laboratory-wide survey to gather input to improve the quality and value of the Green Ride Program. The results will be used to inform future Green Ride Program investments based on which services are most valuable to the Laboratory.

Survey responses were collected using the online tool Survey Monkey from July 8 – 26, 2019. In total, 826 responses were collected from the Laboratory community, which includes Argonne employees, students, DOE employees, facility users, contractors, and other site occupants.

Survey results indicate that 30% of respondents use Argonne's bike share program, which celebrated its 11th season in FY 2019. The program provides 120 bicycles that are available across the Laboratory, and is open to site occupants at no cost after they complete safety training. Upgrading the program's bicycles is a top priority for survey respondents. Recommendations include providing bicycles that are lighter and easier to ride, providing a greater variety of bicycle sizes, and redistributing bicycles on a regular basis to ensure they are more available to users.



Sustainability Program staff collect survey responses from employees outside of the Building 401 Grill during lunchtime.



To help employees travel to and from the Laboratory, Argonne offers the Carpool Connect website to facilitate carpooling. Argonne, Fermilab, DOE, and UChicago employees can use the website at no cost to search for potential carpool partners in their neighborhood or along their commute route. Although 13% of survey respondents said that they were registered users, half of those registered said they had not yet used the tool. This indicates that Argonne can increase participation in and the effectiveness of the carpooling program by providing more functionality with the Green Ride Connect website, or developing an incentive program that provides added benefits for participating. Both strategies will be considered in the future, along with other survey recommendations.

Argonne's employee electric vehicle charging program provides 40 charging stations across the Laboratory campus, and participation has doubled in the last two years. Participating employees contribute a monthly fee of \$7.75 to cover the cost of electricity and maintenance. Survey results indicate that program growth will continue, as 33% of survey respondents plan to purchase an electric vehicle in the near future. Investment in several key areas would address the expected

program growth and feedback from current participants. Investments could include a more user-friendly reservation tool, an increase in availability and location of charging stations, and an additional process that would allow non-employees to participate in the charging program.

Several common themes emerged from the Green Ride Survey. All the program components would benefit from an increase in communication and awareness. For example, 45% of survey responses selected lack of familiarity with Argonne's carpooling resources as a barrier to participating in carpooling. The programs themselves also complement one another and improvements to one would benefit the others. For example, improvements to onsite travel would help increase from 13% the number of respondents that utilize an alternative form of transportation such as carpooling, bicycle, bus, train, and vanpooling.

The Sustainability Program is committed to providing mobility solutions that are efficient, environmentally friendly, and cost effective to program users. Green Ride survey results will be combined with additional outreach planned for FY 2020 to help improve and shape our future planning and investment in these programs.

**FOR MORE INFORMATION
PLEASE EMAIL**

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10. Fugitives and Refrigerants

10.1 Performance Status

Scope 1 fugitive emissions in FY 2019 decreased by 88 percent from the FY 2008 baseline. The largest contribution to fugitive gas is sulfur hexafluoride (SF₆), which is used in a variety of scientific electrical equipment including accelerators and electron microscopes. SF₆ emissions have decreased by 70 percent since FY 2008, primarily due to the complete shutdown of ATLAS, decreased emissions from other accelerators, and recovery using portable equipment.

In FY 2019, Argonne continued to support fugitive emissions capture and equipment repair projects. For several years, the Sustainability Program has partnered with the High Energy Physics division (HEP) to reduce the loss of SF₆ used at the Wakefield Accelerator Facility. Wakefield Accelerator remains the largest user of SF₆ at Argonne, and the ongoing partnership ensures that proactive measures are taken to reduce SF₆ emission without any negative impact on the research activities (Figure 21). In FY 2019, the Sustainability Program provided funding to replace the compressor in the onsite SF₆ recovery unit. Continued maintenance of the recovery unit is critical in capturing and reducing SF₆.

The Sustainability Program also responded to several inquiries in FY 2019 from ES&H Coordinators who are working with researchers on the purchase of new microscopes. Information on the mobile SF₆ recovery unit in the 200 Area was provided to those who inquired. In each case, the 200 Area portable recovery equipment is a viable option that can be used once the microscopes are installed.

Historical and projected emissions of SF₆ from FY 2010 to FY 2020 are provided in Attachment F.

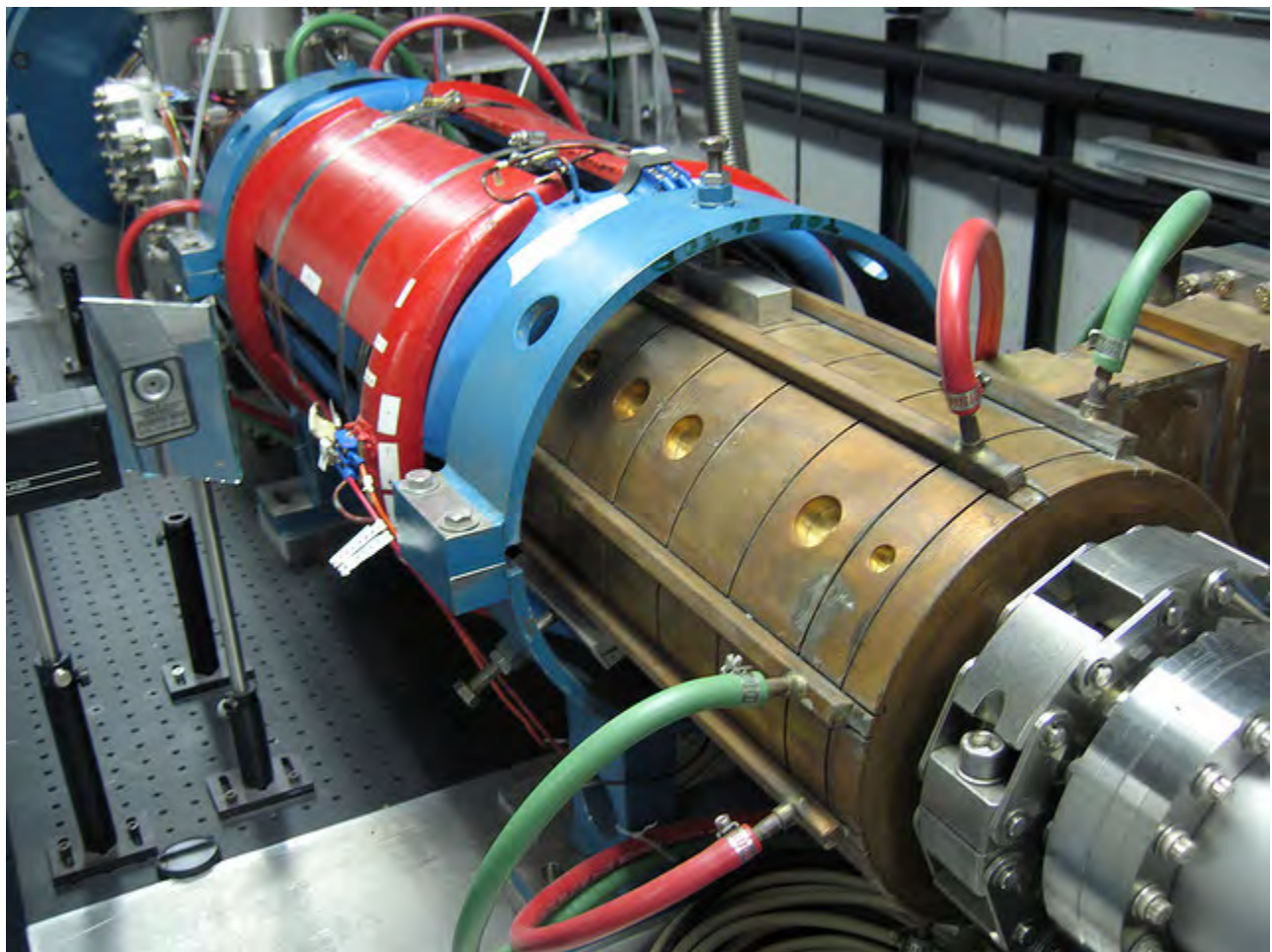


Figure 21: Wakefield Accelerator is Largest Source of SF₆ use at Argonne

10.2 Plans and Projected Performance

In FY 2020, Argonne's Sustainability Program will continue to work with SF₆ users on the Laboratory's emission capture program. Current funding levels and plans are sufficient to continue achieving the Laboratory's goals related to fugitives and refrigerants.

HEP has identified an ultra-sensitive device that can detect SF₆ at small quantities and identify leaking components. The Sustainability Program will work with HEP to explore the purchase of the equipment so a new leak detection program can be implemented at the Wakefield Accelerator. Argonne is also implementing several recommendations from the Utility Master Plan that will help to reduce fugitive emissions.

Argonne will also formalize a refrigerant management plan to guide campus staff in data gathering for reporting, management of refrigerants, and leakage target rates. Any chlorofluorocarbons and hydrochlorofluorocarbons must have a leakage rate of less than 5 percent annually, or less than 30 percent over a 5-year period. In addition to tracking refrigerant use and leakage rates, a conversation or replacement study is planned within the next 5 years.

11. Electronic Stewardship

11.1 Performance Status

As a scientific research laboratory, Argonne continues to have high demand for new electronic equipment while also maintaining a backlog of obsolete or legacy material. Argonne is working to improve lifecycle management of electronics used at the Laboratory and to make investments in the areas of acquisition, operations, and disposal.

11.1.1 Acquisition

Argonne seeks to address sustainability goals for electronics by purchasing products that are EPEAT registered, Energy STAR qualified, or FEMP designated, as appropriate. Argonne's Prime Contract for site operations contains clauses that require purchases to meet these standards, per federal acquisition regulations. Argonne annually works with the vendors that provide the majority of the Laboratory's electronic products to report annually on EPEAT and Energy STAR status.

In FY 2019, Argonne increased the percentage of purchased electronic products that are EPEAT registered, Energy STAR qualified, or FEMP designated, by adding requirements for EPEAT electronics into the planning, design, and construction of infrastructure projects. Language was added to the Project Implementation Plan, which is used by all project managers to plan their work, and the Facilities Design Guide, which consultants and engineering staff use to design projects. Electronics requirements were also added to the Division 1 Construction Specifications.

11.1.2 Operations

Electronic products are centrally managed by BIS for all operational divisions and a limited number of scientific divisions. The majority of the Laboratory's research directorates locally administer electronic products to address their unique scientific needs. Centrally managed computers use advanced power management software to reduce energy consumption and operating costs on 100 percent of nonexempt computers. Duplexing is also enabled on 100 percent of eligible centrally managed computers and imaging equipment, and this setting cannot be changed except on a per-print-job basis. Because many of Argonne's research groups use decentralized computer resource management, the overall number of Argonne computers with active power management enabled is an estimate.

In FY 2019, Argonne replaced one-third of all the printers at the Laboratory. The new equipment has additional features that encourage less printing, makes duplex printing the default setting, and track usage to individual divisions. Argonne also has implemented improved hardware tracking. This allows Argonne to continue consolidating individual printers to more-efficient, multifunction printer/copiers and supports better annual reporting.

11.1.3 End of Life

The Property Management Group continues to manage 100 percent of Argonne's electronic waste, or e-waste. Working electronics that cannot be reused at Argonne are entered into the Energy Asset Disposal System and made available to other federal agencies. End-of-life and obsolete electronics are collected from across the Laboratory and processed at a centralized location. Hard drives are sanitized onsite to ensure that confidential information is secure and appropriately managed. Processed e-waste is sent to Fermi National Accelerator Laboratory, which consolidates e-waste from both Argonne and Fermilab and ships it to an R2-certified recycler. For the last 15 years, Argonne and Fermilab have partnered to responsibly manage e-waste.

In FY 2019, Argonne completed the collection, inventory, and recycling of electronics that were identified as part of the 2018 Disposal Days Program (Figure 22). The second 50 percent of electronics that were identified during Disposal Days were collected during the first 9 months of 2019. This resulted in the Laboratory recycling a significant amount of e-waste for a second consecutive year. Free pickup of the waste materials and the support provided across multiple divisions to help identify, package, and oversee the collection process were two key aspects that resulted in the success of Disposal Days. A summary of the Disposal Days program results are presented in Figure 22.



Figure 22: Inventory and Preparation of Electronics for Recycling

11.1.4 Data Centers

Argonne continues to leverage the Enterprise Data Center (EDC) to meet the goals of the Data Center Optimization Initiative (DCOI), which calls for the consolidation and optimization of Federal data centers. The EDC was completed in FY 2017 and supports consolidation of existing enterprise equipment in the new facility, which will operate with higher energy efficiency and provide enhanced cybersecurity.

In FY 2019, Argonne focused on closing and consolidating existing data center spaces. The Laboratory officially closed the Building 201 DOE data center, Building 362 Energy and Global Security division (EGS) data center, and Building 208 Nuclear Energy/EGS data center. The equipment in these spaces was shut down where possible, and the remainder were moved to the EDC. In each of these buildings, existing equipment was legacy infrastructure and no infrastructure system monitoring was in place. Argonne also identified spaces that will need to remain "Tiered" spaces and those that can move to "Key Mission Facilities" (dedicated to science) per the DCOI. "Tiered" data centers as defined by the DCOI include those that utilize the following: 1) a separate space for IT infrastructure; 2) an uninterruptible power supply; 3) a dedicated cooling system or zone; and 4) a backup power generator for prolonged power outages.

In order to ensure that the EDC can operate without interruption, Argonne completed design for the Building 386 Chilled-Water Plant Project in FY 2019. This project will provide independent and redundant cooling capability for the EDC by adding a dedicated chilled-water plant. Providing this capability will satisfy an important functional requirement for the EDC as a Tier II data center. Reliability at the EDC is a key factor in centralizing data center infrastructure across the laboratory.

11.2 Plans and Projected Performance

Argonne's existing suite of programs enables the Laboratory to meet goals that address the full lifecycle management of electronics used at the Laboratory. Argonne expects to continue meeting goals for electronic stewardship by maintaining existing programs and through the support of robust funding. Planned activities for FY 2020 are described below. Details of expected performance across the various goals associated with electronic stewardship are summarized in Table ES-1 in the Executive Summary.

11.2.1 Acquisition

Argonne plans to continue working with vendors who provide electronics through AMOS to ensure they can meet the Laboratory's electronic product requirements. In addition, FMPS will review all AMOS contracts to ensure that the proper sustainable acquisition clauses are included. Argonne also plans to update various training programs to include information about sustainable acquisition requirements, including electronics. Section 7 provides additional description of Argonne's plans to improve sustainable acquisition.

11.2.2 Operations

BIS and the Sustainability Program will collaborate to increase the percentage of computers, monitors, and printers that BIS manages centrally. A communications campaign is planned to articulate the benefits of central management. Research divisions will be encouraged to add their existing and planned equipment to the centrally managed framework.

Argonne already implemented several strategies that are consistent with the DOE Sustainable Print Management Guide. In FY 2020, Argonne plans to revisit the guide and identify additional strategies that could be implemented.

11.2.3 End of Life

Argonne's e-waste recycling program will continue to support the responsible disposal of electronics at the Laboratory. Argonne will evaluate additional strategies to incentivize identification of e-waste to be recycled through the Laboratory's existing program, including working with the Building 362 GAT to support a focused recycling effort for electronics in their building. Although a large volume of electronics was recycled in the last two fiscal years, Argonne still has significant quantities of obsolete and unused electronics that can be recycled. The Sustainability Program will collaborate with Nuclear and Waste Management and the Property Management Group to promote future electronics recycling.

11.2.4 Data Centers

Argonne will continue data center consolidation efforts made possible by completion and occupancy of the EDC. Argonne will continue to pursue consolidation of several more small spaces on campus. Because significant progress was made in preceding years, those that remain are the most difficult to close, but at least one data center is expected to be closed. Argonne's Tiered data centers will be brought into the Laboratory's data center infrastructure management software. This will provide more automated monitoring and visibility into those spaces, and help identify opportunities for improvement. The Sustainability Program will also leverage the ongoing metering program to assist the existing data centers that remain in their current locations to measure their power usage for future reporting.

Argonne will complete the construction of the Building 386 Chilled-Water Plant Project in FY 2020. When the project is complete, the EDC will no longer depend on the Laboratory's chilled-water utility, but will be able to utilize it as a secondary source for cooling.

12. Organizational Resilience

Argonne is committed to helping maintain the security and welfare of the Laboratory, especially in view of the different threats our country faces. Argonne works closely with Office of Science to ensure continued improvements to both the physical and cyber security infrastructures to ensure we are appropriately positioned to protect from, mitigate, respond to, and recover from a wide spectrum of national and global security threats and challenges.

Any number of events could occur that could disrupt activities at Argonne. A Continuity of Operations Plan (COOP) is in place to ensure that mission-essential functions and Argonne-essential supporting activities can be performed during certain emergency events that are particularly disruptive to normal activities. In the case of an event that meets the criteria for COOP events (e.g., cyber, pandemic, weather events, economic), the plan provides specific steps on how direction and control should be performed.

Argonne's utility infrastructure and emergency response program are at the core of Argonne's scientific strategy. The Laboratory continues to evaluate strengths and weaknesses in these areas and is making proactive investments to improve the site's resilience.

12.1 Infrastructure

Argonne recently completed several independent condition assessments and planning studies using external consultants to inform the prioritization of infrastructure repairs and upgrades, including a site-wide utilities master plan, an APS infrastructure master plan, and a chilled-water and electrical assessment for the ALCF exascale computing investments. Through the Argonne Utilities Upgrade (AU2) Project, wherein the DOE-Science Laboratories Infrastructure (SLI) program granted CD-0, Approval of Mission Need, in May 2019, the Laboratory will repair and or replace several major utility systems to support mission-critical facilities and operations over the next 5 years.

The Argonne water supply system serves all user facilities and other mission-critical and mission-support facilities to provide potable water, laboratory water, and fire protection water across the whole site. Overall, the site water system relies on a single source of potable water, with only one connection from the utility provider. Loss of this supply would limit the Laboratory's ability to provide water for domestic consumption, fire protection, and makeup water for the steam plant. With the AU2, Argonne plans to investigate additional water connections, to provide a redundant system for adequate supply in the event of a failure or catastrophic event.

Roughly 25 percent of the onsite steam distribution system's condensate is not returned to the boiler house; 15 percent is attributed to system failures and leaks and the remaining 10 percent is lost to process requirements. Argonne completed critical maintenance and repair activities on the steam distribution piping and at the boiler house during a site-wide steam shutdown in FY 2019. The shutdown was a success and will increase the efficiency of the steam system and reduce the amount of system losses. More information is provided in the Resilience Success Story.



Figure 23: Maintenance of Steam Distribution Piping Improves Resilience of Campus Heating System

Even after the maintenance shutdown, the steam system will experience some losses. The loss of potable makeup water to the steam plant would affect the plant's ability to produce steam and heat during the winter. Argonne plans a study for FY 2020 to analyze the feasibility of utilizing the site's industrial graywater supply, canal water, as makeup water for the steam generation plant instead of using domestic water. This would improve water and energy efficiency overall.

Chilled water for the site's cooling towers is supplied by canal water, a low-cost industrial water supply. The addition of new buildings and expansion of computing initiatives will limit the Laboratory's chilled-water capacity. The site chilled-water distribution system is not currently a closed loop, which increases energy use, and satellite chillers at individual buildings reduce overall system energy efficiency. The AU2 project will improve the capacity and redundancy of the chilled-water system.

The ECDC Project will improve site energy efficiency and resilience for mission-critical operations, through the installation of a secondary power feed to the Laboratory, as well as equipment upgrades and replacements. Existing switchgear equipment will be automated to increase distribution reliability.

While DOE and Argonne target utility infrastructure improvements through the AU2 and ECDC projects, the Sustainability Program will continue to work with Laboratory stakeholders to create a strategy for completing a site-wide risk and vulnerability assessment. This study would identify hazards to meeting the programmatic mission, laboratory operations and personnel. The program goal is to have a plan in place within the next 2-3 years' timeframe.

Metering investments over the past 10 years have increased the Laboratory's resilience, as exemplified during an outage at the 460 Guest House. An underground feeder fault on July 7, 2019, led to loss of power at the Guest House while the facility was at 100 percent capacity with summer interns. Metering installed in FY 2017 allowed engineers to access data that proved a reduced number of feeders would carry the load capacity of the transformer until a more permanent solution could be implemented. This information allowed engineers to restore electric service to the Guest House more quickly and reduce the amount of time occupants had to spend in other accommodations.

During FY 2019, the Sustainability Program completed a feasibility study for a solar installation on the Argonne campus. The installation would provide some of the renewable energy required for the site, as well as the potential for battery storage integrated with renewable energy sources. (More information appears in Section 5.) The Laboratory maintains several backup generators run by diesel fuel to provide redundant power to mission-critical user facilities and radiological facilities in the event of a supply grid disruption. These may be opportunities to incorporate renewable energy generation.

Argonne will continue to identify methods to incorporate resilience measures into planned projects, such as integrating solar panels on guard post facilities under future security upgrade projects. The Strategic Planning Program leads these planning activities to improve organizational resilience. The collaboration between the Strategic Planning and Sustainability programs will integrate adaptation strategies into ongoing work to ensure overall mission readiness through Laboratory-wide facility and infrastructure strategic planning. Argonne's Facility and Infrastructure Strategic Investment Plan details the planned building and utility repair and modernizations required to support Argonne's mission-critical programs, scientific core capabilities, and major initiatives.

12.2 Emergency Response

Argonne maintains an emergency management program that complies with the core program requirements outlined in DOE Order 151.1D. Emergency response processes and procedures are revised annually after each annual site emergency management exercise is conducted to ensure all Lab emergency response organizations are aligned with respective roles and responsibilities. The Office of Emergency Management has enhanced their hazards analysis to include daily reviews of all requested purchases of hazardous chemicals and materials to ensure the site is adequately prepared to respond to events that have the potential to create onsite and/or offsite consequences.

Argonne is a campus-like environment with few of the assets, such as classified matter and Category IV Special Nuclear Material (SNM), whose enhanced protection is mandated by law, regulation, and DOE safeguards and security policy. A site-specific risk assessment of Argonne has been conducted to identify assets that require enhanced security, such as DOE Office of Science program critical assets, high-value property, critical facilities, hazardous materials, classified matter, and/or SNM for which additional protection is required by DOE directives. This enhanced security protection will include protective measures that will be provided at the specific facility/area based take the form of security islands superimposed upon the DOE Office of Science protection baseline.



SITE-WIDE STEAM SHUTDOWN IMPROVES RELIABILITY AND EFFICIENCY OF CRITICAL LABORATORY SYSTEM

To ensure the reliability of onsite steam service, Argonne completed a 2-week shutdown of the site-wide steam system in FY 2019.

The goal of the shutdown was to safely and efficiently complete repairs at the Boiler House, the Combined Heat and Power Plant, and ancillary valves at individual buildings. Because operations at the Laboratory run around the clock, Argonne's last planned steam shutdown was in 1994.

The site-wide steam system is a critical laboratory asset that is required year-round to support heating, ventilation, and air conditioning (HVAC); climate control for offices and labs; hot water; and miscellaneous industrial processes. Steam is generated at the Boiler House, which was placed in service over 60 years ago and operates 24/7. There are also many miles of steam distribution piping (above and below ground) that make up the remainder of the steam system at the Laboratory. Even though the system is well maintained, some components require a site-wide steam shutdown for corrective and preventative maintenance to ensure reliability and resilience.

Argonne began planning the steam shutdown in FY 2018, with the Utilities and Maintenance Department of the Facilities Division (FAC) and the Project Management Organization (PMO) working closely to develop a project implementation plan. The shutdown started at 5 p.m. Friday, August 23, 2019. Steam was available at 8:00 a.m. on September 9, 2019. The shutdown impacted 28 buildings across the site.



Section of elevated steam piping

The project team created and implemented a detailed communications plan to ensure all stakeholders were informed of the project and its potential impact on site occupants. On May 14th, the project was announced in a site-wide communication and follow-up information was included in *Argonne Today*, the Laboratory's information blog, and the daily employee email newsletter, *Snapshot*. Information was displayed on Argonne's network of monitors across the site. A special e-mail address was created to serve as a centralized place for site occupants to direct questions and comments about the shutdown: steamfix@anl.gov.

The 2-week site-wide shutdown of the steam system was completed safely and successfully. This work significantly contributed to the safety, efficiency, and reliability of our campus buildings, ensuring continued operational excellence in support of Argonne's mission.

The Facilities Utilities Group (Facilities) focused on critical components at the boiler house and on the distribution lines. Their work included repairs and

maintenance in steam vaults, work on steam traps, and maintenance for over 500 valves in the steam plant and elsewhere across the site. Facilities staff were also able to inspect multiple tanks in the steam plant during the shutdown.

The Facilities Building Maintenance Group (Building Maintenance) focused on the critical components of the steam system within the buildings. Building Maintenance repaired or replaced any steam isolation valves and pressure-reducing valves that were not operating properly. They also repaired or replaced condensate return systems and numerous steam traps that were creating system problems because they were not operating correctly.

Site resilience is crucial to maintaining a world-class facility. The work completed during this planned shutdown will ensure the steam system will function more efficiently and significantly reduce the possibility of unplanned shutdowns in the future.

**FOR MORE INFORMATION
PLEASE EMAIL**

**Sustainability Program Manager
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Appendix 1 - Fleet Management Plan

Organization and Structure

The vehicle fleet at Argonne is comprised predominantly of leased vehicles. The vehicles are supplied under a lease agreement through the GSA. The GSA recovers vehicle expenses by charging the lessee a monthly fee and a per-mile fee for vehicles. The monthly fee is for fixed costs associated with the vehicle and the mileage fee is for maintenance, repair, and fuel. The vehicles offered by GSA meet more than 90 percent of Argonne's vehicle fleet requirements. Other vehicle purchases are generally limited to specialty vehicles, such as emergency response and utility vehicles, which are not acquired through GSA fleet offerings. In recent years, GSA-leased vehicles were approximately 25 percent more fuel efficient on average than the vehicles they replaced. Approximately 50 percent of GSA's offerings are AFVs. The GSA turnover rate on light-duty trucks and passenger vehicles is typically 7 years. Therefore, the use of GSA-supplied vehicles directly translates to lower fuel consumption for Argonne. Ninety-three percent of the vehicles in the Argonne fleet are AFVs. Ten fleet vehicles are used exclusively to support scientific research located in rural areas in the Midwest that do not have reasonable access to alternative fuels. Management of the Argonne fleet is provided by the Facilities Management Services Division. The group also includes a fleet specialist and an onsite vehicle maintenance group.

Fleet Procurement

Vehicles are selected for addition or replacement based on the operational needs of the laboratory. GSA leasing is the preferred option for vehicles when the GSA vehicle offerings meet minimum operational requirements. Federal management regulations require GSA to select vehicles that achieve maximum fuel efficiency and limit body size, engine size, and optional equipment to what is essential to meet operational requirements. In addition, low-GHG passenger vehicle and light-duty truck GSA options are considered when available. All additions to the vehicle fleet are authorized by the DOE Argonne Site Office. Details of the fleet procurement process, including required approvals, are specified in Argonne's Vehicle Management Manual.

Fuel Infrastructure

Argonne vehicles are almost exclusively fueled on site. Currently, the site dispenses biodiesel (B20, and B5 during the winter season only), E85, and unleaded fuels. The onsite fueling infrastructure allows for maximum alternative fuel use in diesel and flex-fuel fleet vehicles. The GSA leasing program supplies vehicles that are compatible with the alternative fuels available on site.

Argonne uses a keyed fueling system with an embedded chip to support onsite vehicle fueling operations. The chip keys are programmed so that alternative-fueled passenger and light-duty trucks are authorized to utilize E85 only. The site dispenses only biodiesel for vehicles designed to operate on diesel fuel.

Vehicle Use Policies

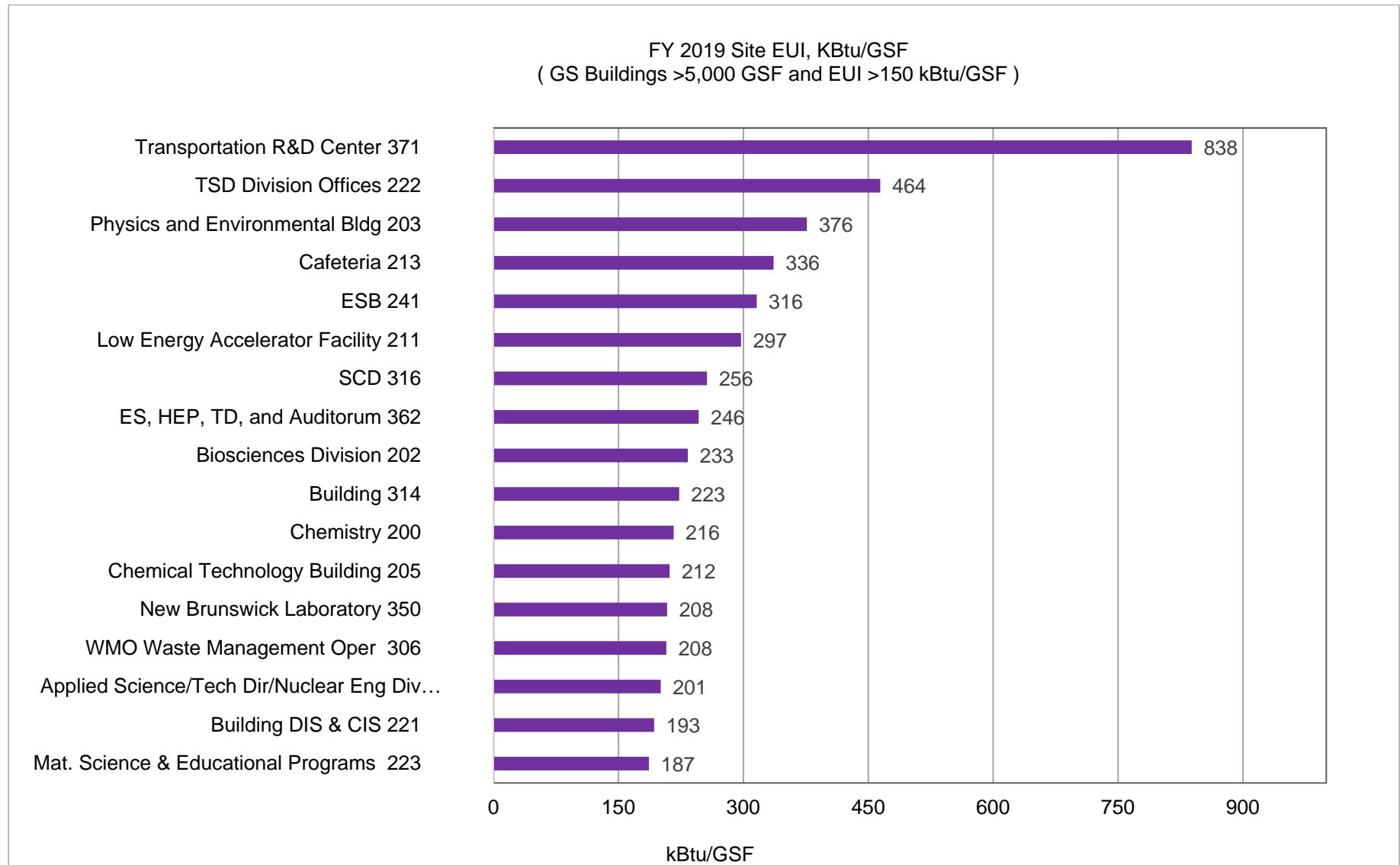
Argonne has a documented vehicle use policy, the details of which are contained in the Vehicle Management Manual. The work instruction details responsibilities of vehicle custodians, vehicle operators, and supervisors. Topics addressed in the procedure include vehicle idling restrictions, employee checkout standards, safe operations, fueling requirements, limitations on vehicle usage, and preventative maintenance responsibilities. The work instruction is required reading for all vehicle custodians and operators. Recently acquired GSA lease vehicles have telematics that are used to track and manage use and performance.

Additional Fuel Reduction, Alternative Fuel Use, and Vehicle Reduction Activities and Policies

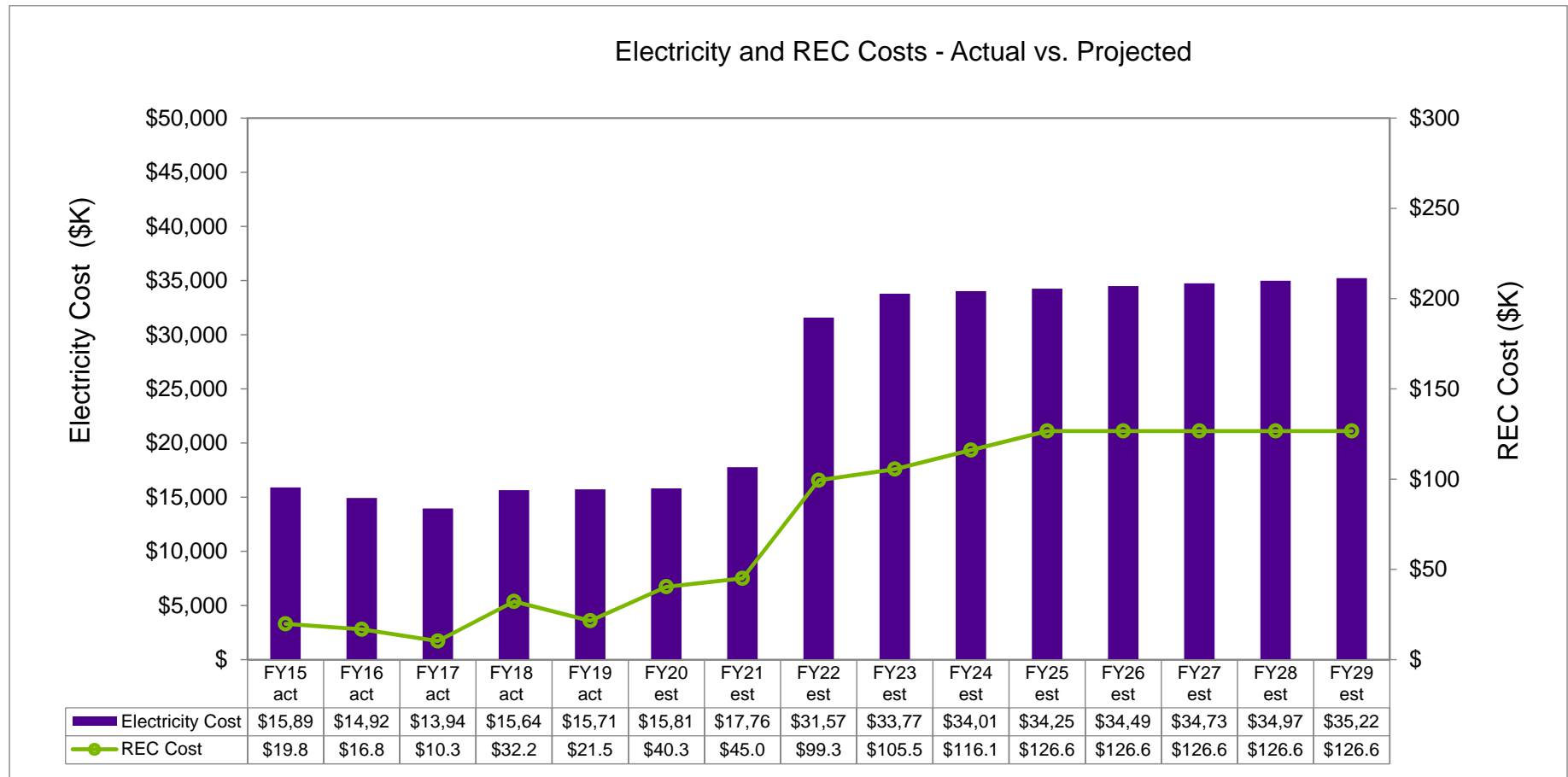
Argonne has reduced its fleet by replacing traditional fleet vehicles with electric and biodiesel vehicles. In response to the U.S. Secretary of Energy's fleet reduction goals, a fleet right-sizing plan was created. The plan established criteria and provided justification for the continued use of each vehicle in the Argonne fleet. The outcome of the plan demonstrated that the remaining vehicles that make up the Argonne fleet are mission critical.

In an effort to further reduce fuel consumption, Argonne is participating in a GSA-sponsored electric vehicle pilot program. Onsite electric-vehicle charging infrastructure has been created as part of an ongoing electric vehicle charging research program. The charging stations are accessible for fleet vehicle charging and laboratory employee personal vehicles.

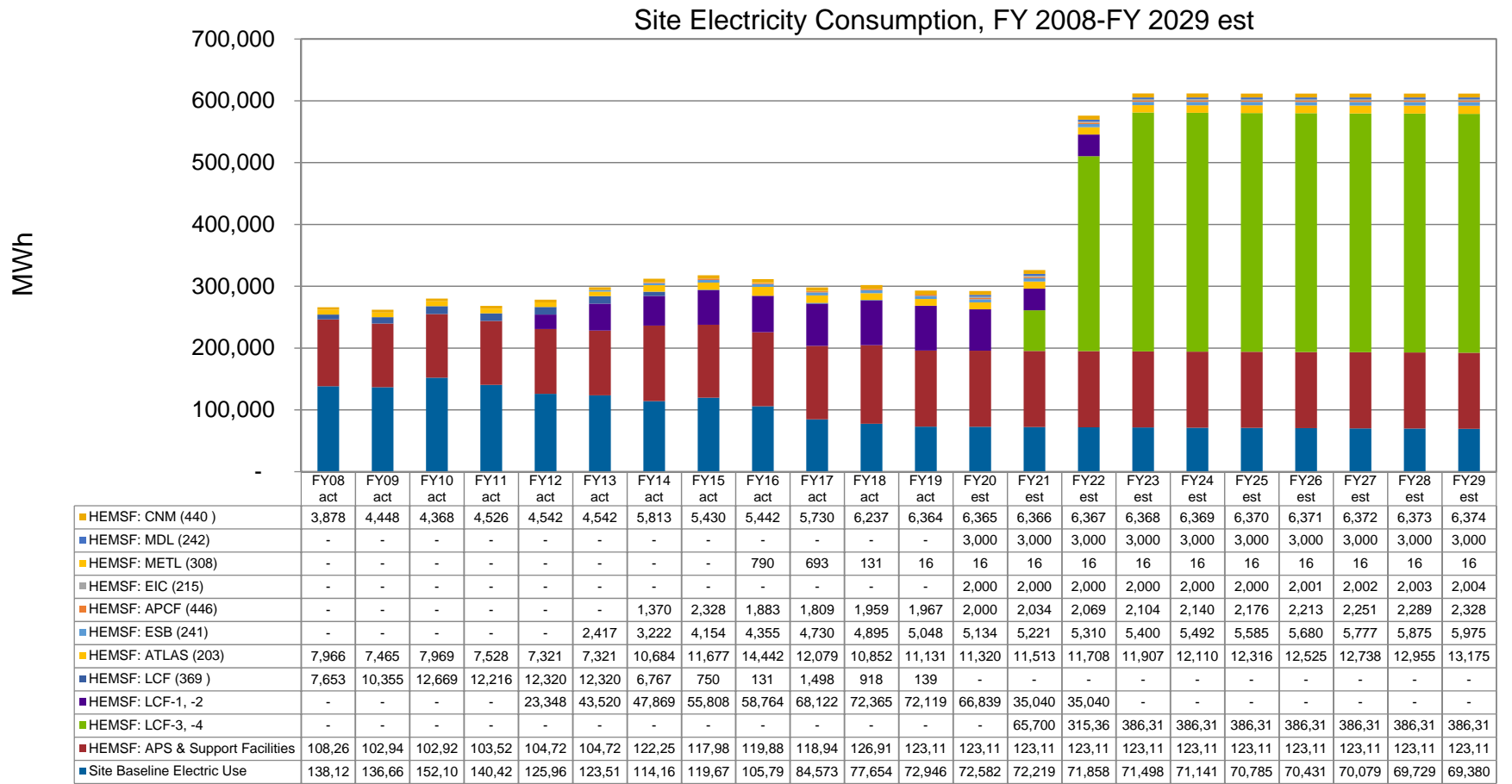
Attachment A—Buildings with EUI Greater than 150 Btu/GSF



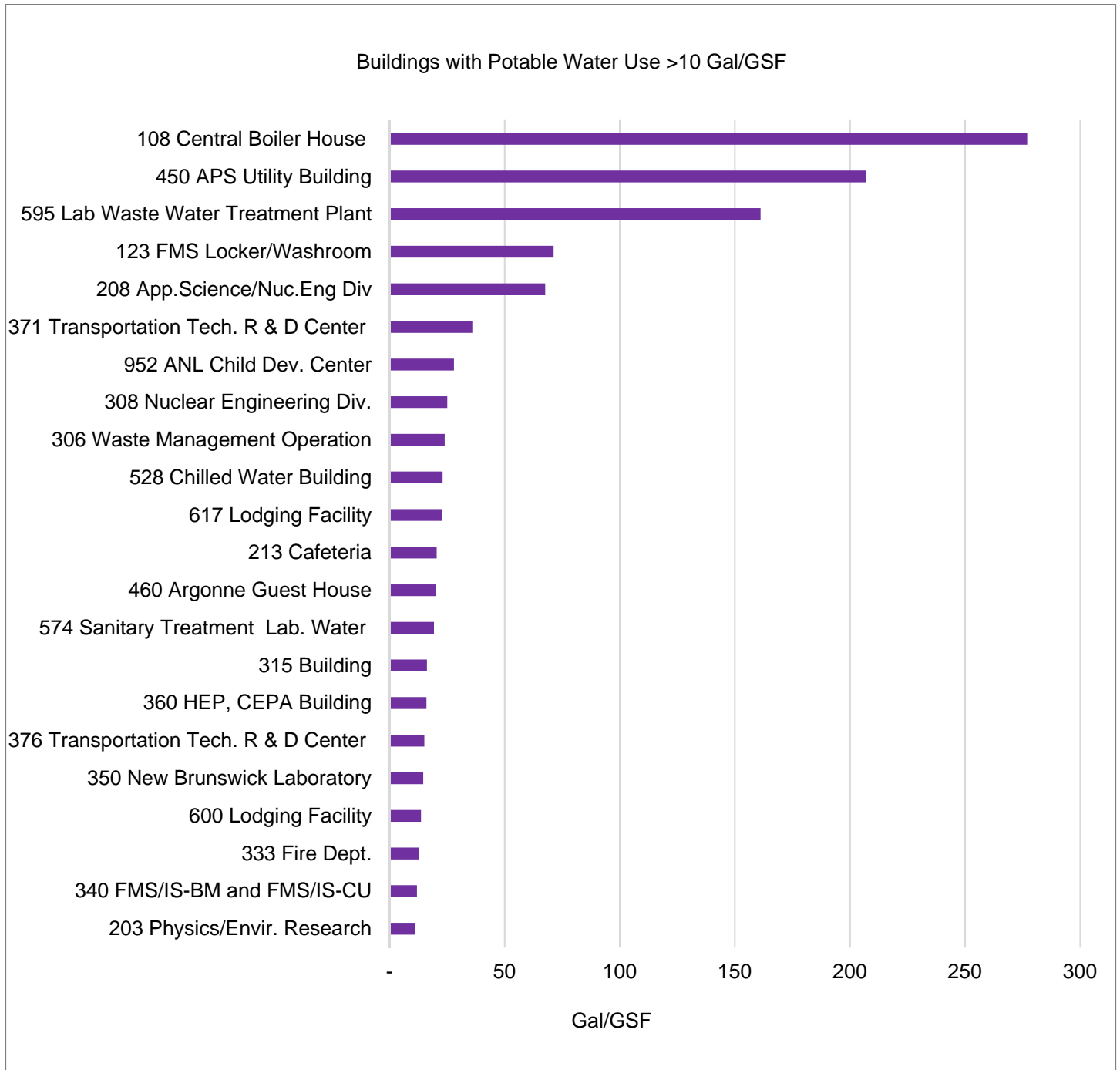
Attachment B—Electricity and REC Costs: Actual vs. Projected, FY 2008–FY 2029



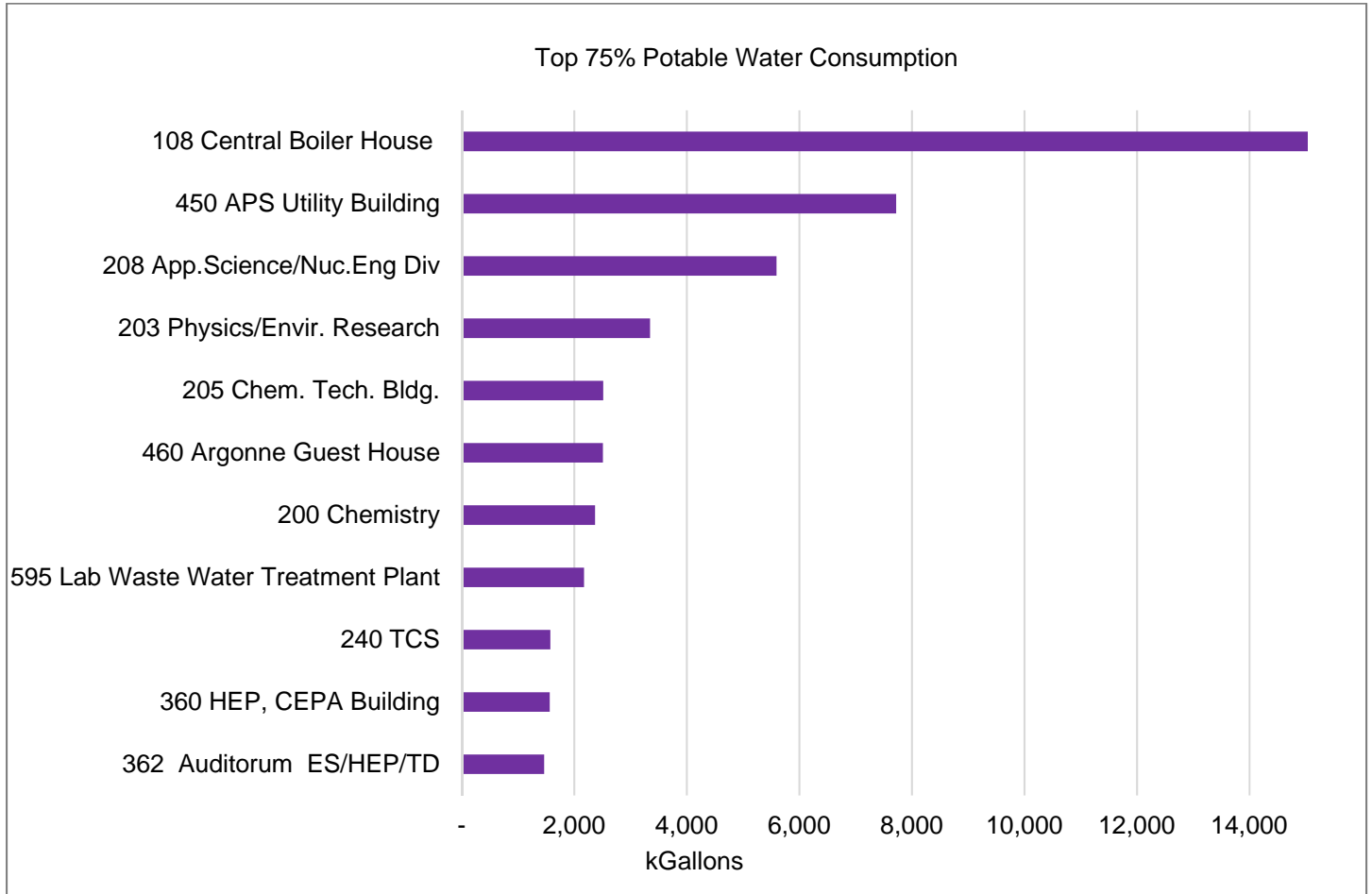
Attachment C—Electricity Consumption, Actual and Projected



Attachment D—Buildings with Potable Water Intensity Greater than 10 Gallons/GSF



Attachment E—Buildings Accounting for 75% of Site Potable Water Use



Attachment F—Actual and Projected SF₆ Emissions by Device

Application/Processes/ Facilities/Systems Using SF ₆ *	Identify Key Facilities by FIMS Asset No.	Current SF ₆ Storage Inventory (lb.)	SF ₆ Device Inventory (lb.)	Emissions (lb.)												
				FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Total: FY 2010 to FY 2015	FY 2016 Actual	FY 2017 Actual	FY 2018 Actual	FY 2019 (Est.)	FY 2020 (Est.)	Total: FY 2016 to FY 2020 (Est.)
ATLAS Tandem Accelerator	FIMS—OSF 067	0	0	115	0	2,795	1,320	10	400	4,640	0	0	0	0	0	0
Ion Implant Accelerator	FIMS—Bldg. 212	115	862	490	396	60	88	181	88	1,303	80	183	100	100	100	563
Bldg. 211 Linac	FIMS—OSF 070	340	8	0	0	0	115	532	920	1,567	240	360	250	250	250	1350
Argonne Wakefield Accelerator	FIMS—Bldg. 366	400	45	700	692	513	340	333	272	2,850	266	205	200	200	200	1071
Site Utilities (Switchgear)	FIMS—OSF 543, 544, 545, 546, 548, 549, 551	262	1,749	100	86	86	115	178	185	750	199	218	125	125	125	792
Advanced Photon Source— Linac	FIMS—OSF 081	30	–	7	9	70	50	47	27	210	198	70	50	50	50	418
Center for Nanoscale Materials (CNM)	FIMS—Bldg. 440	50	N/A	0	0.4	0.4	Trace	1	2	4	6.5	5	5	5	5	26.5
Sub-angstrom Microscopy & Microanalysis (SAMM)	FIMS—Bldg. 216	40	–	0	23	0	0	0	0	23	0	0	0	0	0	0
Energy Systems (ES)	FIMS—Bldg. 362	1	N/A	0	0	0	182	0	0	182	0	0	0	0	0	0
Balance of Site		130	–	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		1,368	2,664	1,412	1,206	3,524	2,210	1,282	1,894	11,529	990	1,041	730	730	730	4,221



Department of Energy

Argonne Site Office
9800 South Cass Avenue
Lemont, Illinois 60439

NOV 21 2019

MEMORANDUM FOR SUSTAINABILITY PERFORMANCE OFFICE

FROM: JOANNA M. LIVENGOOD
MANAGER

A handwritten signature in black ink that reads "Joanna M. Livengood".

SUBJECT: SELF-CERTIFICATION FORM FOR DASHBOARD DATA ACCURACY
VERIFICATION

The Department of Energy (DOE) annually reports the agency's greenhouse gas emissions, energy and water use, fleet optimization, green buildings, and renewable energy to comply with the sustainability goals mandated by EISA §527 and DOE Order 436.1 *Departmental Sustainability Directive*.

I certify that the data submitted for FY 2019 through the Dashboard as of November 22, 2019 for Argonne National Laboratory has been accurately entered and completed to the best of my knowledge and expertise.

If you have any questions, please contact Jurgis Paliulionis of my staff at (630)252-2724 or by email at jurgis.paliulionis@science.doe.gov.

cc: K. Sawyer, ANL-OPS
K. Hellman, ANL-IS
J. Budd, ANL-PMO
J. Busch, ANL-FAC
C. Hurley, ANL-PMO



Department of Energy

Argonne Site Office
9800 South Cass Avenue
Lemont, Illinois 60439

NOV 21 2019

MEMORANDUM FOR SUSTAINABILITY PERFORMANCE OFFICE

FROM: JOANNA M. LIVENGOOD
MANAGER

A handwritten signature in black ink that reads "Joanna M. Livengood".

SUBJECT: SELF-CERTIFICATION FORM FOR THE ENERGY INTENSITY GOAL OF EISA 2007

Each building or group of building excluded under the criteria for Part G or Part H exclusion is/are for energy consumption and their consumption is reported annually.

If any building has been excluded under the criteria for Part H for impracticability then all practicable energy and water conservation measures with a payback of less than 10 years have been installed. A justification statement that explains why process-dedicated energy in the facility may impact the ability to meet the goal has been provided in the Dashboard's EUI Excluded Facilities Report.

I certify that the buildings listed on the EUI Excluded Facilities Report, produced by the Dashboard as dated November 22, 2019 for Argonne National Laboratory, meets the exclusion criteria in *Guidelines Establishing Criteria for Excluding Buildings*. This was published by FEMP on January 27, 2006.

If you have any questions, please contact Jurgis Paliulionis of my staff at (630)252-2724 or by email at jurgis.paliulionis@science.doe.gov.

cc: K. Sawyer, ANL-OPS
K. Hellman, ANL-IS
J. Budd, ANL-PMO
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C. Hurley, ANL-PMO

A component of the Office of Science

Argonne National Laboratory Buildings Excluded from Energy Intensity Goal Calculation as of November 2019

Site #	Fiscal Year	Property Name	Property ID	Real Property Unique ID	Property Type	Ownership	Goal Subject SqFt	Excluded SqFt	Exclusion Part
301	2019	SANITARY LIFT EAST AREA	30	123687	Building	DOE Owned (O)	150	0	
301	2019	Storage	31	123660	Building	DOE Owned (O)	300	0	
301	2019	Storage	32	123659	Building	DOE Owned (O)	300	0	
301	2019	Transportation Building	46	216311	Building	DOE Owned (O)	3,028	0	
301	2019	Transportation Building	46	123713	Building	DOE Owned (O)	49,809	0	
301	2019	Guard Post Eastwood Dr	91	123670	Building	DOE Owned (O)	50	0	
301	2019	Storage Building	107	123517	Building	DOE Owned (O)	1,907	0	
301	2019	Central Boiler House Bldg 108A	108	216323	Building	DOE Owned (O)	0	59,367	G - Separately Metered Intensive Load(s)
301	2019	Combined Heat and Power Plant	109	217015	Building	DOE Owned (O)	0	5,500	G - Separately Metered Intensive Load(s)
301	2019	Util Systems Offices	114	123535	Building	DOE Owned (O)	1,818	0	
301	2019	Crusher House	115	123671	Building	DOE Owned (O)	0	1,050	H - Impracticability
301	2019	Shaker House	116	123699	Building	DOE Owned (O)	0	980	H - Impracticability
301	2019	FMS LOCKER/WASHROOM	123	133901	Building	DOE Owned (O)	2,617	0	
301	2019	Lake Michigan Flow Control Station	127	135754	Building	DOE Owned (O)	165	0	
301	2019	Waste Water - Domestic Water	128	123617	Building	DOE Owned (O)	0	2,121	H - Impracticability
301	2019	Pumping Station, Office	129	123662	Building	DOE Owned (O)	0	6,050	H - Impracticability
301	2019	Storage Bldg	130	123604	Building	DOE Owned (O)	1,282	0	
301	2019	Storage Building and Shop	145	123534	Building	DOE Owned (O)	3,526	0	
301	2019	Utilities Office Building	146	123582	Building	DOE Owned (O)	1,397	0	
301	2019	Storage	160	123658	Building	DOE Owned (O)	240	0	
301	2019	Storage	163	123656	Building	DOE Owned (O)	250	0	
301	2019	Chemistry	200	123515	Building	DOE Owned (O)	356,889	0	
301	2019	DOE-ASO/CH ARGONNE ADMIN., UC	201	123533	Building	DOE Owned (O)	220,099	0	
301	2019	Biosciences Division	202	123564	Building	DOE Owned (O)	203,002	0	
301	2019	Biosciences Division	202	216309	Building	DOE Owned (O)	5,664	0	
301	2019	Physics and Environmental Research	203	123563	Building	DOE Owned (O)	304,852	0	

301	2019	Chemical Technology Building	205	123562	Building	DOE Owned (O)	262,073	0	
301	2019	Engineering Development Shed 206 A	206	216322	Building	DOE Owned (O)	120	0	
301	2019	Engineering Development Laboratory	206	123583	Building	DOE Owned (O)	24,177	0	
301	2019	Applied Science/Tech Dir/Nuclear Eng Div	208	123712	Building	DOE Owned (O)	82,666	0	
301	2019	Low Energy Accelerator Facilit	211	123577	Building	DOE Owned (O)	56,118	0	
301	2019	NWM, NE, ES, ESQ, and FMS	212	123519	Building	DOE Owned (O)	304,572	0	
301	2019	Cafeteria	213	123602	Building	DOE Owned (O)	34,492	0	
301	2019	IS Division	214	123560	Building	DOE Owned (O)	23,664	0	
301	2019	Sub-Angstrom Microscopy & Micro	216	206768	Building	DOE Owned (O)	0	7,289	G - Separately Metered Intensive Load(s)
301	2019	DIS & CIS Building	221	123559	Building	DOE Owned (O)	72,356	0	
301	2019	TSD Division Office, ES and FMS Dept	222	123588	Building	DOE Owned (O)	58,737	0	
301	2019	Mat. Science & Educational Programs	223	123520	Building	DOE Owned (O)	110,303	0	
301	2019	ARGONNE INFORMATION CENTER	224	123587	Building	DOE Owned (O)	7,500	0	
301	2019	Building 233	233	219209	Building	DOE Owned (O)	0	0	8200 GSF --New Building for FY20, assume GS
301	2019	ESB	241	211590	Building	DOE Owned (O)	172,311	0	
301	2019	MDL Building	242	218978	Building	DOE Owned (O)	0	0	115,000 GSF-- New Building for FY20, assume GS
301	2019	Guard Post Northgate Rd	291	123669	Building	DOE Owned (O)	50	0	
301	2019	Smart Energy Plaza	300	123706	Building	DOE Owned (O)	2,403	0	
301	2019	Security	302	123707	Building	DOE Owned (O)	19,360	0	
301	2019	WMO Waste Storage	303	123610	Building	DOE Owned (O)	6,257	0	
301	2019	WMO Waste Management Oper	306	123565	Building	DOE Owned (O)	45,639	0	
301	2019	Nuclear Engineering Division/Inspector G	308	123556	Building	DOE Owned (O)	25,606	0	
301	2019	Nuclear Engineering Division	309	123555	Building	DOE Owned (O)	9,453	0	
301	2019	Experimental Building	311	123553	Building	DOE Owned (O)	2,365	0	
301	2019	Building 313	313	123581	Building	DOE Owned (O)	1,771	0	
301	2019	Building 314	314	123527	Building	DOE Owned (O)	16,586	0	
301	2019	NE, SCD, ES, NOD	315	123552	Building	DOE Owned (O)	59,694	0	
301	2019	SCD	316	123551	Building	DOE Owned (O)	17,299	0	

301	2019	NWM-Waste Management Storage	318	135441	Building	DOE Owned (O)	150	0	
301	2019	USDA Wildlife Services Field Facility	320	123586	Building	DOE Owned (O)	1,561	0	
301	2019	NWM-Rad Waste Storage	331	123548	Building	DOE Owned (O)	32,444	0	
301	2019	FMS Dept - Fire Protection	331	216310	Building	DOE Owned (O)	6,937	0	
301	2019	Fire Department	333	123603	Building	DOE Owned (O)	11,395	0	
301	2019	Building 335 APS	335	123547	Building	DOE Owned (O)	14,511	0	
301	2019	FMS-BM and FMS-CU	340	123546	Building	DOE Owned (O)	4,339	0	
301	2019	Building 350	350	123601	Building	DOE Owned (O)	85,372	0	
301	2019	HEP, CEPA Building	360	123579	Building	DOE Owned (O)	0	97,166	G - Separately Metered Intensive Load(s)
301	2019	IPNS Linac Injector Building	361	123521	Building	DOE Owned (O)	0	24,899	E - Skewed Energy Usage
301	2019	ES, HEP, TD, and Auditorum	362	123578	Building	DOE Owned (O)	198,840	0	
301	2019	Central Shops	363	123573	Building	DOE Owned (O)	0	48,195	G - Separately Metered Intensive Load(s)
301	2019	Center Bldg	364	123600	Building	DOE Owned (O)	0	33,812	G - Separately Metered Intensive Load(s)
301	2019	Ring Building/SNS Development Test Area	365	123522	Building	DOE Owned (O)	0	51,173	E - Skewed Energy Usage
301	2019	Fabrication Area	366	123544	Building	DOE Owned (O)	0	26,594	G - Separately Metered Intensive Load(s)
301	2019	WMO Facility Storage	367	123543	Building	DOE Owned (O)	0	8,240	E - Skewed Energy Usage
301	2019	Power Distribution and Crafts	368	123542	Building	DOE Owned (O)	0	19,998	G - Separately Metered Intensive Load(s)
301	2019	Building 369- ALCF & ES	369	123541	Building	DOE Owned (O)	0	30,771	G - Separately Metered Intensive Load(s)
301	2019	Nuclear Eng Alex Facility/ES Facility	370	123572	Building	DOE Owned (O)	0	41,088	G - Separately Metered Intensive Load(s)
301	2019	Transportation Technology Storage	371	216314	Building	DOE Owned (O)	196	0	
301	2019	TRANSPORTATION TECHNOLOGY R & D CENTER,	371	123524	Building	DOE Owned (O)	25,884	0	G - Separately Metered Intensive Load(s)
301	2019	Transportation Technology Storage	371	216312	Building	DOE Owned (O)	600	0	
301	2019	OEM Offices - EOC	372	123571	Building	DOE Owned (O)	0	3,649	G - Separately Metered Intensive Load(s)
301	2019	ES Equipment Storage	373	123523	Building	DOE Owned (O)	0	2,489	G - Separately Metered Intensive Load(s)
301	2019	IPNS Experimental Area & Neutr	375	123569	Building	DOE Owned (O)	0	24,331	E - Skewed Energy Usage
301	2019	Transportation Technology, R&D Center En	376	123568	Building	DOE Owned (O)	0	22,691	G - Separately Metered Intensive Load(s)

301	2019	Cooling Water Tower Fac A	377	216292	Building	DOE Owned (O)	0	1,998	G - Separately Metered Intensive Load(s)
301	2019	Cooling Water Tower Fac G	377	216294	Building	DOE Owned (O)	0	554	G - Separately Metered Intensive Load(s)
301	2019	Cooling Water Tower Fac B	377	216293	Building	DOE Owned (O)	0	992	G - Separately Metered Intensive Load(s)
301	2019	APS Storage	378	123576	Building	DOE Owned (O)	0	9,709	G - Separately Metered Intensive Load(s)
301	2019	Building 379	379	123672	Building	DOE Owned (O)	0	4,155	G - Separately Metered Intensive Load(s)
301	2019	APS Vacuum Systems	382	123566	Building	DOE Owned (O)	0	18,573	G - Separately Metered Intensive Load(s)
301	2019	Storage	384	123590	Building	DOE Owned (O)	768	0	
301	2019	IPNS Survey Calibration Area	385	123589	Building	DOE Owned (O)	0	518	E - Skewed Energy Usage
301	2019	Enterprise Data Center	386	217824	Building	DOE Owned (O)	0	12,984	G - Separately Metered Intensive Load(s)
301	2019	IPNS RF Power Supply Bldg	389	123598	Building	DOE Owned (O)	0	640	E - Skewed Energy Usage
301	2019	IPNS Rapid Cycling Synchronro	391	123596	Building	DOE Owned (O)	0	7,810	E - Skewed Energy Usage
301	2019	IPNS NGS Control and Computer	399	123595	Building	DOE Owned (O)	0	2,805	E - Skewed Energy Usage
301	2019	APS Exper Hall/Storage Ring & EAA	400	123720	Building	DOE Owned (O)	0	490,493	G - Separately Metered Intensive Load(s)
301	2019	Central Lab & Office Bldg.and Control Ce	401	128755	Building	DOE Owned (O)	0	191,336	G - Separately Metered Intensive Load(s)
301	2019	APS Conference Center	402	128756	Building	DOE Owned (O)	0	27,252	G - Separately Metered Intensive Load(s)
301	2019	APS Linear Accelerator Facility	411	123728	Building	DOE Owned (O)	0	10,061	G - Separately Metered Intensive Load(s)
301	2019	APS Injection Wing	412	123729	Building	DOE Owned (O)	0	26,978	G - Separately Metered Intensive Load(s)
301	2019	APS Low Energy Undulator Test Line Bldg.	413	135713	Building	DOE Owned (O)	0	4,477	G - Separately Metered Intensive Load(s)
301	2019	APS Booster/ Synchrotron Tunnel	415	123730	Building	DOE Owned (O)	0	19,810	G - Separately Metered Intensive Load(s)
301	2019	APS Rf Extraction Wing	420	123731	Building	DOE Owned (O)	0	36,444	G - Separately Metered Intensive Load(s)
301	2019	APS Lab/Office Module	431	128780	Building	DOE Owned (O)	0	27,989	G - Separately Metered Intensive Load(s)
301	2019	APS Lab/Office Module	432	128773	Building	DOE Owned (O)	0	22,894	G - Separately Metered Intensive Load(s)
301	2019	APS Lab/Office Module	433	128776	Building	DOE Owned (O)	0	24,430	G - Separately Metered Intensive Load(s)

301	2019	APS Lab/Office Module	434	128777	Building	DOE Owned (O)	0	22,679	G - Separately Metered Intensive Load(s)
301	2019	APS Lab/Office Module	435	128778	Building	DOE Owned (O)	0	23,831	G - Separately Metered Intensive Load(s)
301	2019	APS Lab/Office Module	436	140752	Building	DOE Owned (O)	0	22,619	G - Separately Metered Intensive Load(s)
301	2019	APS Lab/Office Module	437	205543	Building	DOE Owned (O)	0	23,637	G - Separately Metered Intensive Load(s)
301	2019	APS Lab/Office Module	438	128779	Building	DOE Owned (O)	0	28,921	G - Separately Metered Intensive Load(s)
301	2019	Center For Nano Materials -CNM Building	440	204124	Building	DOE Owned (O)	0	88,369	G - Separately Metered Intensive Load(s)
301	2019	Scanning Probing Microscope	441	208134	Building	DOE Owned (O)	0	4,682	G - Separately Metered Intensive Load(s)
301	2019	APCF Building	446	215882	Building	DOE Owned (O)	66,705	0	
301	2019	APS Utility Building	450	123710	Building	DOE Owned (O)	0	37,340	G - Separately Metered Intensive Load(s)
301	2019	Argonne Guest House	460	135146	Building	DOE Owned (O)	0	124,153	G - Separately Metered Intensive Load(s)
301	2019	Meteorological Facility	484	125717	Building	DOE Owned (O)	2,003	0	
301	2019	Meterological Facility	484	216454	Building	DOE Owned (O)	411	0	
301	2019	Greenhouse	485	123605	Building	DOE Owned (O)	2,122	0	
301	2019	200 Area Chilled Water Building	528	216295	Building	DOE Owned (O)	0	10,271	G - Separately Metered Intensive Load(s)
301	2019	Steam Dist. Building A	531	216296	Building	DOE Owned (O)	1,035	0	
301	2019	Communications Systems Bldg 541 A	541	216297	Building	DOE Owned (O)	0	202	H - Impracticability
301	2019	Communications Sytem Bldg 541 B	541	216298	Building	DOE Owned (O)	0	2,560	H - Impracticability
301	2019	Communications System Building 541 C	541	216299	Building	DOE Owned (O)	0	672	H - Impracticability
301	2019	Outdoor Load 543 A	543	216300	Building	DOE Owned (O)	756	0	
301	2019	Outdoor Load 544 A	544	216301	Building	DOE Owned (O)	269	0	
301	2019	Outdoor Load Building 544 B	544	216302	Building	DOE Owned (O)	997	0	
301	2019	Outdoor Load Center 300 & 400 549-3	549	216303	Building	DOE Owned (O)	1,180	0	
301	2019	Outdoor Load 300 & 400 549-4	549	216304	Building	DOE Owned (O)	1,643	0	
301	2019	Outdoor Load Center 300 & 400 Area 549 7	549	216305	Building	DOE Owned (O)	2,054	0	
301	2019	Outdoor Load Bldg 200 551 A	551	216306	Building	DOE Owned (O)	2,046	0	

301	2019	Lake Michigan Water Pump Station	567	123732	Building	DOE Owned (O)	683	0	
301	2019	Blower Bldg	572	123626	Building	DOE Owned (O)	0	158	H - Impracticability
301	2019	Sanitary Sampling	573	123627	Building	DOE Owned (O)	0	144	H - Impracticability
301	2019	Sanitary Treatment Laboratory,	574	123628	Building	DOE Owned (O)	0	1,085	H - Impracticability
301	2019	WWTP Maint Bldg, & Storage	576	134636	Building	DOE Owned (O)	3,052	0	
301	2019	CANAL WATER PUMPING STATION	582	123657	Building	DOE Owned (O)	0	1,673	G - Separately Metered Intensive Load(s)
301	2019	Canal Treatment (Cooling Water)	583	123661	Building	DOE Owned (O)	6,235	0	
301	2019	LAB WWTP	592	123616	Building	DOE Owned (O)	401	0	
301	2019	FMS-Utility Services Storage	593	123629	Building	DOE Owned (O)	308	0	
301	2019	Lab Waste Water Treatment Plan	595	132003	Building	DOE Owned (O)	13,494	0	
301	2019	Lab Waste Water Blower Bldg	596	132004	Building	DOE Owned (O)	360	0	
301	2019	LAB WASTE WATER INFLUENT PUMP STATION	597	132005	Building	DOE Owned (O)	214	0	
301	2019	Lodging Facility	600	123594	Building	DOE Owned (O)	6,106	0	
301	2019	Pavilion (Summer House)		123618	OSF	DOE Owned (O)	503	0	
301	2019	Bath House	604	123599	Building	DOE Owned (O)	563	0	
301	2019	Pool Filter & Pump Hse	607	123718	Building	DOE Owned (O)	240	0	
301	2019	Lodging Fac	614	123532	Building	DOE Owned (O)	1,025	0	
301	2019	Lodging Fac	615	123516	Building	DOE Owned (O)	1,025	0	
301	2019	Lodging Fac	617	123518	Building	DOE Owned (O)	12,994	0	
301	2019	Lodging Fac	618	123531	Building	DOE Owned (O)	6,539	0	
301	2019	Lodging Fac	619	123530	Building	DOE Owned (O)	7,742	0	
301	2019	Lodging Fac	620	123529	Building	DOE Owned (O)	4,200	0	
301	2019	Lodging Fac	621	123528	Building	DOE Owned (O)	7,102	0	
301	2019	Guard Post Westgate Rd	891	123623	Building	DOE Owned (O)	50	0	
301	2019	Guard Post Westgate Rd 891 A	891	216320	Building	DOE Owned (O)	78	0	
301	2019	Argonne Park Restrooms Fac	950	123624	Building	DOE Owned (O)	400	0	
301	2019	Argonne Child Develop	951	123526	Building	DOE Owned (O)	3,960	0	
301	2019	Argonne Child Development	952	123675	Building	DOE Owned (O)	9,000	0	
301	2019	Argonne Park Pavillion		126953	OSF	DOE Owned (O)	3,264	0	

note: 317,788 GSF of leased buildings not counted in GSF reported

3,126,673	1,853,351	4,980,024
Goal Subject GSF	Excluded GSF	Total GSF

ARGONNE NATIONAL LABORATORY

- U.S. Department of Energy research facility
- Operated by the University of Chicago
- Midwest's largest federally funded R&D facility
- Located in Lemont, IL, about 25 miles (40 km) southwest of Chicago, IL (USA)
- Conducts basic and applied research in dozens of fields
- Unique suite of leading-edge scientific user facilities

FOR MORE INFORMATION

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ENERGY

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