



Smithsonian Institution

## 2016 Strategic Sustainability Performance Plan

Smithsonian Facilities

06/30/2016

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## Policy Statement

Founded in 1846, the Smithsonian Institution is the world's largest museum and research complex, containing 19 museums and galleries, numerous research centers and supporting facilities, and the National Zoological Park. We are active in over 80 countries around the world, with permanent locations in eight states plus Washington, D.C. and Panama.

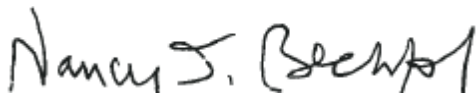
James Smithson established the Smithsonian Institution as “an Establishment for the increase and diffusion of knowledge...” with a sweeping public mission for learning and teaching. The Smithsonian has been, and must be, sustainable for generations to come.

As a trust instrumentality of the United States<sup>1</sup>, the Smithsonian is committed to the goals which Executive Order 13693 set for federal agencies, and is focused on making improvements in environmental, energy, and economic performance. Goal elements of this plan also respond to EO 13690 and EO 13653. Some employees and programs, and a portion of the Smithsonian budget, are non-Federal. Although Executive Order guidance refers to Federal activities, non-Federal activities are integral to our sustainability planning and performance. Therefore we include them in this plan. For example in Table 1: Agency Size and Scope, Total number of employees includes both Federal and Trust positions. As stated in the current Smithsonian Strategic Plan, one of the four grand challenges we have undertaken is “Understanding and Sustaining a Biodiverse Planet.” The goals established by the Executive Order complement this grand challenge and underscore our mission and values.

The Smithsonian is the steward of the nation's treasures in perpetuity, and is much more than a collection of facilities. Through scientific research, education, and access to the visiting public, the Smithsonian is uniquely positioned to study, test, implement and educate the world on actions that will lead us into a sustainable future.

In response to the Executive Order, the Smithsonian is meeting goals to decrease potable water use per square foot, decrease fleet petroleum use, and increase use of renewable energy. Smithsonian is making progress but has not yet reached the goal for reduced direct and indirect greenhouse gas emissions. Deployment of energy efficient, electric, hybrid, and bio-fuel vehicles is reducing petroleum use. A growing recycling program diverts increasing quantities of solid waste from landfill disposal, and cuts Smithsonian greenhouse gas emissions. Fulfilling goals for energy and sustainability performance of the buildings is a particular challenge. Demands on the buildings, some of which are historic, include maintaining environments suitable for conservation of 137 million collection objects, caring for more than 2,000 live animals, accommodating 30 million visitors each year, and hosting hundreds of special events. While continuing to meet these demands, the Smithsonian has attained 3<sup>rd</sup> party sustainability certifications for building construction and revitalization projects, operation and maintenance practices, and restaurants.

The Strategic Sustainability Performance Plan reports sustainability successes and challenges of the past year. It describes the Smithsonian today. More importantly, it identifies the sustainability strategies we will pursue in the year ahead, how we will measure progress, and the milestones we intend to reach. It is a map the Smithsonian can follow towards a sustainable future. For more information on sustainability-related programs, please visit our website at: [www.si.edu](http://www.si.edu).



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Nancy J. Bechtol, Chief Sustainability Officer

June 30, 2016

Date

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<sup>1</sup> Recognized as a tax-exempt organization under Section 501(c)(3) of the Internal Revenue Code

# Executive Summary

## VISION

As a trust instrumentality of the United States<sup>2</sup>, the Smithsonian is committed to the goals which Executive Order 13693 set for federal agencies, and is focused on making improvements in environmental, energy, and economic performance. As stated in the current Smithsonian Strategic Plan, one of the four grand challenges we have undertaken is “Understanding and Sustaining a Biodiverse Planet.” The goals established by the Executive Order complement this grand challenge and underscore our mission and values.

This 2016 Smithsonian Institution Strategic Sustainability Performance Plan reports sustainability successes and challenges of the past year. It describes the Smithsonian today. More importantly, it identifies the sustainability strategies we will pursue in the year ahead, how we will measure progress, and the milestones we intend to reach. It is a map the Smithsonian can follow towards a sustainable future.

## LEADERSHIP

Nancy J. Bechtol, Director, Office of Facilities Engineering and Operations, is designated Smithsonian Institution Chief Sustainability Officer for implementation of Executive Order 13693.

The Smithsonian Executive Committee on Sustainability, appointed by the Secretary, provides leadership, accountability, and inspiration.

The Energy Management Branch supports the Chief Sustainability Officer, coordinates and participates in Smithsonian-wide implementation of Executive Order 13693. Sustainability leaders in many other Smithsonian units are responsible for progress and planning.

Currently, and into the foreseeable future, sustainability work at the Smithsonian is performed as collateral duty by on-board staff.

## PERFORMANCE SUMMARY REVIEW

### Goal 1: Greenhouse Gas (GHG) Reduction

Evaluation of progress is based on annual emissions expressed in metric tons of carbon dioxide equivalent (MTCO<sub>2e</sub>). The Smithsonian utilizes the Federal Energy Management Program Energy and GHG Reporting Tool to generate the annual inventory of GHG emissions. Fluorinated gas inventory accuracy had been enhanced since transition to an internet-based refrigerant tracking and accounting system. To determine emissions associated with employee commuting, the Smithsonian conducted a Scope 3 Commuter Survey using the General Services Administration (GSA) Carbon Footprint Tool. The Smithsonian relies on the GSA Travel Management Information Service to report GHG emissions associated with employee business travel.

- In FY 2015 the Smithsonian achieved a 20.8% reduction in Scope 1&2 GHG emissions compared to the FY 2008 baseline and is on track to meet the 40% reduction target established for FY 2025.
- In FY 2015 the Smithsonian achieved an 8.0% reduction in Scope 3 GHG emissions compared to the FY 2008 baseline, and is on track to meet the 20% reduction target established for FY 2025.

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Smithsonian GHG emission reductions are attributable to: decreased use of purchased electricity and steam in the buildings, relative to the 2008 baseline; increased purchasing of green power; decreased use of petroleum in the vehicles and equipment; and recycling, which diverts solid waste from landfill disposal. In 2015 revised composting processes and vendor changes led to a temporary decrease in diversion. We anticipate being on track to improve this metric even with the additional of new building inventory.

Priorities for the year ahead include reducing on-site use of fossil fuel, reducing use of grid-supplied electricity, and employing operations and maintenance best practices.

## **Goal 2: Sustainable Buildings**

### **Smithsonian Environmental Research Center - Mathias Laboratory Building, LEED Platinum certified in FY 2015**

Evaluation of progress is based on energy intensity expressed in British thermal units per gross square foot, and buildings conforming to the Federal Guiding Principles for High Performance and Sustainable Buildings (Guiding Principles).

- FY 2015 energy intensity of Smithsonian goal-subject buildings was 16.9% below the FY 2003 baseline, but fell short of the 30% Federal goal for the year.
- The Smithsonian has not determined that any of its buildings conform to the Guiding Principles, but continues to pursue and achieve LEED® green building certifications.

Energy management accomplishments in FY 2015 includes development and implementation of a variety of conservation measures. One team reached contract award and began implementing \$9.6M in contractor-financed lighting, water, cooling and heating improvements, and an on-site renewable energy system, for facilities in Suitland and Edgewater, Maryland. Current project implementation value is \$12.2M with all aspects expected to conclude by October 2016. Another team developed \$19.9M in contractor-financed lighting, water, cooling and heating improvements, HVAC control upgrades, and an on-site renewable energy system, for facilities in Washington, DC and Front Royal, Virginia.

Sustainable design and LEED certified project criteria are hallmarks of Smithsonian Facilities policy. The Smithsonian is actively working on more than a dozen LEED certified projects receiving LEED-EB: O&M Silver Certification and LEED-NC Platinum Certifications in 2015.

Smithsonian restaurants are serving sustainability in the form of Green Restaurant Association certifications. Smithsonian is working aggressively to maximize waste diversion and recycling content and has implemented strategies to optimize collection cycles and assure compost meets the minimum acceptable criteria set by regional haulers. While these strategies have improved the quality of reported data, Scope 3 GHG emission temporarily increased while new processes were instituted.

The Smithsonian continues efforts to integrate sustainable practices into existing building operations and maintenance. Driving this effort is Smithsonian Institution, Office of Facility Management and Reliability target to training staff on two LEED prerequisites per annum in preparation for additional LEED EB applications. Academic partnership is planned to first assess business processes then develop a roadmap for documenting fulfillment of LEED Building Operations and Maintenance rating system requirements.

### **Goal 3: Clean & Renewable Energy**

Evaluation of progress is based on percentage of electricity from renewable sources.

- In FY 2015, the Smithsonian purchased renewable energy certificates (RECs) equal to 14.3% of electricity used. This surpassed the 7.5% Federal goal for the year.

RECs also supported green power credits in projects pursuing LEED certification. Sources of the certificates included wood and wood residuals in Florida; wind in Wyoming and Texas; and municipal solid waste in Florida. Additionally, 311kW of on-site solar photovoltaic was constructed and operational in FY2015.

Planned actions in the next 12 months include installation of on-site renewable energy, and continuing work with other agencies on renewable energy purchases. The SI will continue to seek goal-level renewable energy percentages in new electricity supply contracts, and will purchase additional renewable energy certificates as needed, when funding allows. Recent electric solicitations found Green-e renewables did not mirror the same 10-year horizon on renewable certificate criteria for Federal Agencies. The expectation is the Green-e will change to meet Federal customer criteria. The energy management department will explore sales of future SRECS generated by the Mathias PV array to purchase a higher amount of RECs. Additionally, the National Museum of African American History and Culture constructed 98kW PV and the Capital Solar Challenge is estimated to construct 352kW PV.

### **Goal 4: Water Use Efficiency & Management**

Evaluation of progress is based on potable water intensity, expressed in gallons per gross square foot of building area.

- In FY 2015 the Smithsonian achieved a 54.6% reduction in potable water intensity compared to the FY 2007 baseline. This already exceeds the Federal 26% reduction goal for FY 2020.

Smithsonian water efficiency successes include application of sub-meters and leak detectors to discover water waste, and water-efficient management of gardens and landscapes. Water intensive operations are a challenge. Heavy water use can occur in museum air-conditioning systems, National Zoo exhibit pools, irrigation and museum water features.

Priority strategies for the next 12 months include purchasing and installing water efficient technologies, developing and deploying operational controls; and designing, installing and maintaining landscapes for reduced water use. Enhanced water treatment systems are being deployed on cooling tower systems to reduce blow-down. This water treatment upgrade will be implemented in FY2016 under a DOE performance contract. Additionally, electronic water level controls will be deployed in cooling towers whereby providing more robust control and minimized waste. In 2016 new water chemistry was piloted in order to maintain higher cycles of concentration whereby reducing blow-down. If successful, this strategy is planned for expansion to other facilities with chiller plant operation.

### **Goal 5: Fleet Management**

Evaluation of progress is based on metrics including petroleum use, alternative fuel use, and counts of conventional and alternate fuel vehicles. The Smithsonian participates in General Services Administration Federal Automotive Statistical Tool (FAST) reporting.

- On the metric of petroleum use in vehicles, the Smithsonian achieved an 80.0% reduction in FY 2015, compared to the FY 2005 baseline. This surpassed the Federal 20% reduction goal for the year and already exceeds the Federal 30% goal for FY 2020.
- E.O. 13693 introduces a new metric of total fleet GHG/mile. The 2017 goal is a 4% reduction against a 2014 baseline. The Smithsonian has achieved a 3.3% reduction for 2015. Planned increases in E85 usage in FY16 will contribute to meeting the 2017 goal.

FY 2014 use of telematics for work in fleet management sustainability was discontinued at the end of the contract term. Telematics linked with the fleet management information system enabling faster response to vehicle problems, more analysis of performance including fuel economy, and better management of the vehicle inventory. The continuance of telematics contract is being explored in FY 16.

Insufficient E85 fueling locations in the national capital region are a barrier to increasing use of this alternate fuel. In 2015, the Smithsonian Institution installed a new E85 tanks at its Paul E. Garber facility in Suitland, MD. Fleet expects a 20% increase in the use of E85 in FY16-17 due to this new fueling facility.

Electric vehicle charging stations are receiving expanded implementation and evoking policy investigations whereby staff may be allowed to utilize this infrastructure. By November 2017 the network of infrastructure for plug-in electric vehicles will span all but (1) facility (HAZY) outside of the National Mall area where the core agency campus resides. At HAZY, capital projects is studying EV charging options for agency, staff and public.

Priorities for the year ahead include reinstating telematics, optimizing and right-sizing composition of the fleet and acquiring only highly fuel efficient and alternate fuel vehicles. For vehicle acquisitions the Smithsonian anticipates using the General Services Administration Customer Acquisition Model system. Vehicle procurement is based on the availability of surplus funds.

## Goal 6: Sustainable Acquisition

The metric for sustainable acquisition progress is percent of contracts complying with Federal green product requirements. Inability of Smithsonian financial systems to identify, track and report sustainable procurements, and to support this metric, has been a barrier.

Order rate of recycled content paper increased from 50% in FY12 to 86% in FY14 Q2, most likely due to changes made to the online ordering system that promote recycled content paper as an ordering option.

Strategies for the next 12 months include updating and deploying procurement policies, and deploying corrective actions to address identified barriers.



Smithsonian organizers and a portion of more than two tons of electronics collected for recycling, Earth Day 2014

## **Goal 7: Pollution Prevention & Waste Reduction**

Evaluation of progress is based on metrics including diversion rate, and weight of materials disposed in thirteen discrete streams of non-hazardous solid waste.

- In FY 2015 the Smithsonian diverted 42.1% of non-hazardous solid waste from landfill disposal, and is on track to maintain the Federal 50% goal. The Smithsonian Recycle Task Force is working to identify opportunities to increase waste diversion. The current diversion rate does not include credit for waste to energy as permitted in new 2016 guidance. SI will maintain at least 50% diversion before accounting for any waste to energy credits.

Increased composting in Smithsonian restaurants is a main contributor to this success. Recycling performance was one of more than 60 criteria met in the process to become a 3 Star Certified Green Restaurant®. Composting operations began at the National Museum of Natural History restaurants in FY 2012.

Key challenges are inadequate space at some museums for sorting, storing and shipping solid waste; and a diverse waste stream.

In April 2014 the Smithsonian replaced and expanded its disposal program for excess electronics. The program now accepts and properly disposes assets including computers and peripherals, televisions, telephones, electric typewriters, digital cameras, toasters, and microwave ovens. Earth Day events for staff at Smithsonian museums featured the new program, and resulted in collection of at least 29,000 pounds of excess electronics during the 2015 Earth Day collection event.

Actions planned for the next 12 months include elimination, reduction and recovery of refrigerants; reducing waste generation, increasing composting participation, improving landscape management, and improving tracking and reporting of construction and demolition waste.

## **Goal 8: Energy Performance Contracts**

The Smithsonian Institution supports the President's directive to implement performance-based contracts for Federal building energy efficiency, and is on track to meet its commitment under this initiative.

In July, 2013, the SI successfully reached order award for an Energy Savings Performance Contract (ESPC) project with total implementation price \$9,556,666. The award fulfilled the SI commitment to the President's Performance Contracting Challenge. The project meets revitalization needs including replacement of the boiler plant at the Museum Support Center in Suitland, MD. It also includes a photovoltaic power system at the Smithsonian Environmental Research Center Mathias Laboratory in Edgewater, MD.

In May 2014, the Smithsonian National Zoo and Conservation Biology Institute began the process of implementing an ESPC. The Investment Grade Audit is complete and award was made in July 2016 with construction start in late FY16. The final award of \$19.9M significantly exceeds SI's \$5 million commitment to phase II of the PPCC.

Planned actions in the next twelve months include reviewing facilities not covered by ESPC projects against future projects to identify new energy performance candidates.



## **Goal 9: Electronic Stewardship & Data Centers**

Evaluation of progress is based on metrics including percentage of eligible products purchased which are EPEAT compliant, percentage of surplus and end-of-life electronics recycled, percentage of power management-enabled computer, and percentage of power management-enabled monitors.

100% of covered electronic products purchased by the SI Office of the Chief Information Officer (OCIO) are EPEAT (Electronic Product Environmental Assessment Tool) registered. OCIO will continue to research and publish recommendations for sustainable IT products. OCIO also continues to include sustainable requirements as part of contract vehicles managed by OCIO.

The FY2015 E-Cycle Campaign collected more than 75,000 pounds of recyclable electronics (Desktops, Laptops, cords and batteries, LCD Monitors, Printers, and MSC Electronic Equipment) from museums participating in electronic turn in/disposal. All excess IT components and non-working electronics are disposed of through an R2 recycler. Working electronics are sent to GSA for reutilization in other Government agencies. E-Cycle Campaign will continue annually in conjunction with Earth Day events to promote the recycling and proper disposal methods of all excess property.

100% of covered electronic products purchased by SI/OCIO are Federal Energy Management Program-designated and Energy Star qualified. SI employs power management software called NightWatchman on desktop computers and monitors. This software ensures computers transition to a low energy state when not being used. The FY2016 goal is 85% compliance with Windows machines and to extend monitor control to 90% of MAC machines.

Successful practices in Smithsonian electronics stewardship include designation of EPEAT compliant equipment on the preferred products list, deployment of power management software with setting managed through user authentication, and a hardware recovery program which returns credit towards future equipment purchases.

Priorities for the next 12 months include ensuring that additional power management options are enabled; updating procedures for disposition compliance; and implementing new guidelines for purchasing EPEAT-compliant equipment. Sustainable features of electronic devices will be promoted to SI staff.

**Data Center** - Smithsonian OCIO implemented a server virtualization architecture in late 2011 and continues to promote the migration of physical servers to a virtual platform. FY2015 PUE increased slightly to 1.90, up from 1.86. According to Energy Star Portfolio Manager average PUE is 1.821 (July 2013). Energy intensity has improved from FY2014 to FY2015 decreasing 458kBtu /sqft to 435.7kBtu/sqft. Priorities for the next 12 months include Research, test, and implement solution(s) to optimize current server virtualization architecture to support more virtualization efforts.

## **Goal 10: Climate Change Resilience**

For over 165 years the Smithsonian has been carrying out a wide-ranging agenda of scientific and cultural research. Smithsonian research helps produce data for understanding natural adaptive processes, the ways we can build resilience into the human-adapted ecosystems; and the needs of systems in change. Commitments to climate change research, mitigation and adaptation are integral to the Smithsonian mission and also to the current Smithsonian strategic plan.

The development of Smithsonian's first Climate Change Adaptation Plan (CCAP) is complete. This collaborative effort is steered by the Climate Change Adaptation Committee, a body co-chaired by OFEO Director Nancy Bechtol and SERC Deputy Director Pat Megonigal. The group includes scientists, cultural heritage protection experts, engineers, architects, planners, landscape professionals and social scientists from OUSS, OUSHAC, OFMR, OPDC, OPS, NZP, OBATS and OP+A.

The impacts of climate change are highly localized and will be experienced differently at different Smithsonian facilities and locations. Because of this, the Committee has decided to take an incremental approach. The first CCAP is Phase 1 aims to address the following initial goals:

- Identify climate change-related flood risks to two key geographical areas of Smithsonian operations—the National Mall and the Rock Creek campus of the National Zoological Park (herein the Zoo)—and consider how those risks may evolve as a result of climate change.
- Identify high-priority measures for mitigating flood risks and increasing resilience on the Mall and at the Zoo.
- Develop a framework for evaluating, prioritizing, and addressing climate change-related flood risks that can be applied to other Smithsonian properties.
- Provide guidance on increasing the Smithsonian’s adaptive capacity to climate change-related flood threats.
- Identify data gaps where additional research and modeling are needed to understand climate change-related risks to Smithsonian assets and operations, and how these risks may evolve.
- Develop strategies for implementing adaptation measures moving forward.

The strategies outlined in this document suggest initial steps toward systematically integrating climate change adaptation measures into planning, decision making, and policy, as well as some near-term mitigation measures. Given the gaps in existing data and the uncertainty about the magnitude of climate change impacts, the Smithsonian has adopted an adaptive management approach. Phase 1 strategies are expected to evolve as new information becomes available and as the effectiveness of initial strategies is evaluated.

Phase 1 Strategies are divided amongst 5 categories which aim to:

- Raise Awareness: expand Smithsonian workforce’s awareness of this evolving threat and incorporate their awareness into their thinking, decisions, and actions at all levels.
- Adapt: minimize the risks associated with climate change to Smithsonian assets.
- Enhance Sustainability: reduce Smithsonian’s greenhouse gas emissions.
- Enhance Smithsonian Climate Change Adaptation Governance: develop policies and organizational support structures to better leverage existing and future efforts across the Institution.
- Enhance Partnerships: maintain and expand collaboration with external organizations

In this first phase of climate change adaptation, the Smithsonian will prioritize strategies for implementation based on the following factors:

- Importance (with higher impact strategies given higher priority).
- Timeframe of the underlying threat (with nearer term threats given higher priority).
- Resource requirements (with strategies that can be implemented without significant additional resources given higher priority).
- Potential to raise awareness.
- Potential to incorporate into facilities master plans, capital projects, and ongoing maintenance.



Severe flooding in downtown Washington, DC led to as much as 4 inches of water in the west wing basement of the National Museum of Natural History; adaptation actions included addition of a new 80,000 gallon storm water vault designed to hold and release metered excess runoff during extreme storms.

## **PROGRESS ON ADMINISTRATION PRIORITIES**

### **President's Performance Contracting Challenge**

Smithsonian Institution exceeded its 2016 commitment to the President's Performance Contracting Challenge. The final award of \$19.9M significantly exceeded SI's \$5 million commitment to phase II of the PPCC. Planned actions in the next twelve months include reviewing facilities not covered by ESPC projects against future projects to identify new energy performance candidates.

### **Electric and Zero Emission Vehicles**

Priorities for the year ahead include optimizing and right-sizing composition of the fleet and acquiring only highly fuel efficient and alternate fuel vehicles. For vehicle acquisitions the Smithsonian anticipates using the General Services Administration Customer Acquisition Model system. Vehicle procurement is based on the availability of surplus funds.

Electric vehicle charging stations are receiving expanded implementation and evoking policy investigations whereby staff may be allowed to utilize this infrastructure. By November 2017 the network of infrastructure for plug-in electric vehicles will span all but (1) facility (HAZY) outside of the National Mall area where the core agency campus resides. At HAZY, capital projects is studying EV charging options for agency, staff and public.

### **Climate Preparedness and Resilience**

Smithsonian completed its first Climate Change Adaptation Plan (CCAP). An incremental approach was utilized to address localized impacts of climate change. Amongst the Phase 1, CCAP goals are identifying climate change-related flood risks at two key geographical areas of Smithsonian operations—the National Mall and the Rock Creek campus of the National Zoological Park. The strategies outlined in this document suggest initial steps toward systematically integrating climate change adaptation measures into planning, decision making, and policy, as well as some near-term mitigation measures. Phase 1 strategies are expected to evolve as new information becomes available and as the effectiveness of initial strategies is evaluated.

## Size & Scope of Agency Operations

<b>Agency Size and Scope</b>	<b>FY 2014</b>	<b>FY 2015</b>
Total Number of Employees as Reported in the President's Budget	5,779	5,867
Total Acres of Land Managed	42,993	42,993
Total Number of Buildings Owned	559	555
Total Number of Buildings Leased (GSA and Non-GSA Lease)	26	23
Total Building Gross Square Feet (GSF)	12,537,382	12,498,240
Operates in Number of Locations Throughout U.S.	19	20
Operates in Number of Locations Outside of U.S.	13	13
Total Number of Fleet Vehicles Owned	362	369
Total Number of Fleet Vehicles Leased	22	22
Total Number of Exempted-Fleet Vehicles (Tactical, Law Enforcement, Emergency, Etc.)	0	0
Total Amount Contracts Awarded as Reported in FPDS (\$Millions)	283,013,024	

## **Agency Progress and Strategies to Meet Federal Sustainability Goals**

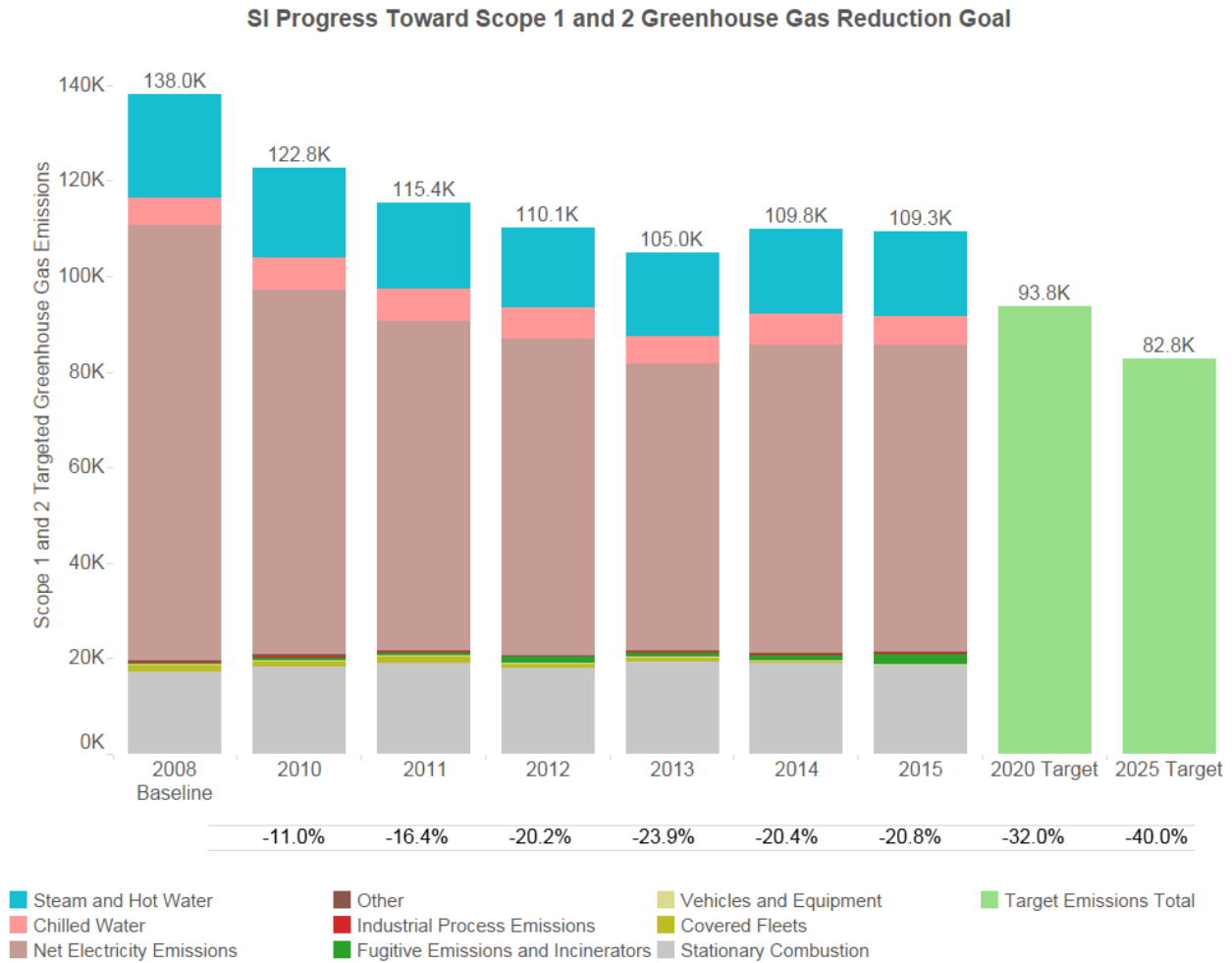
This section provides an overview of progress through FY 2015 on sustainability goals contained in Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, and agency strategies to meet the new and updated goals established by Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*.

# Goal 1: Greenhouse Gas (GHG) Reduction

## Scope 1 & 2 GHG Reduction Goal

E.O. 13693 requires each agency to establish a Scope 1 & 2 GHG emissions reduction target to be achieved by FY 2025 compared to a 2008 baseline. The Smithsonian Institution’s 2025 Scope 1 & 2 GHG reduction target is 40%.

### Chart: Progress Toward Scope 1 & 2 GHG Reduction Goal



The reduction of Scope 1 and 2 GHG has a synergistic relationship with ongoing energy efficiency projects and Renewable Energy Credit (REC) purchasing. The rise in 2014 and 2015 GHG is a direct result of the reduced REC purchase. In previous years a larger budget surplus was available to increase REC purchases. Electricity savings will have the largest lasting impact to Scope 1 and 2 reductions without increasing the budget for REC purchases. Undoubtedly a combination of energy projects and REC purchases will be required to meet future goals. When financially appropriate PPA’s will be contemplated as a means to reduce net electric emissions.

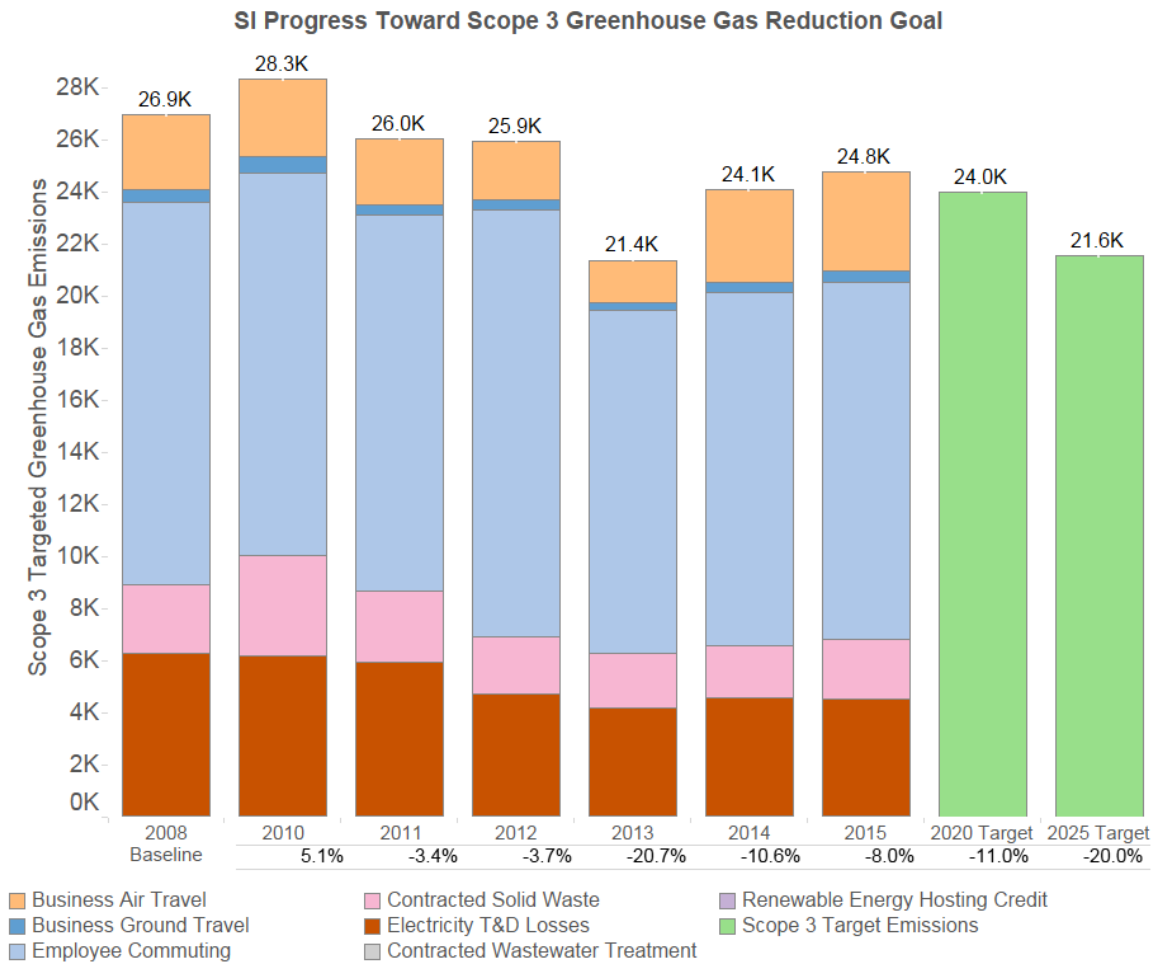
## Scope 1 & 2 GHG Reduction Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Use the Federal Energy Management Program (FEMP) GHG emission report to identify/target high emission categories and implement specific actions to address high emission areas identified.	YES	Continue to evaluate Scope 1&2 and Scope 3 progress toward 2025 goals.	Target 3% year over year improvement Scope 1&2.
Identify and support management practices or training programs that encourage employee engagement in addressing GHG reduction.	YES	SI will evaluate various plug load reduction strategies through employee pilot programs	Complete Pilot of space heater program by Q2 FY17. Develop new approved list of heaters and SOP for requesting space heaters.
Determine unsuccessful programs or measures to be discontinued to better allocate agency resources.	N/A	Resources are allocated to the most effective programs.	
Given agency performance to date, determine whether current agency GHG target should be revised to a more aggressive/ambitious target.	NO	Energy performance to date has been limited to 1-2% reduction per year and increasing our GHG target would result in poor performance	
Employ operations and management (O&M) best practices for emission generating and energy consuming equipment.	YES	Use building retuning to optimized building controls for energy savings.	July FY16 training start. Semi-annual retraining/refresh.
Explore options to increase renewable energy credit purchasing	YES	Identify budget amount of RECs to meet goals over the next 3 years. Explore all options including the sale of SRECs for a REC swap.	Complete first estimate with the next utility budget submission
Identify additional sources of data or analysis with the potential to support GHG reduction goals.	N/A	Resources are allocated to the most effective programs.	

### Scope 3 GHG Reduction Goal

E.O. 13693 requires each agency to establish a Scope 3 GHG emission reduction target to be achieved by FY 2025 compared to a 2008 baseline. The Smithsonian Institution’s 2025 Scope 3 GHG reduction target is 20%.

**Chart: Progress Toward Scope 3 GHG Reduction Goal**



The Smithsonian continues to seek opportunities for reduced scope 3 GHG emissions by conducting an annual commuter survey and reviewing results. Smithsonian primary business operations take place in the Washington, DC metro area with many alternative commuting options available to staff. In 2017, Smithsonian will promote the commuter survey to improve participation resulting in accurate representation of employee commuting.



### Scope 3 GHG Reduction Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Reduce employee business ground travel.	N/A	Resources are allocated to the most effective programs.	
Reduce employee business air travel.	N/A	Resources are allocated to the most effective programs. Training requests are screened for locally available sources.	
Develop and deploy an employee commuter emissions reduction plan.	N/A	Resources are allocated to the most effective programs. Telework and Alternative Work Schedules are currently exercised where possible.	
Use an employee commuting survey to identify opportunities and strategies for reducing commuter emissions.	Yes	Increase participation plan of survey	FY2017 Issue email notices to both: Under Secretary for Finance & Administration/Chief Financial Officer, and Under Secretary for Museums & Research/Provost requesting each office to promote awareness at town hall meetings.
Increase & track number of employees eligible for telework and/or the total number of days teleworked.	N/A	Telework and Alternative Work Schedules are currently exercised where possible.	
Develop and implement a program to support alternative/zero emissions commuting methods and provide necessary infrastructure.	NO	Commuter Bicycle Reimbursement Program is already in place.	
Establish policies and programs to facilitate workplace charging for employee electric vehicles.	NO	There are currently not sufficient resources to perform this work in FY2017. Until the Fleet Manager vacancy is filled, this would have to be driven from outside offices.	

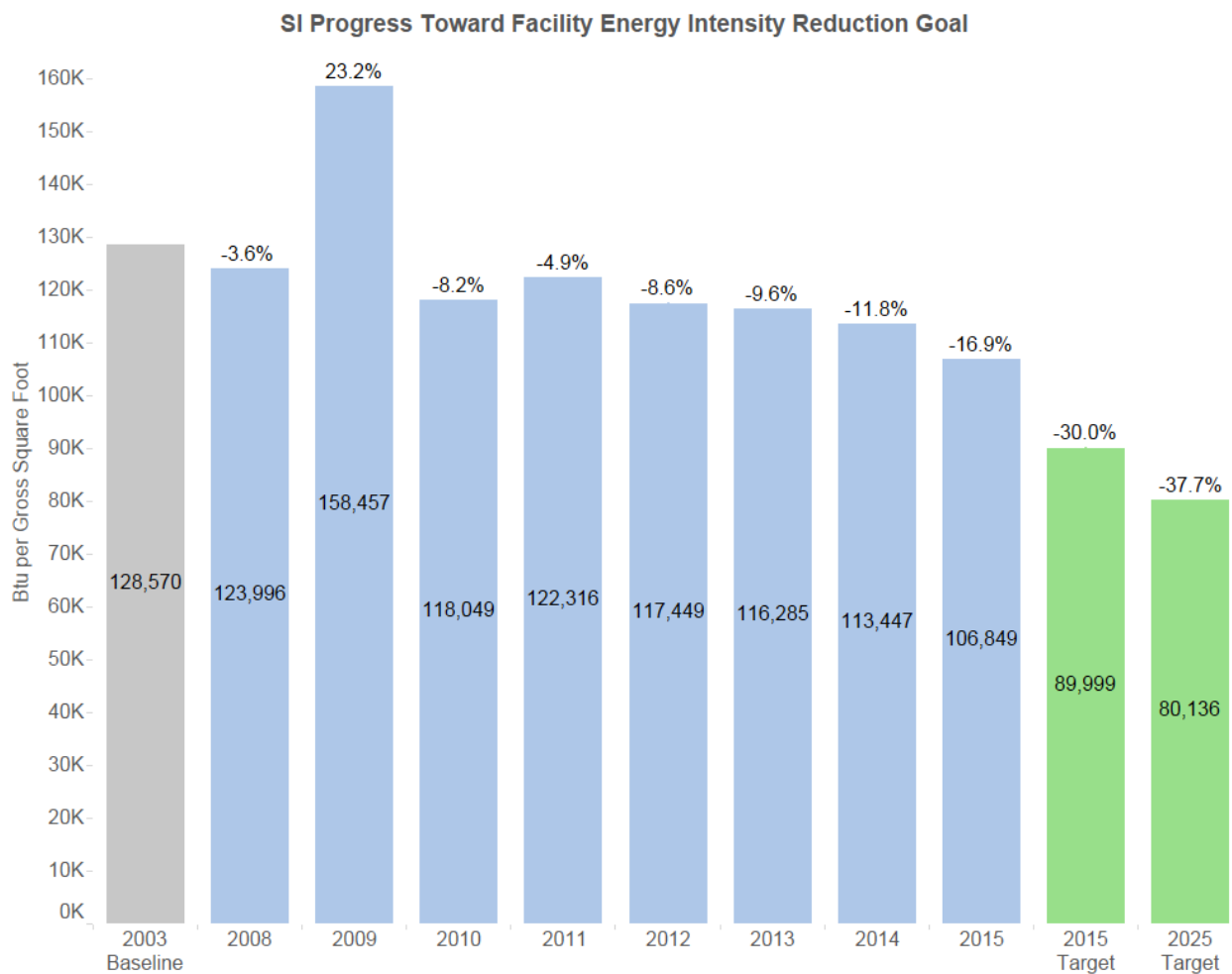
<b>Strategy</b>	<b>Priority for FY 2017</b>	<b>Strategy Narrative</b>	<b>Targets and Metrics</b>
<p>Include requirements for building lessor disclosure of carbon emission or energy consumption data and report Scope 3 GHG emissions for leases over 10,000 rentable square feet.</p>	<p>NO</p>	<p>SI Real Estate office is aware of the new requirement and will be incorporating language into new lease agreements or renewals where cost effective. Smart meter upgrades have been implemented where requested by the utility provider.</p>	

## Goal 2: Sustainable Buildings

### Building Energy Conservation Goal

The Energy Independence and Security Act of 2007 (EISA) requires each agency to reduce energy intensity 30% by FY 2015 as compared to FY 2003 baseline. Section 3(a) of E.O. 13693 requires agencies to promote building energy conservation, efficiency, and management and reduce building energy intensity by 2.5% annually through the end of FY 2025, relative to a FY 2015 baseline and taking into account agency progress to date, except where revised pursuant to Section 9(f) of E.O. 13693.

### Chart: Progress Toward Facility Energy Intensity Reduction Goal



Improved Geospatial property accounting and new building inventory of over 400,000 GSF increased FY2015 goal subject gross area by 550,000 SF. Excluding new building inventory, FY2015 energy intensity would have been approximately unchanged from FY2014..

## Building Energy Conservation Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Make energy efficiency investments in agency buildings.	Yes	Annually Energy Management updates a project list and solicits funding from either budget surplus, revenue generated from incentive programs, or unfunded requests.	Unfunded requests are submitted in Q3. Budget surplus and access to funding received as incentives are requests by Q4. Metrics are any implementation of any energy conservation measure.
Use remote building energy performance assessment auditing technology	Yes	Remote building energy audits are more effective when preceded by a Level 2 ASHRAE audit conducted by a professional engineer.	Retro commission and Level 2 ASHRAE audit of 664k SF out of 783k SF property Q3 FY 2017.
Participate in demand management programs.	NO	SI is currently enrolled in DR programs. Collaborate with building engineers to ensure demand response procedures are documented and staff trained where not programmed for automatic control.	Meet enrollment levels at each building registered in demand response program.
Incorporate Green Button data access system into reporting, data analytics, and automation processes.	NO	Once upgraded EnergyCAP will have capability to import data from utilities and sub-metering. It's our understanding that this is a fee based add-on service of EnergyCAP so it is not a priority in FY2017. It could be prioritized as advanced metering and dashboards are developed.	
Redesign interior space to reduce energy use through daylighting, space optimization, and sensors and control systems.	YES	NASM Office design	Multi-year funding is required to realize this strategy. FY2017 target is to promote this strategy in all design documents and LEED application.
Identify opportunities to transition test-bed technologies to achieve energy reduction goals.	NO	Museum and collection spaces are more risk adverse than an office building.	

<b>Strategy</b>	<b>Priority for FY 2017</b>	<b>Strategy Narrative</b>	<b>Targets and Metrics</b>
Follow city energy performance benchmarking and reporting requirements.	NO	SI follows city requirements for benchmarking	
Install and monitor energy meters and sub-meters.	NO	Financial constraints prevent expanding current meter and sub-meter programs. Implementation of sub-meters is included in capital construction and major renovation where feasible.	
Collect and utilize building and facility energy use data to improve building energy management and performance.	NO	Quarterly energy data is supplied to all building managers and reviewed in leadership meetings.	
Ensure that monthly performance data is entered into the EPA ENERGY STAR Portfolio Manager.	YES	EnergyCAP upgrade will restore ENERGY STAR Portfolio Manager capability.	FY2017 upgrade to EnergyCAP Web-Client version.

## **Building Efficiency, Performance, and Management Goal**

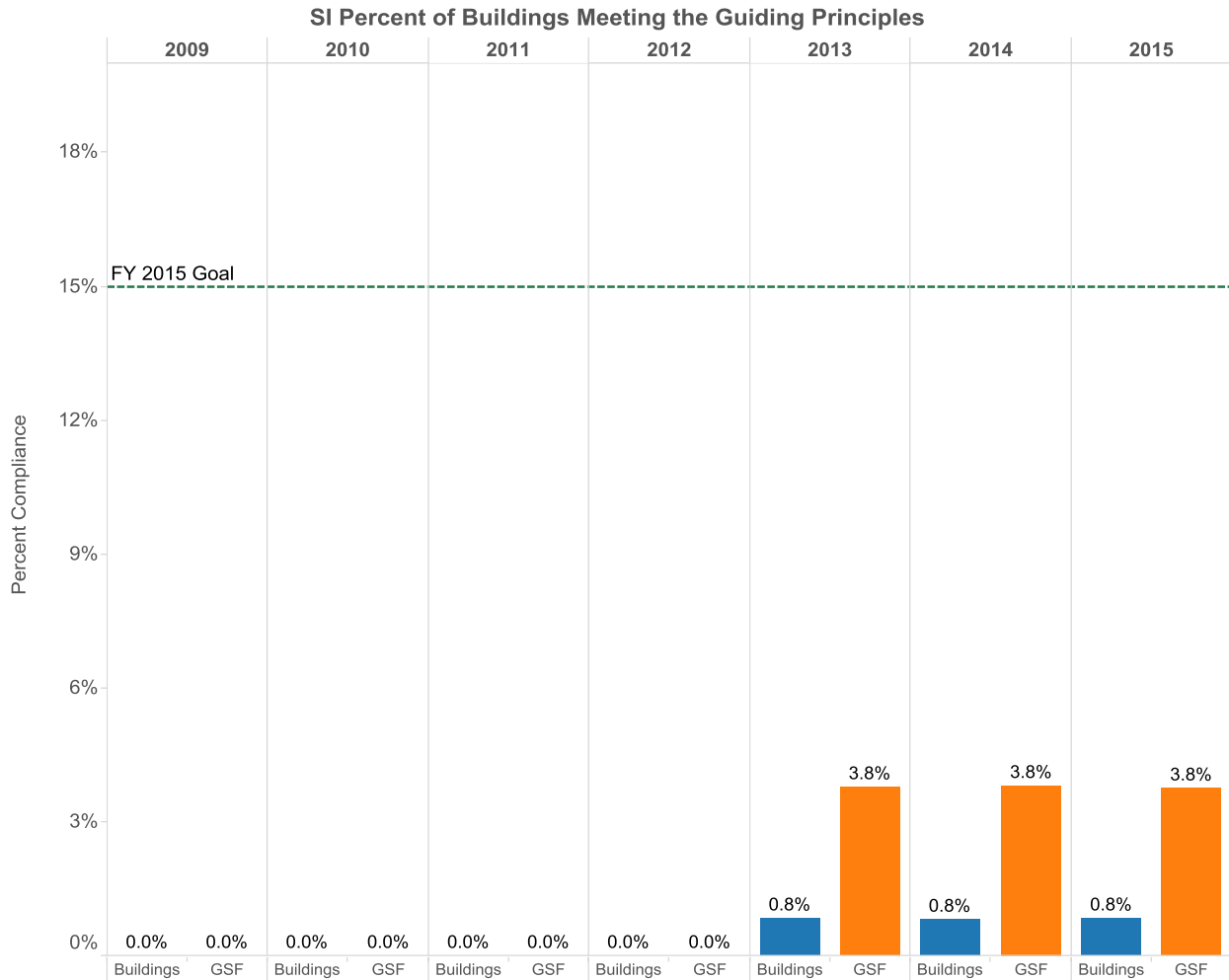
Section 3(h) of E.O. 13693 states that agencies will improve building efficiency, performance, and management and requires that agencies identify a percentage of existing buildings above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY 2025 and implementing actions that will allow those buildings to meet that target. Smithsonian Institution's 2025 target is 0.00%. Due to the utility of Smithsonian building inventory it is unlikely that many buildings will be able to meet net-zero criteria without substantial master planning and/or renovation scope. There are several buildings which could be net-zero candidates in one or more category, however these opportunity diminish as the building gross square-foot increases.

## **Guiding Principles for Sustainable Federal Buildings**

Section 3(h) of E.O. 13693 also states that agencies will identify a percentage, by number or total GSF, of existing buildings above 5,000 GSF that will comply with the *Guiding Principles for Sustainable Federal Buildings (Guiding Principles)* by FY 2025.

The Smithsonian Institution's FY 2025 target is 0.8% of 118 buildings or 3.8% by total GSF. At the present time, only deep retrofits and new, capital construction are likely to contribute to improvement of target levels. We anticipate LEED rating categories may satisfy some Guiding Principles and it is not known which categories will be sought until designs commence.

## Chart: Percent of Buildings Meeting the Guiding Principles



Evaluation of progress is based on energy intensity expressed in British thermal units per gross square foot, and buildings conforming to the Federal Guiding Principles for High Performance and Sustainable Buildings (Guiding Principles). The Smithsonian has not determined that any of its buildings conform to the Guiding Principles, but continues to pursue and achieve LEED® green building certifications. At one time in our annual GHG reporting cycle LEED was allowed as a proxy for compliance with the Guiding Principles. While this is no longer the case, this data point is 1 of 118 building assets determining SI percent of buildings meeting the Guiding Principles as 0.8% or 3.8% Gross Square Feet. The particular building reported in this metric is NMAI.

## Sustainable Buildings Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Include climate resilient design and management into the operation, repair, and renovation of existing agency buildings and the design of new buildings.	YES	FRed is our agency Facility Requirements Database. Disseminating information regarding our FY2016 Climate Change Adaptation Plan and Vulnerability Assessment.	The balance of FY2016 and FY2017 will be spend informing constituents
In planning new facilities or leases, include cost-effective strategies to optimize sustainable space utilization and consideration of existing community transportation planning and infrastructure, including access to public transit.	NO	New facilities require LEED certification which would account for this strategy. There are no significant lease changes in FY17	
Ensure all new construction of Federal buildings greater than 5,000 GSF that enters the planning process be designed to achieve energy net-zero and, where feasible, water or waste net-zero by FY 2030.	YES	Update Smithsonian Sustainability Requirements related to Design and Construction to match 2016 Guiding Principles for Sustainable Federal Buildings and Associated Instructions.	Update Appendix A of Smithsonian Institution Facilities Design Standards.
Include criteria for energy efficiency as a performance specification or source selection evaluation factor in all new agency lease solicitations over 10,000 rentable square feet.	NO	SI Real Estate office is aware of the new requirement and will be incorporating language into new lease agreements or renewals where cost effective. Smart meter upgrades have been implemented where requested by the utility provider.	
Incorporate green building specifications into all new construction, modernization, and major renovation projects.	YES	Incorporate green building specifications and apply sustainable operations and maintenance practices.	Update Smithsonian Institution Facilities Design Standards in the next 12 months
Implement space utilization and optimization practices and policies.	NO	Master planning efforts are already being performed.	



<b>Strategy</b>	<b>Priority for FY 2017</b>	<b>Strategy Narrative</b>	<b>Targets and Metrics</b>
Implement programs on occupant health and well-being in accordance with the <i>Guiding Principles</i> .	NO	Occupant health and wellness areas already exist such as: indoor air quality, accessibility of staircases, fitness facilities, bicycle commuter facilities, and healthy dining options.	

### Goal 3: Clean & Renewable Energy

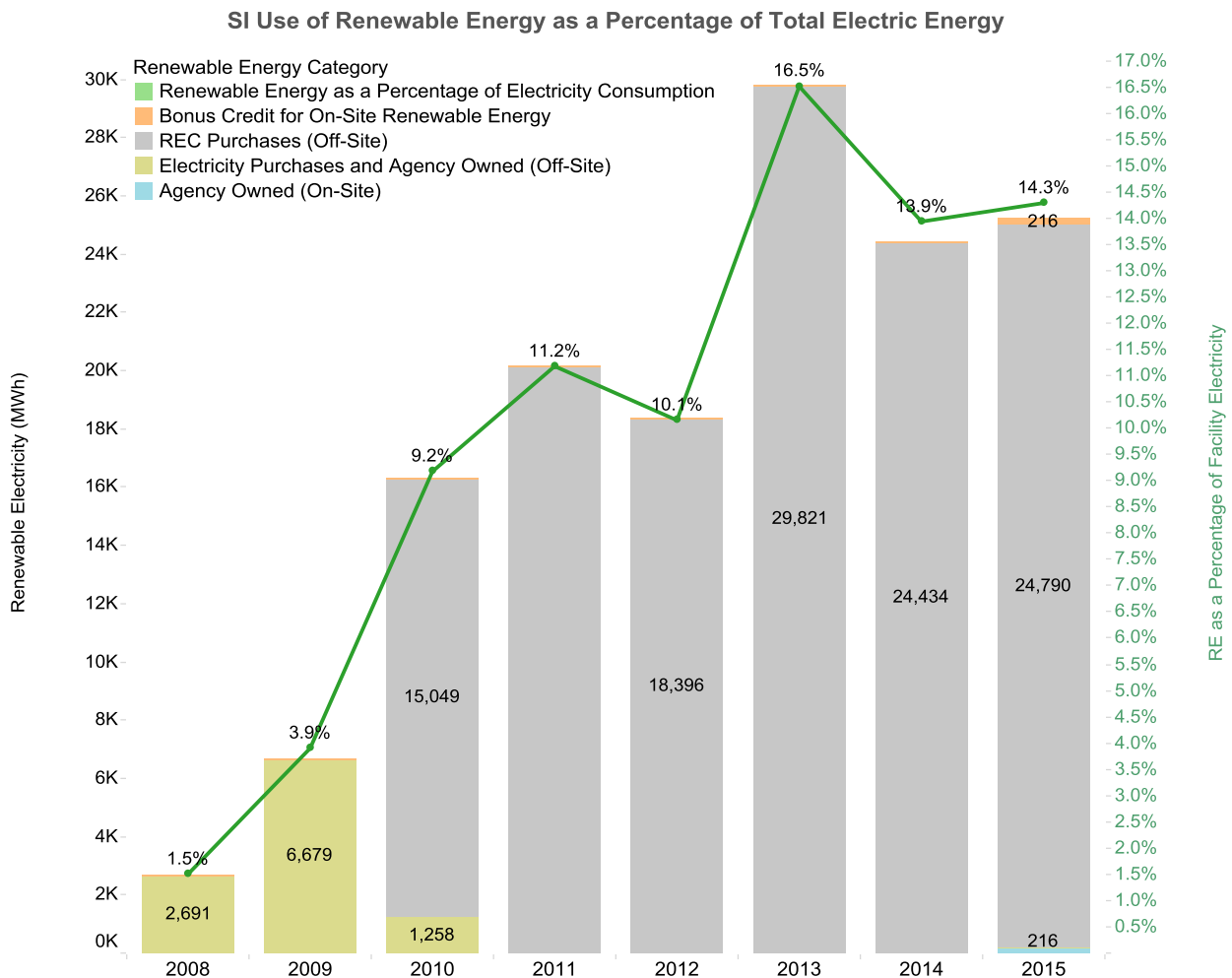
#### Clean Energy Goal

E.O. 13693 Section 3(b) requires that, at a minimum, the percentage of an Agencies total electric and thermal energy accounted for by renewable and alternative energy shall be not less than: 10% in FY 2016-17; 13% in FY 2018-19; 16% in FY 2020-21; 20% in FY 2022-23; and 25% by FY 2025.

#### Renewable Electric Energy Goal

E.O. 13693 Section 3(c) requires that renewable energy account for not less than 10% of total electric energy consumed by an agency in FY 2016-17; 15% in FY 2018-19; 20% in FY 2020-21; 25% in FY 2022-23; and 30% by 2025.

#### Chart: Use of Renewable Energy as a Percentage of Total Electric Energy



In FY 2015, the Smithsonian purchased renewable energy certificates (RECs) equal to 14.3% of electricity used. This surpassed the 7.5% Federal goal for the year.

## Clean and Renewable Energy Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Install agency-funded renewable on-site and retain corresponding renewable energy certificates (RECs).	YES	<p>The new National Museum of African American History and Culture NMAAHC will open in Sept 16 and includes 90KW of Agency Owned solar.</p> <p>The Zoo ESPC currently includes Solar PV.</p> <p>It is likely that SI will pursue the sale of SRECs to increase the budget for purchase of RECS.</p>	<p>Take ownership of NMAAHC PV and begin tracking output.</p> <p>Complete Task Order Award for Zoo ESPC and begin construction of PV array- FY17</p>
Contract for the purchase of energy that includes installation of renewable energy on or off-site and retain RECs or obtain replacement RECs.	YES	<p>SI is participating in the Capital Solar Challenge PPA which will include solar PV on 3 buildings. SI will use existing REC purchase to replace the SRECs sold.</p> <p>Pursue PPA's where cost effective.</p>	PPA for CSC starts in early Q2 of FY17.
Purchase electricity and corresponding RECs or obtain equal value replacement RECs.	YES	The current GSA NCR Electricity purchase includes RECs.	Target for contract award is Q4 FY2016.
Purchase RECs to supplement installations and purchases of renewable energy, when needed to achieve renewable goals.	YES	SI will increase purchase of RECs as required to meet goals and when surplus funding permits.	As required and funding permits.
Install on-site thermal renewable energy and retain corresponding renewable attributes or obtain equal value replacement RECs.	NO	Thermal solar offsetting natural gas is not cost effective. PV will be prioritized over solar thermal due to reduced maintenance.	
Install on-site combined heat and power processes.	NO	Not feasible based on current rate environment	

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Identify opportunities to install on-site fuel cell energy systems.	NO	Available fuel cells are sensitive to injections of propane and butane used by the local gas utilities. Will continue to review for cost effective strategies.	
Identify opportunities to utilize energy that includes the active capture and storage of carbon dioxide emissions associated with energy generation.	N/A	There are no regional CCS plants or projects in development.	
Identify and analyze opportunities to install or contract for energy installed on current or formerly contaminated lands, landfills, and mine sites.	NO	Contracting authority is limited to 10-years and there is no agency precedent for such activity.	
Identify opportunities to utilize energy from small modular nuclear reactor technologies.	N/A	SI believes the location of our primary facilities make obtaining regulatory approval impossible. The capacity of one reactor would power a significant fraction of our facilities	

## **Goal 4: Water Use Efficiency & Management**

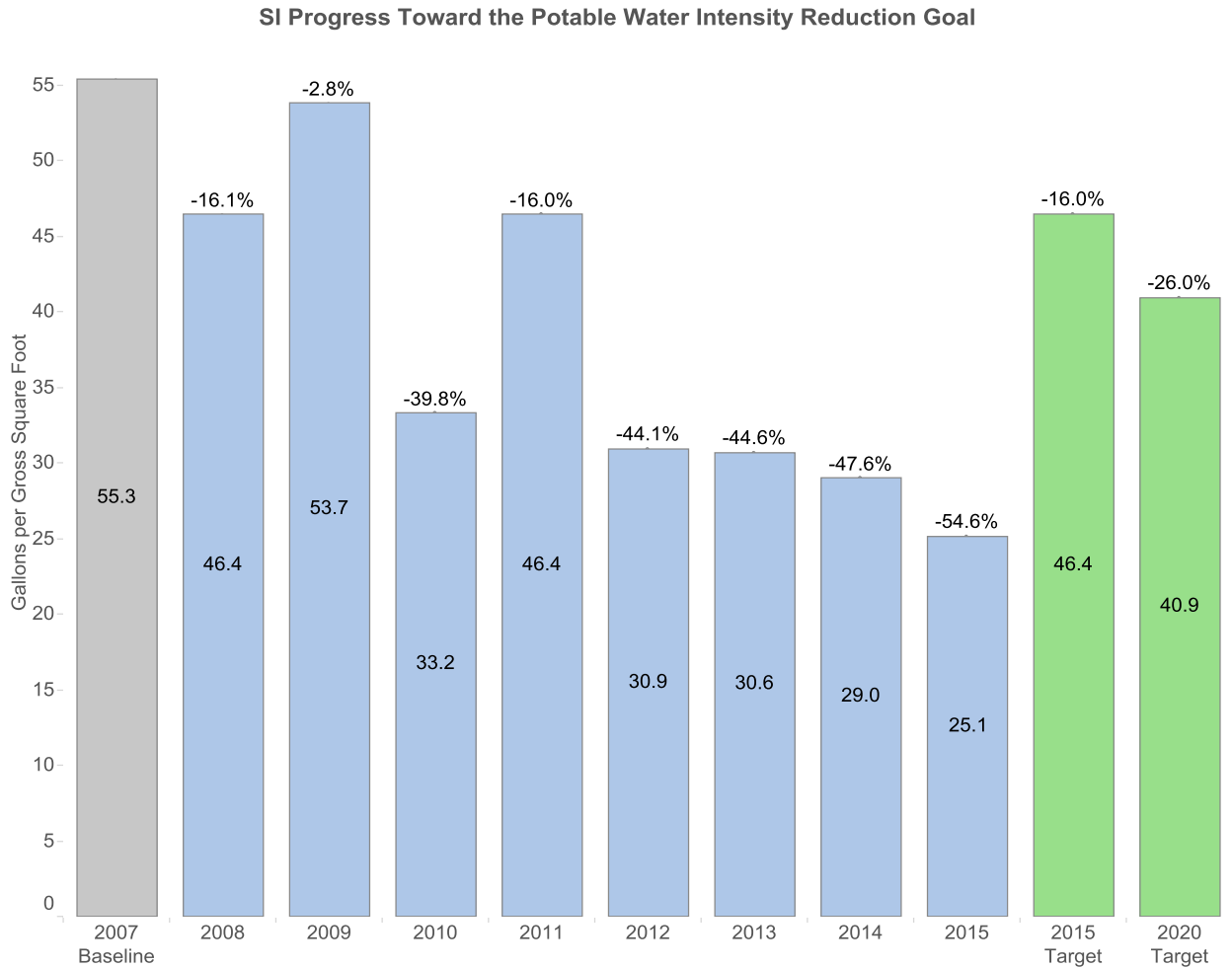
### **Potable Water Consumption Intensity Goal**

E.O. 13693 Section 3(f) states that agencies must improve water use efficiency and management, including stormwater management, and requires agencies to reduce potable water consumption intensity, measured in gallons per square foot, by 2% annually through FY 2025 relative to an FY 2007 baseline. A 36% reduction is required by FY 2025.

### **Industrial, Landscaping and Agricultural (ILA) Water Goal**

E.O. 13693 section 3(f) also requires that agencies reduce ILA water consumption, measured in gallons, by 2% annually through FY 2025 relative to a FY 2010 baseline.

## Chart: Progress Toward the Potable Water Intensity Reduction Goal



In FY 2015 the Smithsonian achieved a 54.6% reduction in potable water intensity compared to the FY 2007 baseline. NZP is the largest consumer of all SI accounts and success in exceeding potable water reduction goals are largely attributed to capital projects at NZP. Other water efficiency successes include application of sub-meters and leak detectors to discover water waste, and water-efficient management of gardens and landscapes. Water intensive operations are a challenge. Heavy water use can occur in museum air-conditioning systems, National Zoo exhibit pools, irrigation and museum water features.

## Water Use Efficiency & Management Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Install green infrastructure features to assist with storm and wastewater management.	NO	The District Stormwater regulations require stormwater volume retention on all major construction projects.	
Install and monitor water meters and utilize data to advance water conservation and management.	YES	Performance contracts will utilize water meters to promote conservation and management where feasible.	As opportunity for performance contracts are available.
Install high efficiency technologies, e.g. WaterSense fixtures.	YES	Appendix A of Smithsonian Institution Facilities Design Standards is intended as a tool to aid sustainability reviews of Smithsonian design and construction projects.	WaterSense fixtures are anticipated at NZP no later than Q4 FY2017 and NMAI in Q4 FY2016
Prepare and implement a water asset management plan to maintain desired level of service at lowest life cycle cost.	NO	Resources are allocated to the most effective programs.	
Minimize outdoor water use and use alternative water sources as much as possible.	YES	While a rainwater capture system is planned for Greenhouse operations and existing irrigation meters provide, advanced control, Smithsonian Gardens curates living collections.	Award contract for rainwater capture system in Q2 FY17
Design and deploy water closed-loop, capture, recharge, and/or reclamation systems.	NO	Resources are allocated to the most effective programs. This strategy requires broad institutional policy/guidance to compete with lower first cost of equipment and other sustainable practices.	

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Install advanced meters to measure and monitor potable and ILA water use.	NO	Once upgraded EnergyCAP will have capability to import data from utilities and sub-metering. It's our understanding that this is a fee based add-on service of EnergyCAP so it is not a priority in FY2017. It could be prioritized as advanced metering and dashboards are developed.	
Develop and implement programs to educate employees about methods to minimize water use.	NO	While employees receive sustainability newsletters, resources are allocated to the most effective programs.	
Assess the interconnections and dependencies of energy and water on agency operations, particularly climate change's effects on water which may impact energy use.	NO	Climate Change Adaptation Plan and Vulnerability Assessment has only focused on flood risk of particular regions.	
Consistent with State law, maximize use of grey-water and water reuse systems that reduce potable and ILA water consumption.	YES	Compliance with state laws will be maintained.	As required.
Consistent with State law, identify opportunities for aquifer storage and recovery to ensure consistent water supply availability.	YES	Compliance with state laws will be maintained, however, resources are allocated to the most effective programs.	As required.
Ensure that planned energy efficiency improvements consider associated opportunities for water conservation.	YES	Energy conservation measures will seek capture associated water conservation opportunity where feasible.	As opportunity are identified.
Where appropriate, identify and implement regional and local drought management and preparedness strategies that reduce agency water consumption	N/A	Climate Change Adaptation Plan and Vulnerability Assessment has only focused on flood risk of particular regions.	

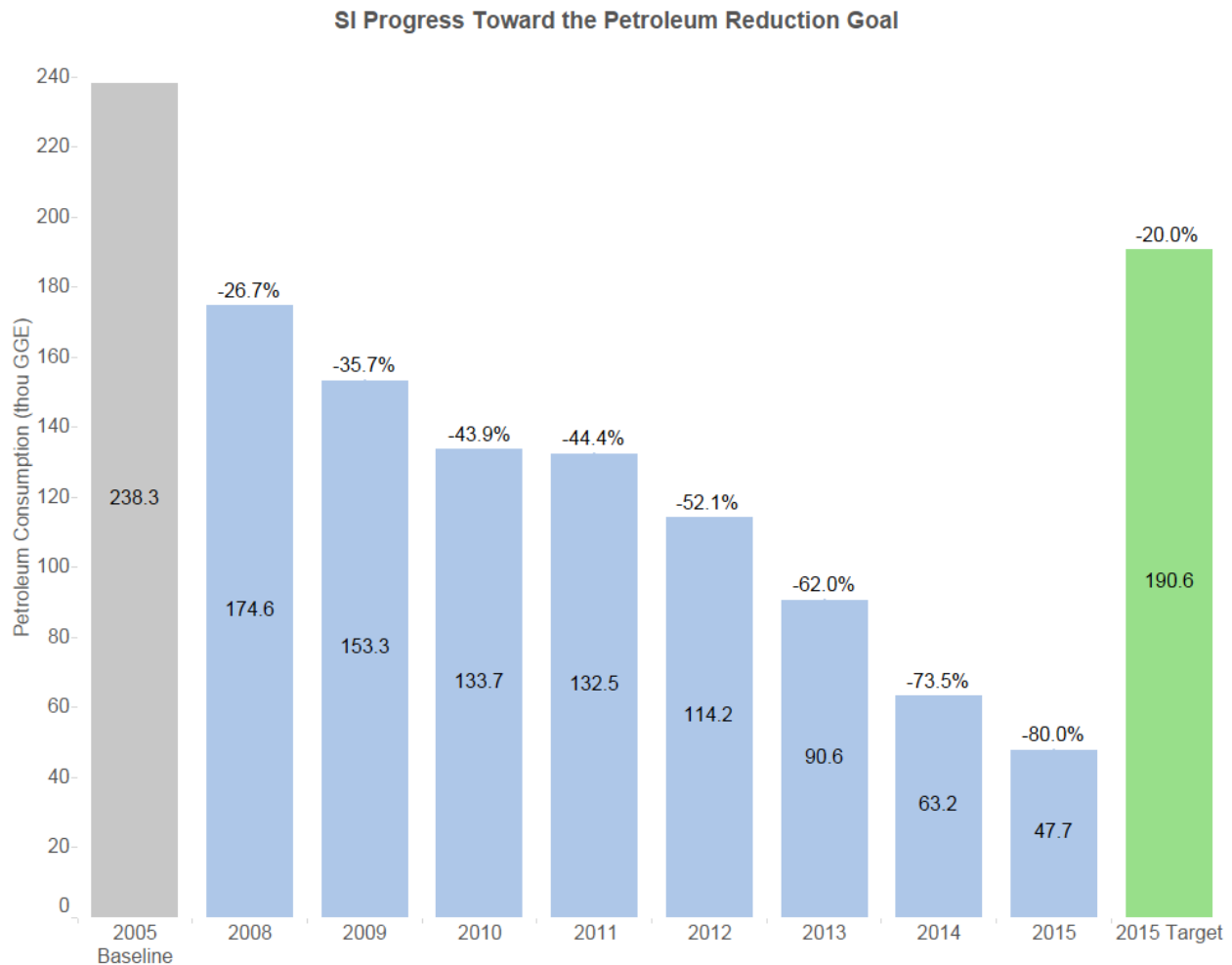


## Goal 5: Fleet Management

### Fleet Petroleum Use Reduction Goal

E.O. 13514 and the Energy Independence and Security Act of 2007 (EISA) required that by FY 2015 agencies reduce fleet petroleum use by 20% compared to a FY 2005 baseline.

#### Chart: Progress Toward the Petroleum Reduction Goal



### Fleet Alternative Fuel Consumption Goal

Agencies should have exceeded an alternative fuel use that is at least 5% of total fuel use. In addition, E.O. 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, required that agencies increase total alternative fuel consumption by 10% annually from the prior year starting in FY 2005. By FY 2015, agencies must have increased alternative fuel use by 159.4%, relative to FY 2005.

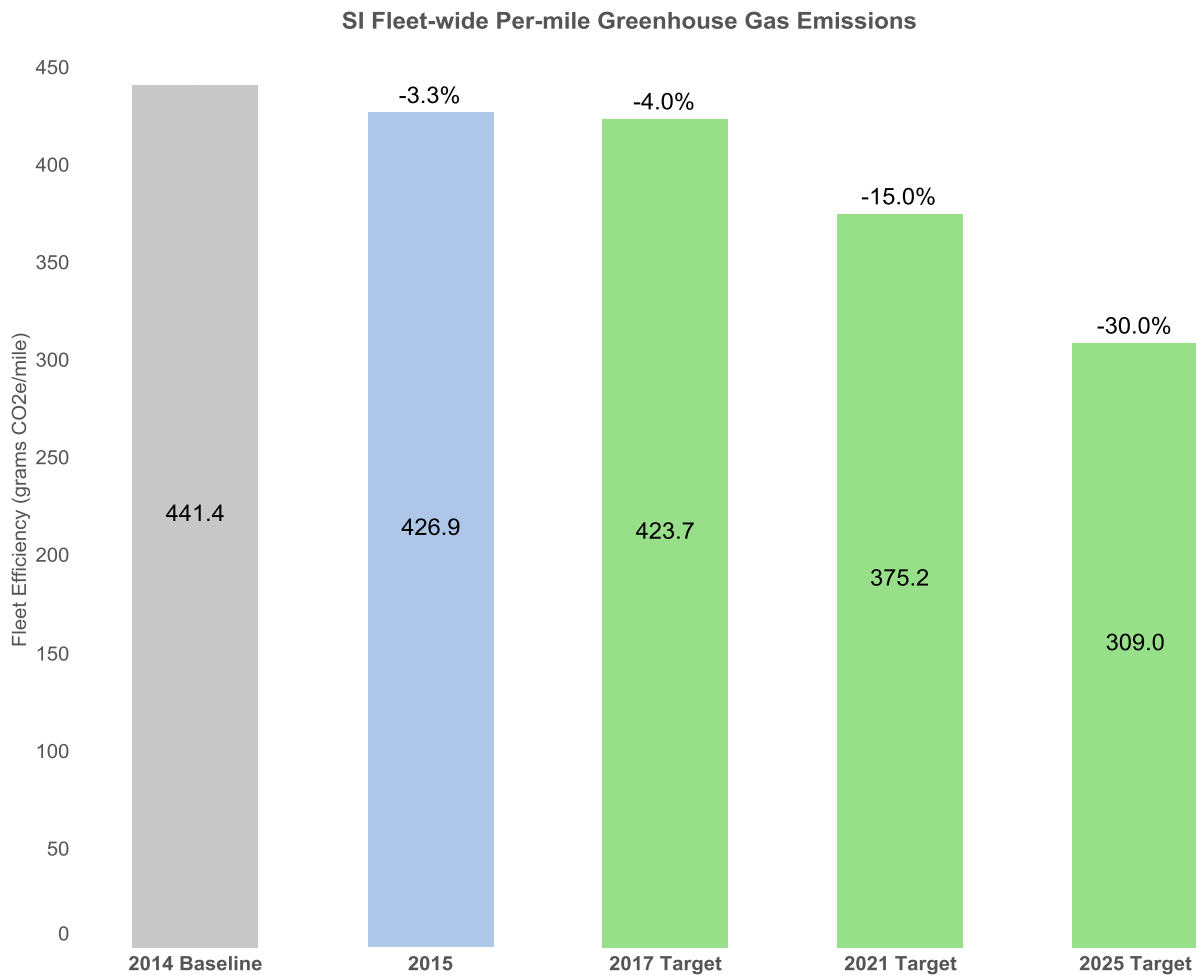
In FY 2015, Smithsonian's use of alternative fuel equaled 38% of total fuel use. Smithsonian has increased its alternative fuel use by 374% since FY 2005.

## Fleet Per-Mile Greenhouse Gas (GHG) Emissions Goal

E.O. 13693 Section 3(g) states that agencies with a fleet of at least 20 motor vehicles will improve fleet and vehicle efficiency and management. E.O. 13693 section 3(g)(ii) requires agencies to reduce fleet-wide per-mile GHG emissions from agency fleet vehicles relative to a FY 2014 baseline and sets new goals for percentage reductions: not less than 4% by FY 2017; not less than 15 % by FY 2020; and not less than 30% by FY 2025.

E.O. 13693 Section 3(g)(i) requires that agencies determine the optimum fleet inventory, emphasizing eliminating unnecessary or non-essential vehicles. The Fleet Management Plan and Vehicle Allocation Methodology (VAM) Report are included as appendices to this plan.

### Chart: Fleet-wide Per-mile GHG Emissions



When excess funds are available Fleet Management purchases replacement vehicles with zero or low emissions as a priority. The new E85 fueling station is expected to increase alternative fuel use by up to 20% in FY17. This will also reduce the GHGe/mile.

## Fleet Management Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Collect and utilize agency fleet operational data through deployment of vehicle telematics.	YES	We plan to deploy telematics in approximately 80% of all assigned light duty trucks and passenger carrying vehicles. The remainders of vehicles in this category or higher are used primarily as campus-type assets.	Procure vehicle telematics system/devices by December 2016.  Complete installation of telematics devices by September 2017.
Ensure that agency annual asset-level fleet data is properly and accurately accounted for in a formal Fleet Management Information System as well as submitted to the Federal Automotive Statistical Tool reporting database, the Federal Motor Vehicle Registration System, and the Fleet Sustainability Dashboard (FLEETDASH) system.	YES	Comprehensive review of existing FMIS and internal processes is ongoing to improve and/or ensure data accuracy across reporting systems.	Anticipate FMIS and associated internal reviews to be completed by February 2017.
Increase acquisitions of zero emission and plug-in hybrid vehicles.	NO	With no dedicated vehicle replacement fund, at present the Fleet Manager relies on non-reliable surplus funds to purchase vehicles. With that said, if funds become available it is priority to acquire zero emission and plug-in hybrid vehicles.	
Issue agency policy and a plan to install appropriate charging or refueling infrastructure for zero emission or plug-in hybrid vehicles and opportunities for ancillary services to support vehicle-to-grid technology.	YES	SI's plans to install EV charging stations at all SI locations stalled due to the loss of Fleet Manager. Upon onboarding of new Fleet Manager, we anticipate aggressive action to move this initiative forward.	By November 2017 installation of charging stations will be completed at the following SI locations Edgewater, MD, NZP in D.C., and SCBI in Front Royal, VA.
Optimize and right-size fleet composition, by reducing vehicle size, eliminating underutilized vehicles, and acquiring and locating vehicles to match local fuel infrastructure.	NO	The practice of optimizing the fleet will always be ongoing, however SI already has structure and policy in place that drives maintaining an optimized fleet.	

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Increase utilization of alternative fuel in dual-fuel vehicles.	YES	In FY2016, Smithsonian completed installation of fueling site which includes an E85 tank/dispenser. As a means to force usage of E-85 with Flex-fuel vehicles that utilize the site, fueling keys are being programmed to access E-85 fuel only.	Anticipate at least 20% increased usage of E-85 by September 2017.
Use a FMIS to track real-time fuel consumption throughout the year for agency-owned, GSA-leased, and commercially-leased vehicles.	NO	Awaiting onboarding of new Fleet Manager to lead this initiative.	
Implement vehicle idle mitigation technologies.	NO	Awaiting onboarding of new Fleet Manager to lead this initiative.	
Minimize use of law enforcement exemptions by implementing GSA Bulletin FMR B-33, <i>Motor Vehicle Management, Alternative Fuel Vehicle Guidance for Law Enforcement and Emergency Vehicle Fleets</i> .	NO	SI has only (1) LE packaged vehicle in the fleet and it is an AFV. Internal structure is already in place to avoid exemptions by procuring AFVs.	
Where State vehicle or fleet technology or fueling infrastructure policies are in place, meet minimum requirements.	NO	This strategy is not a priority because SI maintains an ongoing practice of meeting minimum requirements.	
Establish policy/plan to reduce miles traveled, e.g. through vehicle sharing, improving routing with telematics, eliminating trips, improving scheduling, and using shuttles, etc.	YES	As most SI vehicle travel is on-site and/or local area, miles traveled is not an agency wide priority for reduction. Additionally, we already have a very effective shuttle program in place. In FY 17, we will focus on standing up a "Vehicle Sharing Program".	By September 2016 identify & prioritize IT requirement FMIS modification. By October 2017 have FMIS modifications completed. December 2017 implement Vehicle Sharing Program.

## **Goal 6: Sustainable Acquisition**

### **Sustainable Acquisition Goal**

E.O. 13693 section 3(i) requires agencies to promote sustainable acquisition by ensuring that environmental performance and sustainability factors are considered to the maximum extent practicable for all applicable procurements in the planning, award and execution phases of acquisition.

### **Biobased Purchasing Targets**

The Agricultural Act of 2014 requires that agencies establish a targeted biobased-only procurement requirement. E.O. 13693 section 3(iv) requires agencies to establish an annual target for increasing the number of contracts to be awarded with BioPreferred and biobased criteria and the dollar value of BioPreferred and biobased products to be delivered and reported under those contracts in the following fiscal year.

For FY 2017, Smithsonian Institution has not established a target of contracts and dollar value in products to be delivered. Sustainable acquisition strategies identified as priority are noted in the following table.

## Sustainable Acquisition Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Establish and implement policies to meet statutory mandates requiring purchasing preference for recycled content products, ENERGY STAR qualified and FEMP-designated products, and Biopreferred and biobased products designated by USDA.	YES	(1) Implement a spend analytics process that will increase knowledge on goods commonly purchased across SI that may be sustainable-sourced products, and prioritize order of products for strategic sourcing.	(1) Verify internal procurement system interface with a contracted spend analytics firm's system facilitates determinations of what/when/frequency of goods and commodities are commonly required across SI organizations. (Oct 2016)
Establish and implement policies to purchase sustainable products and services identified by EPA programs, including SNAP, WaterSense, Safer Choice, and Smart Way.	YES	(2) Establish policy on breadth of sustainable procurements at SI and update procurement procedures and staff and buyer education programs consistent with the policy.	(2) Implement scheduled procurement analyses, including determination of goods for which sustainable procurement should apply. (Nov 2016) (3) Address necessary procurement policy and procedures revisions and begin implementing
Establish and implement policies to purchase environmentally preferable products and services that meet or exceed specifications, standards, or labels recommended by EPA.	YES	(3) Where possible, increase number of SI-wide Blanket Purchase Agreements and Contracts for goods identified to be viable for sustainable procurement processes.	sustainable procurement procedures to degree (Feb 2017)
Reduce copier and printing paper use and acquiring uncoated printing and writing paper containing at least 30 percent postconsumer recycled content or higher.	YES	(4) Continue to promote use of copier and print paper that is at least 30% recycled content.	
Improve quality of data and tracking of sustainable acquisition through the Federal Procurement Data System (FPDS).	NO	SI will seek additional guidance on this strategy but will not prioritize.	
Incorporate compliance with contract sustainability requirements into procedures for monitoring contractor past performance and report on contractor compliance in performance reviews.	NO	Not a priority at this time	
Review and update agency specifications to include and encourage products that meet sustainable acquisition criteria.	YES		

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Identify opportunities to reduce supply chain emissions and incorporate criteria or contractor requirements into procurements.	NO	SI is exempt from supply chain reporting.	

## Goal 7: Pollution Prevention & Waste Reduction

### Pollution Prevention & Waste Reduction Goal

E.O. 13693 section 3(j) requires that Federal agencies advance waste prevention and pollution prevention and to annually divert at least 50% of non-hazardous construction and demolition debris. Section 3(j)(ii) further requires agencies to divert at least 50% of non-hazardous solid waste, including food and compostable material, and to pursue opportunities for net-zero waste or additional diversion.

Reporting on progress toward the waste diversion goal will begin with annual data for FY 2016.

### Pollution Prevention & Waste Reduction Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Report in accordance with the requirements of sections 301 through 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (42 U.S.C 11001-11023).	YES	Review existing reporting requirements at all facilities	Ensure safety coordinators are submitting annual reports as required in Q2.
Reduce or minimize the quantity of toxic and hazardous chemicals acquired, used, or disposed of, particularly where such reduction will assist the agency in pursuing agency greenhouse gas reduction targets.	YES	Identify toxic and hazardous chemical used and determine if alternatives exist	Update and maintain list of toxic and hazardous chemical use.
Eliminate, reduce, or recover refrigerants and other fugitive emissions.	YES	Use SIs existing refrigerant tracking system to update current inventory and maintain log of use and recovery	Retrain pertinent staff on use of the existing tracking system
Reduce waste generation through elimination, source reduction, and recycling.	YES	Use spot waste audits and full waste audits to identify areas for improvement in waste diversion and recycling.	Conduct at least one spot audit per quarter and 1 full building waste audit in FY17
Implement integrated pest management and improved landscape management practices to reduce and eliminate the use of toxic and hazardous chemicals and materials.	NO	IPM process already in place.	
Develop or revise Agency Chemicals Inventory Plans and identify and deploy chemical elimination, substitution, and/or management opportunities.	NO	Updating these plans is an annual process as needed.	



Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Inventory current HFC use and purchases.	YES	Tracking system is in place. We will address retraining for existing and new staff in other strategies. All contractors are required to report HFC use and recovery from SI equipment.	Audit 25% of inventory for accuracy
Require high-level waiver or contract approval for any agency use of HFCs.	NO	Resources are allocated to the most effective programs. Global Warming Potential of HFCs requires broad institutional policy/guidance to compete with lower first cost of equipment.	
Ensure HFC management training and recycling equipment are available.	YES	Staff turn-over requires retraining on our current refrigerant tracking system. Add refrigerant training module to environmental training SharePoint	Confirm training needs and complete additional training by end of Q2FY 17

## **Goal 8: Energy Performance Contracts**

### **Performance Contracting Goal**

E.O. 13693 section 3(k) requires that agencies implement performance contracts for Federal buildings. E.O. 13693 section 3(k)(iii) also requires that agencies provide annual agency targets for performance contracting. The Smithsonian Institution's commitment under the President's Performance Contracting Challenge is \$15 Million in contracts awarded by the end of calendar year 2016. The Smithsonian Institution's targets for the next two fiscal years are:

FY 2017: \$ 0

FY 2018: \$ 20 M

The Smithsonian Institution has successfully awarded \$11.0M in contracts and plans to award approximated \$20.0M additional toward the President's Performance Contracting Challenge when the National Zoo contract is awarded near the end of June 2016. The current projects either in the performance period, under construction or due for award cover over 6 major facilities and the entire Zoo site. SI's capacity to award additional projects is limited due to saturation of available facilities and limited staff resources. For this reason SI will not seek additional projects for award in FY17. Based on estimated additional energy project scope, SI estimates \$20 M for FY 2018. SI is also exploring the use of performance contracting for major renovations involving deep energy retrofits.

**Chart: Progress Toward Target under the President’s Performance Contracting Challenge**



Smithsonian will meet the full PPCC commitment by July of 2016 when the Zoo ESPC is awarded. We anticipate \$16M in additional pipeline due to the actual award amount. Schedule and availability of target buildings will limit additional contract awards in FY17. FY17 will be spent identifying target buildings and developing scope for projected \$20 M toward the end of FY18. The next project may focus on deep energy retrofit combined with facilities capital improvements.

## Performance Contracting Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Utilize performance contracting to meet identified energy efficiency and management goals while deploying life-cycle cost effective energy and clean energy technology and water conservation measures.	YES	Complete Construction of the ZOO ESPC and begin M&V.  Identify possible scope for project award in FY18	Complete RFP for 2018 ESPC by Mid FY17  Down select contractor by End FY17
Fulfill existing agency target/ commitments towards the PPCC by the end of CY16.	YES	Award Zoo Contract of ~\$20.0M by end of June 2016	\$15 M target met by July 2016
Evaluate 25% of The Smithsonian Institution's most energy intensive buildings for opportunities to use ESPCs/UESCs to achieve goals.	YES	Explore the remaining building stock not under current ESPC contracts to identify opportunities	Create brief review of opportunities by Q1 FY17
Prioritize top ten portfolio wide projects which will provide greatest energy savings potential.	NO	Already Using this strategy,	
Identify and commit to include onsite renewable energy projects in a percentage of energy performance contracts.	YES	All projects include onsite renewable where appropriate. Explore more cost effective PPA arrangement where financially feasible.	Award zoo contract with Solar PV
Submit proposals for technical or financial assistance to FEMP and/or use FEMP resources to improve performance contracting program.	NO	No assistance is required for ESPC program.	
Work with FEMP/USACE to cut cycle time of performance contracting process, targeting a minimum 25% reduction.	NO	Quantity of remaining available buildings does not require acceleration	
Ensure agency legal and procurement staff are trained by the FEMP ESPC/UESC course curriculum.	NO	Current staff is familiar with ESPC/UESC process	

## **Goal 9: Electronics Stewardship & Data Centers**

### **Electronics Stewardship Goals**

E.O. 13693 Section 3(l) requires that agencies promote electronics stewardship, including procurement preference for environmentally sustainable electronic products; establishing and implementing policies to enable power management, duplex printing, and other energy efficient or environmentally sustainable features on all eligible agency electronic products; and employing environmentally sound practices with respect to the Smithsonian Institution's disposition of all agency excess or surplus electronic products.

### **Agency Progress in Meeting Electronics Stewardship Goals**

#### **Procurement Goal:**

At least 95% of monitors, PCs, and laptops acquired meets environmentally sustainable electronics criteria (EPEAT registered).

FY 2015 Progress: 99.9%

#### **Power Management Goal:**

100% of computers, laptops, and monitors has power management features enabled.

FY 2015 Progress: 100% of equipment has power management enabled.  
0% of equipment has been exempted.

#### **End-of-Life Goal:**

100% of electronics disposed using environmentally sound methods, including GSA Xcess, Computers for Learning, Unicor, U.S. Postal Service Blue Earth Recycling Program, or Certified Recycler (R2 or E-Stewards).

FY 2015 Progress: 100%

### **Data Center Efficiency Goal**

E.O. 13693 Section 3(a) states that agencies must improve data center efficiency at agency facilities, and requires that agencies establish a power usage effectiveness target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers.

## Electronics Stewardship Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Use government-wide strategic sourcing vehicles to ensure procurement of equipment that meets sustainable electronics criteria.	YES	OCIO will continue to research and publish recommendations for sustainable IT products. OCIO also continues to include sustainable requirements as part of contract vehicles managed by OCIO.	Issue to SI community an annual update to list of recommended printers will include highlights of sustainable features and best practices for sustainability.  Quarterly updates to IT Buying Guide on Intranet will include section on sustainability for each product category.
Enable and maintain power management on all eligible electronics; measure and report compliance.	YES	OCIO implemented NightWatchman, a power management tool for desktops, in 2010, and continues to employ this strategy for reducing power consumption outside of business hours. Through the Periodic Desktop Hardware Replacement Program, OCIO continues to adopt new standards for more sustainable equipment. In FY17, OCIO will begin implementing policies on Macintosh computers to put monitors into sleep mode after a period of inactivity.	Review and consolidate current NightWatchman power management policies to reduce exemptions.  85% of Windows desktops are using NightWatchman for power management.  NightWatchman is being upgraded to support Windows 10.  90% of Macintosh monitor will enter into sleep mode after 15 minutes of inactivity.

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
<p>Ensure environmentally sound disposition of all agency excess and surplus electronics, consistent with Federal policies on disposal of electronic assets, and measure and report compliance.</p>	<p>YES</p>	<p>(OCON&amp;PPM FY15 goals)</p> <p>All excess IT components and non-working electronics are disposed of through an R2 recycler. Working electronics are sent to GSA for reutilization in other Government agencies.</p> <p>The Smithsonian ensures environmentally sound disposal practices through the use of an R2 compliant recycler. The SI encourages the disposal of excess property and provides recommended disposal methods during the annual Earth Day Events. Scrap metals are segregated and disposed of through a scrap metal vendor for recycling. Proceeds obtained fund sustainability initiatives SI wide</p>	<p>(OCON&amp;PPM FY 15 goals)</p> <p>Continue GSA annual EOY reporting.</p> <p>Investigate options for measuring sound practices.</p> <p>Continue to explore creative options to repurpose scrap material into useful products such as the Banners to Bags initiative.</p> <p>Continue annual Earth Day events to promote the recycling and proper disposal methods of all excess property.</p> <p>Continue to explore alternative methods of disposal to include CFL and disposal through USPS.</p>
<p>Improve tracking and reporting systems for electronics stewardship requirements through the lifecycle: acquisition and procurement, operations and maintenance, and end-of-life management.</p>			

## Data Center Efficiency Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Develop, issue and implement policies, procedures and guidance for data center energy optimization, efficiency, and performance.	N/A	Smithsonian already has a single consolidated Data Center in Herndon, VA	
Install and monitor advanced energy meters in all data centers (by fiscal year 2018) and actively manage energy and power usage effectiveness.	YES	Smithsonian Facilities will initiate planning with OCIO to prioritize installation of advanced energy meters in the Herndon Data Center	Smithsonian Facilities will install wireless energy meters in the Herndon Data Center by the end of FY 2018 for electrical feeds run directly from panels in electrical room. PDUs, RPPs, and CRACs units will be monitored using a Data Center Infrastructure Management (DCIM) tool.
Minimize total cost of ownership in data center and cloud computing operations.	YES	Compare on-premise Smithsonian enterprise email environment TCO with a cloud hosted solution	Migrate Smithsonian email environment to a cloud hosted environment if TCO is less than upgrading the current on-premise solution by the end of FY17.
Identify, consolidate and migrate obsolete, underutilized agency computer servers or move applications to cloud providers.	YES	Office of the Chief Information Office (OCIO) will replace obsolete equipment through routine equipment refresh cycles and leverage virtualization technologies to ensure the maximum practical utilization of IT resources	OCIO will surplus 80% of obsolete end-of-life equipment by September 30, 2017.
Improve data center temperature and air-flow management to capture energy savings.	YES	Smithsonian Facilities will procure and install additional cold aisle containment barriers to ensure that cool air is directed to computer systems. In addition, SF will review current under floor airflow tiles to ensure efficiency.	Smithsonian Facilities will procure additional containment doors for IDF1/2 and IDF4/5 by the end of FY17. The Herndon Data Center engineer will perform a review of under floor airflow by the end of FY17.
Assign certified Data Center Energy Practitioner(s) to manage core data center(s).	YES	Smithsonian Facilities will ensure staff supporting the Herndon Data Center are trained in Data Center Energy Efficiency.	Enroll two staff member in the Data Center Energy Practitioner (DCEP) training program by the end of FY17



Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Comply with new Data Center Optimization Initiative (DCOI) to consolidate inefficient infrastructure, optimize existing facilities, achieve cost savings, and transition to more efficient infrastructure, such as cloud services and inter-agency shared services.	YES	Implement Data Center Infrastructure Management (DCIM) tool for automated monitoring and operations by the end of FY17.	OCIO will implement DCIM tool by the end of FY17. This project includes conducting a 100% inventory of all equipment in the data center and establish monitoring for all PDUs, RPPs, CRACs, and a subset of racked PDUs by the end of FY17.

## Goal 10: Climate Change Resilience

E.O. 13653, *Preparing the United States for the Impacts of Climate Change*, outlines Federal agency responsibilities in the areas of supporting climate resilient investment; managing lands and waters for climate preparedness and resilience; providing information, data and tools for climate change preparedness and resilience; and planning.

E.O. 13693 Section 3(h)(viii) states that as part of building efficiency, performance, and management, agencies should incorporate climate-resilient design and management elements into the operation, repair, and renovation of existing agency buildings and the design of new agency buildings. In addition, Section 13(a) requires agencies to identify and address projected impacts of climate change on **mission critical** water, energy, communication, and transportation demands and consider those climate impacts in operational preparedness planning for major agency facilities and operations. Section 13(b) requires agencies to calculate the potential cost and risk to mission associated with agency operations that do not take into account such information and consider that cost in agency decision-making.

## Climate Change Resilience Strategies

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
<p>Strengthen agency <i>external</i> mission, programs, policies and operations (including grants, loans, technical assistance, etc.) to incentivize planning for, and addressing the impacts of, climate change.</p>	<p>N/A</p>	<p>The Institution does not offer grants/loans/technical assistance but does support short-term (up to one year) fellowships granted through a competitive proposal process. Many of the successful proposals fund Fellows with interests in climate change which they explore through research in science, history and art.</p>	
<p>Update and strengthen agency <i>internal</i> mission, programs, policies, and operations to align with the Guiding Principles, including facility acquisition, planning, design, training, and asset management processes, to incentivize planning for and addressing the impacts of climate change.</p>	<p>NO</p>	<p>Alignment with the Guiding Principles has not been the focus of CCAP-Phase 1. Strategies for enhanced governance include:</p> <ol style="list-style-type: none"> <li>1) Creating appropriate policies at the Institutional level is an important step toward rationalizing and focusing climate change adaptation measures.</li> <li>2) Assigning formal organizational responsibilities for guiding and supporting climate change adaptation efforts will increase efficiency and effectiveness</li> </ol>	

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Update emergency response, health, and safety procedures and protocols to account for projected climate change, including extreme weather events.	YES	<ol style="list-style-type: none"> <li>1) Review current extreme weather emergency operations procedures with internal SI units to identify deficiencies.</li> <li>2) Assessing flood vulnerabilities associated with climate change to SI properties along the National Mall and at the National Zoo and communicate vulnerabilities to raise awareness regarding current and future vulnerabilities.</li> <li>3) Update extreme weather emergency response procedures to account for vulnerabilities</li> <li>4) Conduct training to review updated emergency response procedures for extreme weather events.</li> </ol>	<ol style="list-style-type: none"> <li>1) Complete plans review for extreme weather event plans with all SI facilities within the U.S. by June 2017</li> <li>2) Extreme weather vulnerability assessment to be finalized by February 2017 and training for SI units along the National Mall and at the National Zoo to be complete by August 2017</li> <li>3) Complete extreme weather Emergency Operations Procedures (EOPs) for units along the National Mall and at the National Zoo by April 2017</li> <li>4) Conduct training on extreme weather EOPs for facilities along the National Mall and at the National Zoo by December 2017</li> </ol>
Ensure climate change adaptation is integrated into both agency-wide and regional planning efforts, in coordination with other Federal agencies as well as state and local partners, Tribal governments, and private stakeholders.	YES	Strengthen partnerships in collaborative efforts to develop and review climate change science	<ol style="list-style-type: none"> <li>1) Continue to engage with the D.C. Silver Jackets and through NCPC Climate Workshops to identify studies that represent the best available climate science for the region.</li> <li>2) Develop a database to track and collect relevant climate change science for regions in which SI has a physical presence.</li> </ol>

Strategy	Priority for FY 2017	Strategy Narrative	Targets and Metrics
Ensure that vulnerable populations potentially impacted by climate change are engaged in agency processes to identify measures addressing relevant climate change impacts.	YES	Current vulnerability assessments focused on flood related risks to the National Mall and National Zoo. The Institution intends to expand climate change flood vulnerability assessments to additional properties.	Collect localized climate change information for Smithsonian properties within Maryland, DC and Virginia. (September 2017)
Identify interagency climate tools and platforms used in updating agency programs and policies to encourage or require planning for, and addressing the impacts of, climate change.	YES	Climate Change Adaption Plan calls for a phased approach which requires interagency collaboration to integrate plan findings into the appropriate tool.	Currently being adopted into the master plans for NMAI and NMAH, expected completion FY2018. Integrating requirements into the Smithsonian Facility Requirements Database.

## **Appendix A: Smithsonian 2016 Climate Change Adaptation Plan, Phase 1**

# Smithsonian Climate Change Adaptation Plan, Phase 1

CLIMATE CHANGE ADAPTATION PLAN WORKING GROUP  
SMITHSONIAN INSTITUTION, JUNE 30, 2016

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## Introduction

*Scientific evidence has demonstrated that the global climate is warming as a result of increasing levels of atmospheric greenhouse gases generated by human activities.*

*...We live in what has come to be called the Anthropocene, or “The Age of Humans.” The Smithsonian is committed to helping our society make the wise choices needed to ensure that future generations inherit a diverse world that sustains our natural environments and our cultures for centuries to come.*

— Smithsonian Statement on Climate Change<sup>1</sup>

Scientific evidence makes clear that climate change is underway and will pose increasing challenges in the coming years. Sea levels are rising, temperatures are increasing, and storms are becoming more intense, among other effects.

Climate change is already a threat to Smithsonian collections, buildings, grounds, operations, research, and personnel. Evidence from the historic 2006 rain event in Washington, D.C., which shut down some Smithsonian facilities for several days, and from 2012’s Tropical Storm Sandy, which caused flooding at the George Gustav Heye Center in lower Manhattan, illustrate the vulnerability of Smithsonian assets and operations to risks associated with climate change. Many of the Smithsonian’s at-risk assets are literally irreplaceable, such as specimen type collections, breeding populations of endangered species, and one-of-a-kind objects and documents in the cultural, historical, and art collections. Others are immovable, including iconic buildings and plots for long-term scientific monitoring and experimentation. Climate change effects also increase operational requirements and costs, putting additional stress on limited financial resources.

The threats from climate change vary depending on geographical location, environmental context, facility age and condition, and other factors. For example, sea-level rise will directly affect research operations in low-lying coastal sites. Other sites, though less exposed to sea-level rise, are still vulnerable to flooding from intensified precipitation and perhaps storm surge. Increases in mean temperatures will result in higher operating and maintenance costs to meet storage condition requirements for fragile collections and provide comfortable environments for visitors.

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<sup>1</sup> Issued October 2, 2014. See <http://newsdesk.si.edu/releases/smithsonian-statement-climate-change>.

The science, data, and methodologies underlying climate change projections are continually evolving, as are adaptation strategies. However, while uncertainty exists around how threats will evolve over time and how to address them most effectively, past experience, current trends, and future projections all indicate that adaptation efforts must start now. This is particularly true for the Smithsonian, which, as noted, is already vulnerable to climate change-related impacts and whose vulnerability is increasing.

Effective integration of climate change adaptation measures into Smithsonian policy, planning, and operations depends on awareness of the risks and on proactive responses at all levels. In an age of accelerated climate change, Smithsonian personnel will need to do their part to increase the Institution's adaptive capacity.

Because managing the risks associated with climate change is a complex and ongoing endeavor, adaptation initiatives will continually need to be evaluated, revised, and expanded in the years ahead. This Smithsonian Climate Change Adaptation Plan (CCAP), Phase 1, suggests some initial steps.

# Smithsonian Climate Change Measures to Date

This Phase 1 Smithsonian Climate Change Adaptation Plan (CCAP) is being developed in response to several federal directives aimed at reducing emissions, increasing sustainability, and adapting to climate change:

- ***Executive Order (EO) 13690: Establishing a Federal Flood Risk Management Standard and Process for Further Soliciting and Considering Stakeholder Input*** (January 30, 2015) directs federal agencies to raise flood risk management standards in order to reduce the impact of flooding in the future.
- ***Executive Order (EO) 13693: Planning for Federal Sustainability in the Next Decade*** (March 25, 2015) directs federal agencies to reduce greenhouse gas emissions by 40% relative to 2008 baseline levels.
- ***The President's Climate Action Plan*** (June 2013) establishes a framework for cutting carbon pollution, preparing the nation for the impacts of climate change, and leading international efforts to address climate change.

In 2012, the Smithsonian established the *Smithsonian Executive Committee on Sustainability (SECS)* and a *Senior Sustainability Officer* to oversee the Institution's response to the EOs dealing with environmental stewardship of facilities and other assets.

In 2013, the SECS appointed a *CCAP Working Group* to research, plan, and support implementation of climate change adaptation measures at the Smithsonian. It is co-chaired by the Director of Smithsonian Facilities (SF) and the Associate Director of Research of the Smithsonian Environmental Research Center (SERC). It includes personnel from several SF divisions, including the Office of Protection Services (OPS), Office of Facilities Management and Reliability (OFMR), Office of Planning, Design, and Construction (OPDC), Office of Business Administration and Technical Services (OBATS), Office of Safety, Health, and Environmental Management (OSHEM), and Office of Emergency Management (OEM), as well as representatives from other central offices, units with unique adaptation needs, and the Smithsonian research and collections communities. Going forward, implementation of the CCAP will require expanded engagement and coordination by the Smithsonian's units and central offices.

## ***Smithsonian Climate Change Initiatives in the Sciences, Arts, and Humanities: Example Activities***

The **Forest Global Earth Observatories (ForestGEO)** and **Marine Global Earth Observatories (MarineGEO)** provide scientists and the public with unprecedented long-term, high-resolution data for documenting climate change at multiple forest and coastal marine sites worldwide. <http://www.forestgeo.si.edu/> and <http://marinegeo.si.edu/>

The **Global Change Research Wetland (GCREW)** is home to the world's longest-running field experiments on global change. Long-term manipulations of CO<sub>2</sub>, temperature, and observations of sea-level rise inform scientists and the public about plant response to global change and consequences for the stability of coastal ecosystems. <http://www.serc.si.edu/gcrew/>

**Climate and Floral Change at the Paleocene-Eocene Thermal Maximum (PETM)** uses fossil plants to examine ecosystem responses during a period of intense warming 55.8 million years ago associated with a massive release of CO<sub>2</sub>. PETM is widely recognized as the best geological analog for human-induced climate change. [http://www.mnh.si.edu/ete/ETE\\_People\\_Wing\\_ResearchThemes\\_Wyoming.html](http://www.mnh.si.edu/ete/ETE_People_Wing_ResearchThemes_Wyoming.html)

**Urban Forest Dynamics** investigates changes over decades in the urban vegetation cover and geographic patterns of urban land use in the District of Columbia. This research provides new perspectives for management of urban resources. <http://airandspace.si.edu/staff/andrew-johnston>

**Climate Change and Migratory Birds** looks at the effects of climate change on migratory birds to increase understanding of the impacts of climate change to Northern Hemisphere ecosystems and inform conservation efforts. <http://nationalzoo.si.edu/SCBI/MigratoryBirds/>

The **Living in the Anthropocene Initiative** seeks to advance the Smithsonian's contribution to both the scientific and public conversations on global climate change through channels such as websites, publications, and public events. <http://www.smithsonianmag.com/science-nature/age-humans-living-anthropocene-180952866/?no-ist>

**Arctic Cultures and Climate Change** documents the cultural knowledge and modern observations of indigenous people of Alaska and the Bering Strait region about the rapidly changing Arctic environment. <http://forces.si.edu/arctic/>

**Environmental Change: The Driver of Human Evolution** looks at how adaptation to dramatic climate variability in the past 6 million years influenced defining characteristics of humans such as using tools and walking on two legs. This knowledge offers new perspective on how our species might adjust in the future. <http://humanorigins.si.edu/research/climate-research/effects>

The CCAP Phase 1 is the first step of an ongoing process and addresses the following initial goals:

- Identify climate change-related flood risks to two key geographical areas of Smithsonian operations—the National Mall and the Rock Creek campus of the National Zoological Park (herein the Zoo)—and consider how those risks may evolve as a result of climate change.
- Identify high-priority measures for mitigating flood risks and increasing resilience on the Mall and at the Zoo.
- Develop a framework for evaluating, prioritizing, and addressing climate change-related flood risks that can be applied to other Smithsonian properties.
- Provide guidance on increasing the Smithsonian’s adaptive capacity to climate change-related flood threats.
- Identify data gaps where additional research and modeling are needed to understand climate change-related risks to Smithsonian assets and operations, and how these risks may evolve.
- Develop strategies for implementing adaptation measures moving forward.

The reasons for focusing Phase 1 on a single type of threat (flooding) to a limited part of the Smithsonian geographic footprint (the Zoo and the Mall) are the following:

- These facilities are deeply interwoven with the Smithsonian’s identity and mission. Thousands of personnel—staff, contractors, volunteers, interns, and fellows—work at the Mall units and at the Zoo, including most of the central leadership. Millions of visitors come to the Mall museums and Zoo every year. The buildings themselves are iconic; collectively, they comprise a large part of the monumental core of Washington, D.C. Finally, these properties house living and non-living collections of incalculable historic, scientific, and cultural value, many of which are exhibited or stored in locations that render them vulnerable to flooding.
- Flooding is already a major concern at both the Mall and Zoo’s Rock Creek campus. Climate change will worsen flood conditions in both short- and long-term time horizons.
- Looking at a limited subset of Smithsonian properties and a single type of risk is a manageable first step toward wider understanding of climate change-related threats and how to address them. Lessons learned from this phase will be applied to future analyses, planning, and measures at other Smithsonian properties.

The analysis of flood vulnerabilities that informed the development of this Plan considered a timeframe extending from the present to 2100. This analysis also identified internal barriers to adaptation efforts that must be addressed if adaptation efforts are to succeed:<sup>2</sup>

- *Financial:* Adaptation to climate change is complicated by continuing financial uncertainty, competing demands that exceed available resources, and the difficulty of securing funds from federal or other sources for climate change adaptation. This financial challenge highlights the need for a strategic approach that prioritizes high-impact actions, integrates adaptation measures into projects already in the pipeline, and emphasizes leveraging resources through partnerships with other federal, state, and local organizations.
- *Cultural:* Even among those concerned about climate change, it is often perceived as a distant, abstract threat rather than today’s challenge. Efforts to raise awareness across the Institution and beyond about the implications of climate change will be critical.
- *Policy:* The Smithsonian’s policies on asset planning, design, maintenance, and protection do not adequately address climate change in the near term or distant future. Modifications to existing policies and development of new ones are required to ensure climate change issues are integrated into programs, processes, and operations across the Institution.
- *Organizational:* Climate change adaptation efforts necessarily involve numerous units, offices, and levels within the Institution, and current efforts are fragmented. Establishment of central coordination and leveraging mechanisms is critical.

The strategies outlined in this document suggest initial steps toward systematically integrating climate change adaptation measures into planning, decision making, and policy, as well as some near-term mitigation measures. Given the gaps in existing data and uncertainty about the magnitude of climate change impacts, the Smithsonian has adopted an adaptive management approach. Phase 1 strategies are expected to evolve as new information becomes available and as the effectiveness of initial strategies is evaluated.

**Adaptive management** is defined by the Intergovernmental Panel on Climate Change (IPCC) as “a process of iteratively planning, implementing, and modifying strategies for managing resources in the face of uncertainty and change. Adaptive management involves adjusting approaches in response to observations of their effects[.]”

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<sup>2</sup> Consistent with the IPCC, we define a barrier as “any obstacle to reaching a potential that can be overcome by policies and measures” ([https://www.ipcc.ch/publications\\_and\\_data/ar4/wg3/en/ch2s2-4-3-1.html](https://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch2s2-4-3-1.html)).

In this first phase of climate change adaptation, the Smithsonian will prioritize strategies for implementation based on the following factors:

- Importance (with higher impact strategies given higher priority).
- Timeframe of the underlying threat (with nearer term threats given higher priority).
- Resource requirements (with strategies that can be implemented without significant additional resources given higher priority).
- Potential to raise internal awareness.
- Potential for incorporation into current processes, facilities master plans, capital projects, and ongoing maintenance.



# Phase 1 Vulnerability Assessment: Summary

This first phase of the CCAP focuses on three mechanisms that heighten climate change-related flood risk:

- *Intensified precipitation.* Severe precipitation events have frequently caused flooding in Washington, D.C. Climate change projections indicate that such events will increase both in intensity and frequency.
- *Sea-level rise.* Changing water levels along the Potomac River, impacted by sea level rise, influences the efficiency of drainage infrastructure in Washington, D.C. and the magnitude of damage caused by coastal storms. Climate change is a driver of rising sea levels, and sea level relative to land is rising at a faster rate in D.C. than in other cities along the Atlantic coast.
- *Storm surge.* Flooding along the Potomac River near the Mall can result from storm surge from coastal storms. Storm surge coupled with rising sea levels will increase the level and frequency of flooding.

## TERMS AND CONCEPTS USED IN THIS CCAP

***Inland riverine*** (or *fluvial*) flooding is the result of water rising and overflowing river banks because of intense precipitation or snow/ice melt.

***Storm surge*** flooding is associated with severe coastal storms such as hurricanes, which generate forces that cause water levels to rise above normal tidal levels.

***Interior drainage*** (or *pluvial*) flooding results from precipitation that exceeds local drainage capacity, and/or from the flow of rainwater over terrain with limited absorption capacity.

***Ponding*** is a consequence of interior drainage flooding; it refers to the accumulation of water at a topographical low point.

***Active flood-control measures*** refer to types of protection that staff must deploy prior to an expected flood event, such as stacking sand bags along an exposed ramp. ***Passive measures*** (such as flood walls) are always in place and do not require deployment in an emergency.

A ***100-year (flood or precipitation) event*** has a 1% (1/100) statistical chance of occurring in any given year. (Note that this probability does not change as the result of an occurrence. That is, the occurrence of a 100-year event in a given year does not reduce the chance of another 100-year event in subsequent years.) References to 10-year, 15-year, and 500-year events can be interpreted in the same way: they are events with a 10%, 6.67%, and 0.2% chance of occurring in a given year, respectively.

By the end of the century, it is projected that the Mall will be affected by all three of these mechanisms, although the effect of sea-level rise will be indirect.<sup>3</sup> Zoo facilities are insulated from the effects of sea-level rise along the Potomac, but are subject to threats associated with intensified precipitation. This does not necessarily mean that climate change-related flood risks to the Zoo are less acute, only that the nature of these risks is different.

This section summarizes the vulnerability of Smithsonian Mall and Zoo properties to flooding. In this context, “vulnerability” is a function of a property’s *exposure* to flooding, its *sensitivity* to flooding, and its *adaptive capacity*.

- **Exposure** refers to the degree to which a property is susceptible to flooding from precipitation, storm surge, and sea-level rise. It is influenced by characteristics of the local area such as geology, topography, hydrology, land use, storm water infrastructure, and area-wide protective measures.
- **Sensitivity** refers to the degree of impact that flooding has on a property. It is determined by property-specific characteristics such as facility design and condition, use of exposed interior space,<sup>4</sup> and operational criticality.<sup>5</sup>
- **Adaptive capacity** refers to a property or organization’s ability to adjust to current and projected flood risks. It is determined by the effectiveness of active and passive flood protection measures and the ability to relocate sensitive assets.

To evaluate vulnerabilities, the CCAP Working Group relied heavily on available flood studies, localized climate change projections, and emergency operations manuals produced by federal and local government agencies within the District. The analysis here centers on extreme events to gain insight into the upper limits of adaptation needs.

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<sup>3</sup> Increasing sea levels alone are not likely to flood areas on Smithsonian properties along the Mall within the timeframe evaluated, but higher water levels along the Potomac will increase the frequency and magnitude of flooding.

<sup>4</sup> Highly sensitive interior space types include those that house collections/archives, building systems (mechanical, electrical, plumbing, IT, and communications), and security operations.

<sup>5</sup> Operationally critical facilities include those that provide a utility service to other facilities, so that damage to them affects operations elsewhere.

### ***An Important Caveat***

Scientific exploration of climate change and its impact on the Washington, D.C. region to date has tended to focus on the individual effects of each of the three types of events discussed above, and not on the impact of combined events, which is much more complex. The limited information about local flooding impacts of combined events is a gap in the research to date. There is a high potential that the impact of combined events—for example, intense local precipitation combined with a storm surge at high tide—would be greater than the impact of either event in isolation, making the analysis in this study conservative with respect to negative impacts. Additional research and modeling of the effects of combined events must be a high priority in future research.

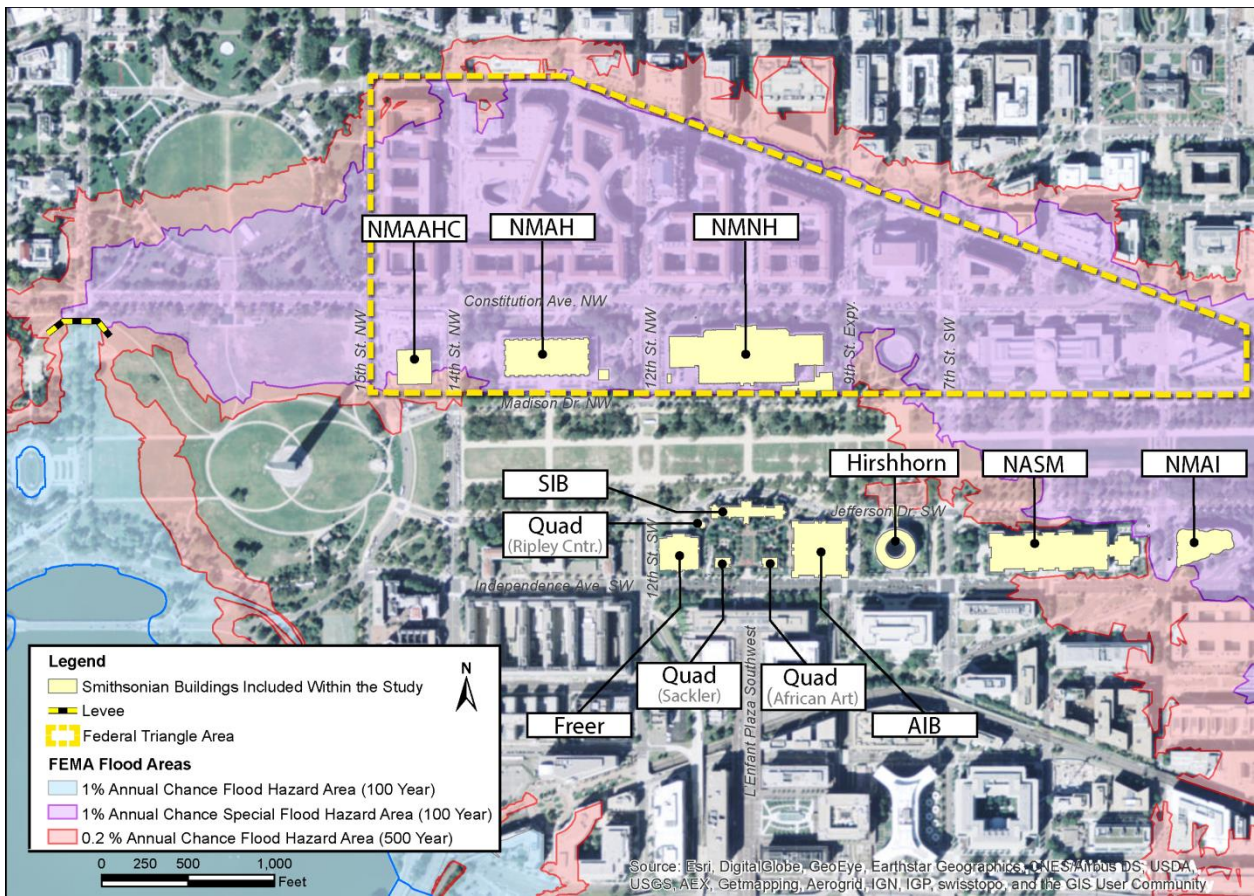
# Facility Risks: The Mall

## General

Five of the Smithsonian facilities analyzed—the National Museum of African American History and Culture (NMAAHC), National Museum of American History (NMAH), National Museum of Natural History (NMNH), National Museum of the American Indian (NMAI), and National Air and Space Museum (NASM)—are highly exposed to flooding because they fall at least partly within the current 1% Annual Chance Flood Hazard Area around Constitution Avenue as determined by the Federal Emergency Management Agency (FEMA) (see Figure 1).

The Potomac Park Levee System, which was recently certified by the U.S. Army Corps of Engineers, along with other local protective measures, reduces the likelihood of flooding from the Potomac along the National Mall. However, portions of the Potomac Park Levee System and other measures are active systems that must be deployed by the responsible

**Figure 1: FEMA Flood Hazard Areas, National Mall**



agencies in timely manner.<sup>6</sup> Those agencies must also carry out regular maintenance of these systems to ensure they remain operable. *Thus, the Smithsonian is highly dependent on the actions of other agencies to protect it from potentially devastating flooding.*

There is an additional issue with respect to the protection offered by the Levee System. Climate change greatly impacts the level of flooding across current, mid-, and long-term timeframes. While the Levee provides substantial protection in a range of future flood scenarios, the increased magnitude and frequency of flooding over time mean the Smithsonian will be increasingly reliant on the Levee, and thus upon other agencies, for protection. Failure of the Levee could have a profound impact on Smithsonian across all timeframes considered.

Despite the protection offered by the Levee, heavy precipitation that exceeds the capacity of the municipal sewer system puts parts of the Mall at significant risk. During heavy precipitation, rainwater runoff flows to low points such as Constitution Avenue, where the water can rapidly accumulate, limiting Smithsonian emergency operations response time and threatening Smithsonian assets.

Flood risks to Smithsonian Mall operations are not confined to properties located in the flood hazard zone. While other facilities along the south side of the Mall—the Hirshhorn Museum and Sculpture Garden (HMSG), Arts and Industries Building (AIB), Freer and Sackler Galleries (FSG), Castle, National Museum of African Art, and Ripley Center—are not as likely to be directly flooded by inland riverine or storm-surge flooding from the Potomac, or by flooding from rainwater runoff as in the Constitution Avenue area, heavy precipitation can cause ponding at the individual site level or loss of utility service.<sup>7</sup> Further, the majority of Mall facilities have uncovered loading ramps that lead to below-ground areas where water can accumulate if the intensity of rainfall surpasses drainage capacity.

Another factor that affects the potential for flooding is that the Mall is characterized by high groundwater which is tidally influenced.<sup>8</sup> Changes to the groundwater level can have detrimental effects on Smithsonian properties. For example, higher levels can exert additional hydrostatic pressure on building foundations; changes in flow rates could exacerbate land subsidence. Additional research and analysis are needed to understand the

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<sup>6</sup> Plans to certify the Potomac Park Levee System to about the 500-year flood level include the replacement of active protection measures with passive measures, which will provide greater protection to the Smithsonian if executed. Federal funding is required to move this project forward.

<sup>7</sup> Approximately 73 percent of Smithsonian property on the Mall is covered with impervious (non-draining) surfaces. Options to increase rainwater absorption onsite through the use of pervious paving are limited due to poor soil and high groundwater conditions, which lessen the absorption of rain water.

<sup>8</sup> Groundwater collects or flows beneath the Earth's surface, filling the porous spaces in soil, sediment, and rocks.

local effects of climate change and other drivers, such as local development, on groundwater levels and the potential impacts to Smithsonian properties.

***By Facility***

The vulnerability level at any given facility depends on site-specific factors such as the extent, location, and use of below-ground space; facility condition; local landscape features; and presence of protective measures. Figure 2 offers a facility-by-facility summary of vulnerabilities from various types of flood events for Mall locations.

**Figure 2: Climate Change-Related Flood Vulnerability, Mall Facilities**

Climate Change Variable	Consequence	Time Frame	AIB	Freer	Hirshorn	NASM	NMAAHC	NMAI	NMAH	NMNH	Quad	SIB
			Increased frequency & intensity of localized precipitation events	Interior Drainage Flooding (Pluvial)	Current	●	●	●	●	●	●	●
		2020s	●	●	●	●	●	●	●	●	●	●
		2080s	●	●	●	●	●	●	●	●	●	●
Coast Storms & Sea Level Rise	Storm Surge Flooding	Current -	○	○	○	○	○	○	○	○	○	○
		2020s	○	○	○	○	○	○	○	○	○	○
		2050s	○	○	○	○	○	○	○	○	○	○
		2100s	○	○	○	○	○	○	○	○	○	

Vulnerability Levels	● Very High	● High	● Moderate	● Low	○ Minimal
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*Sources:* The CCAP Phase 1 assessment of vulnerability to flooding drew from the following: AREA Research, Perkins+Will, Kleinfelder, Atmos Research and Consulting, Paul Kirshen, and Ellen Douglas. Climate Projections & Scenario Development. Prepared under contract for the Department of Energy and Environment, District of Columbia. Rep. no. RFA: 2013-9-OPS. N.p.: June 2015. Print. U.S. Army Corps of Engineers, *North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk*, Final Report, Appendix D: State and District of Columbia Analyses, January 2015.

On the whole, the flood vulnerability of Mall facilities can be summarized as follows:

- The **National Museum of American History** and **National Museum of Natural History** are the most vulnerable. Multiple factors, including extensive collections and building-system spaces on exposed levels, contribute to these facilities' vulnerability in both the present and future. While the Potomac Park Levee System will provide considerable protection and reduce exposure to flooding from the Potomac, failure of the system (or failure of the responsible agencies to deploy it in timely manner) could have devastating results across all timeframes. Among them are the loss of irreplaceable artifacts, destruction of building systems equipment

that multiple facilities rely upon for service, and suspension of operations at these facilities for an extended period.

- The vulnerability of the **National Museum of the American Indian** and **National Air and Space Museum** is comparatively lower because flooding at these locations is likely to be more manageable, and both facilities have comparatively limited collections space located on exposed levels. Additionally, the Potomac Park Levee System will provide significant protection, reducing the likelihood that a flood along the Potomac would impact these facilities—but with the same caveats noted above.
- The **National Museum of African American History and Culture** is highly exposed in terms of siting, but measures to mitigate flood impact have been designed into this facility that reduce its vulnerability. Nevertheless, significant collections and building-systems spaces are below grade, and if flooding exceeded current protection measures, the impact could be catastrophic. The likelihood of this happening will rise over time as a result of climate change, which will significantly increase NMAAHC's vulnerability to Potomac River flooding in the intermediate and long-term timeframes.
- Other Mall properties are less vulnerable. The risks they face are largely confined to site-specific interior flooding from severe precipitation events.<sup>9</sup>

Because climate change will cause flood risks to grow over time, measures to address these risks must be based on best-available projections for the coming decades, not just historical data. As discussed above, however, current understanding of local climate change effects and their impact is far from complete. This points to the need for more work on modeling how risks to the Mall area may evolve.

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<sup>9</sup> While much of the HMSG Sculpture Garden lies barely above sea level, it is surrounded by local landscape features that provide protection against flooding.

## Facility Risks: National Zoo

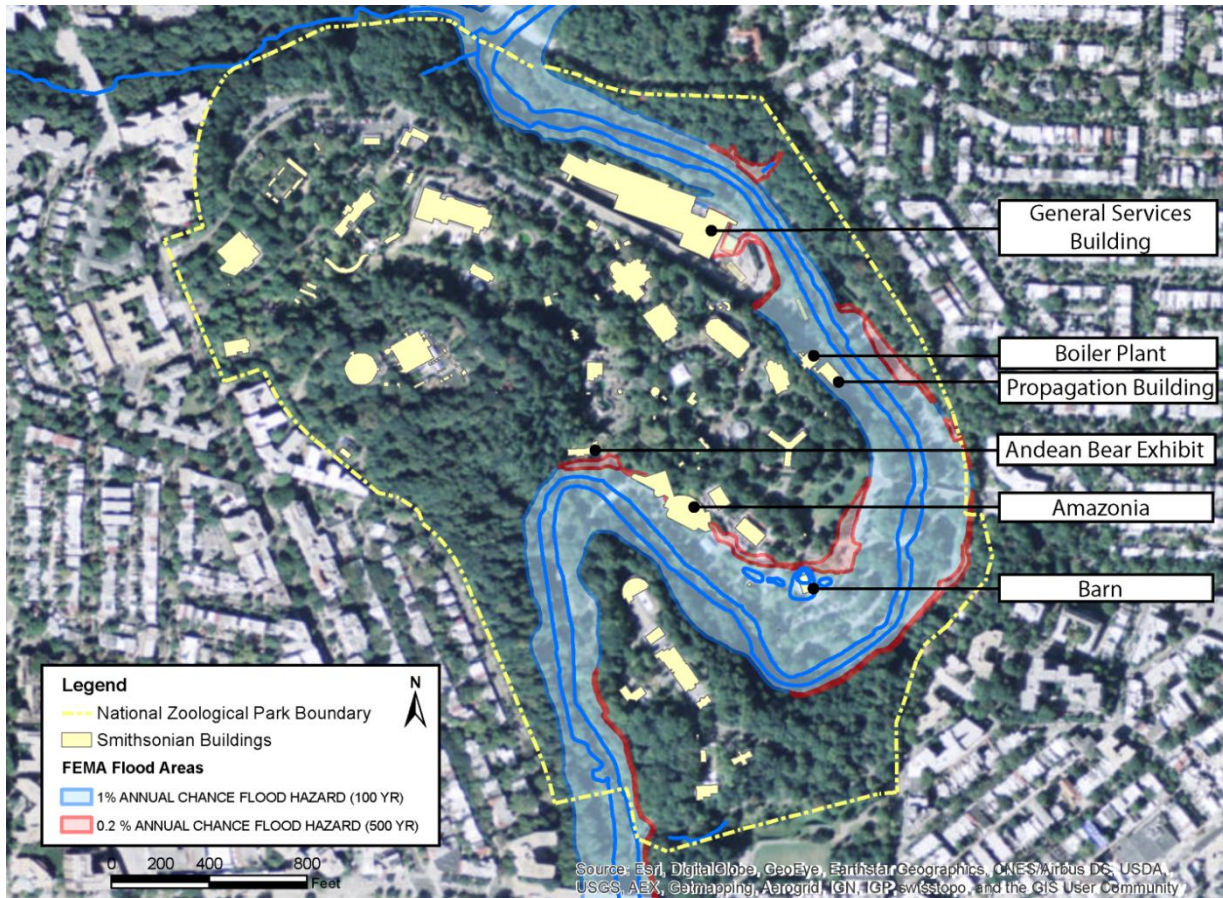
### *General*

Rock Creek is non-tidal until the last quarter mile before it drains into the Potomac, so the part that flows through the Zoo is not subject to sea-level rise which impacts the Potomac. Rather, flooding along most of Rock Creek is the result of severe precipitation events and rapid snow and ice melt within the drainage basin. Moreover, due to the narrow creek bed, flooding can occur quickly, giving minimal response time for Smithsonian emergency operations to deploy active protective measures. Efforts are underway in D.C. and Maryland to reduce runoff and storm sewer overflow into Rock Creek. However, the extent to which these will reduce flood risk is unknown, and future development within the Rock Creek drainage basin will offset some of the benefits.

While the narrow creek bed limits the horizontal extent of flooding, it can result in high flood levels. In the cases of a 100-year and 500-year flood, the water levels near the Zoo could rise approximately 20 feet to 24 feet, respectively, above the Creek bed elevation. Figure 3 identifies facilities that would be affected by 100-year and 500-year floods.



**Figure 3: FEMA Flood Hazard Zones, National Zoo**



The topography of the Zoo campus is characterized by an elevation change of about 200' between the highest points in the northwest corner and the lowest points along Rock Creek. As a result, some areas subject to riverine flooding from Rock Creek are also vulnerable to interior drainage flooding from rainwater runoff. While the area within the Zoo that is covered by impervious surfaces (about 20%) is low compared to Smithsonian properties on the Mall, steep terrain and long stretches of paving contribute to significant and often rapid runoff and ponding at lower elevations. Unless changes are made to capture or slow rainwater runoff, interior drainage flooding will increase as higher intensity storms become more common due to climate change.

Approximately 38 acres of the campus, or 23 percent of the total, are within the 100-year FEMA flood hazard area, including portions of five permanent facilities: the General Services Building (GSB), Boiler Plant, Propagation Building, Main Barn, and Amazonia. An additional 2.9 acres are within the 500-year flood hazard area, including a portion of the lower bear exhibit. Of these facilities, the lower bear exhibit and GSB have spaces below-ground. Additionally, the Zoo's two southeastern parking areas (Lots D and E) and portions of the North Road that runs through the Zoo experience frequent flooding that has resulted in damage.

The projected rise in the frequency and intensity of precipitation events is anticipated to increase flood risks to the low-lying properties along Rock Creek. However, the degree to which that increase will impact flood levels is unknown, as no flood modeling that takes into account future precipitation projections for this section of Rock Creek is currently available. Additional research is needed to better understand the impact of climate change on flood levels at the National Zoo. Despite this limitation, analysis for current vulnerabilities and precipitation projections reveal critical vulnerabilities that must be addressed.

*By Facility*

Figure 4 offers a facility-by-facility summary of vulnerability to flood events for Zoo locations.

**Figure 4: Climate Change-Related Flood Vulnerability, National Zoo Facilities**

Climate Change Variable	Consequence	Time Frame	Amazonia	Bears (lower)	Boiler Plant	General Services	Main Barn	Propagation
Increased frequency and intensity of localized precipitation events	Interior Drainage Flooding (Pluvial)	Current	●	●	●	●	●	●
		Future	*	*	*	*	*	*
Increased frequency and intensity of regional precipitation events	Inland Riverine Flooding (Fluvial)	Current	●	●	●	●	●	●
		Future	**	**	**	**	**	**

Vulnerability Levels	● Very High	● Moderate	○ Minimal
	● High	● Low	

\* Increases to the intensity of localized precipitation events will greatly impact facilities at the Zoo; however, more analysis is required to evaluate the potential magnitude of this impact and to assign a vulnerability rating across short term and long term time horizons.

\*\* Flood level projections considering changes to precipitation patterns and local development are needed to evaluate the vulnerability of Smithsonian properties to flooding along Rock Creek across future time frames.

On the whole, the flood vulnerability of Zoo facilities can be summarized as follows:

- Due to their low elevation and adjacency to Rock Creek, the **Boiler Plant** and **Propagation Building** are highly vulnerable to flooding from the Creek, and are also prone to interior drainage flooding from stormwater runoff.
  - The consequences of flooding to the Boiler Plant would be very serious. Because the Boiler Plant generates steam for most Zoo facilities, damage to plant equipment could leave the Zoo without heat for a period of time, putting animals at risk and requiring their relocation. The Boiler Plant is surrounded by a 5.5’–6’ flood wall and flood gates; the latter, however, are not automated and must be deployed by staff during a flood emergency. Staff report that flood levels nearly breached the wall on several recent occasions.

Based on current FEMA flood profiles, a 10-year flood along Rock Creek would exceed the wall by approximately one foot.

- The Propagation Building is located directly adjacent to the Boiler Plant. While it is also highly exposed to flooding from Rock Creek, its ground level contains fewer critical spaces, thus making it less sensitive to flooding than the boiler plant. The second floor, however, includes temporary animal housing. While currently it is unlikely that flooding would reach this level, increased precipitation will increase this likelihood; if flooding to this level occurred, it could threaten the safety of animals housed there.
- The loading area of the **GSB** is vulnerable to interior drainage flooding from intense precipitation events as well as flooding along Rock Creek. Runoff from the service drives and parking lot accumulates within the loading dock area, which is enclosed by the retaining wall on the northeast side of the service drive. The delivery area has storm drains and two pumps, but the pumps have no back-up power or backflow preventers. In the event of pump failure while Rock Creek water levels are high, sections of the lower level of the facility could be quickly flooded, resulting in damage to equipment and impacts to operations across the Zoo.
- **Amazonia** is at a low elevation directly adjacent to Rock Creek, making it vulnerable to flooding from the Creek. Even a 10-year flood could result in water levels of between 2' and 3' along the southwest facade. Amazonia is equipped with flood shields to protect multiple entrances, but they must be manually deployed by staff in the event of an impending flood. Even then, they offer only limited protection (flooding below the current 100-year flood level). Flooding at this facility could close the exhibit and facility for an extended period of time and harm the animals, vegetation, and collections inside that cannot be easily relocated.
- While not as exposed to flooding as the Boiler Plant, Propagation Building, and Amazonia, the **Main Barn** and a portion of the **lower bear exhibit** are vulnerable to a severe riverine flood event.

## Cross-Cutting Issues

The Smithsonian is in the process of updating its disaster response procedures. In general, currently there is heavy reliance on active flood protection measures that require timely deployment by staff. More intense and erratic precipitation events will increase the challenge of deploying active flood-control measures before serious damage occurs, and increase the advantages of passive measures such as those at NMAAHC.

Smithsonian facilities are vulnerable to utility outages caused by intense storms that threaten the operations of utility providers.<sup>10</sup> For example, water intrusion into facilities in the Federal Triangle area affected Pepco transformers during the 2006 flood, and led to power losses at Smithsonian Mall buildings. Significant disruption to utility services can result in temporary closure of Smithsonian facilities to both staff and visitors, and loss of operations of multiple building systems. Additionally, loss of humidity and temperature controls can put collections at risk. To address this threat, the Zoo has several emergency generators to support continued operations during power outages. Since 2006, back-up power on the Mall during an emergency has been supplied to sewage ejector and sump pumps to ensure continued operation. However, many back-up generators are not stored on site, and extensive flooding within the surrounding area could result in road closures or traffic congestion that could delay the delivery of back-up generators to impacted properties. Also, the majority of facilities do not have exterior connections for back-up generators, which could also delay response operations.

All Metrorail stations and lines in the downtown area of Washington, D.C. are situated underground, making them vulnerable to flooding. In the floods of 2006 and 2010, water intrusion into Metro tunnels stopped service. Many Smithsonian staff who work on the Mall use Metro for their commute. Thus, disruptions to Metro service can impact operations by restricting staff's ability to get to Smithsonian properties. Significant flooding can also cause road closures and increase traffic, which similarly affect the ability of staff to report to work.

A wider range of conditions caused by climate change will stress the Smithsonian's building and infrastructure systems, and lead to accelerated deterioration. This will increase the demand on limited maintenance resources.

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<sup>10</sup> The General Services Administration (GSA) provides most Smithsonian Mall facilities with steam and chilled water; Pepco provides electricity to all facilities on the Mall and at the Zoo; Washington Gas provides gas service; and Continental Petroleum is the emergency generator back-up supplier.

# Phase 1 Strategies

## I. Raise Awareness

Successfully adapting to climate change requires better understanding of the risks to Smithsonian assets by those who manage them. To this end, the Smithsonian must help its workforce to expand their awareness of this evolving threat and incorporate this awareness into their thinking, decisions, and actions at all levels. Those people who work directly or indirectly on climate change adaptation—such as facilities and collections personnel, and managers who make decisions that affect facility vulnerabilities—should be the initial focus of awareness-raising efforts. Over time, the audience can expand to include other personnel, as well as non-personnel stakeholders.

### *Raise Awareness Strategy:*

*Educate and inform relevant Smithsonian personnel about climate change and its impacts on Smithsonian assets and operations.*

The Smithsonian will use its education, training, and outreach capabilities to build awareness of climate change impacts among personnel whose actions and decisions affect vulnerabilities. The intent is to:

- Show these personnel how climate change may affect their areas of professional responsibility. Initial focus areas for such efforts include facilities design, construction, and renovation; facilities management; collections management; emergency preparedness; and leadership personnel who must decide how to prioritize goals, projects, and funding.
- Emphasize that proactive planning is more effective and less costly than damage control, and that climate change adaptation is a challenge that we must start to address *now*.
- Effectively communicate new climate change adaptation guidelines and policies.

### Strategy Implementation

Effective climate change awareness-raising will need to employ a variety of platforms, and support from senior Smithsonian leadership is critical. These efforts will require both technical staff and personnel skilled in communicating technical information to non-specialists.

Initially, the Smithsonian will take steps to identify relevant existing information resources that address both the general impact of climate change and the specific challenges identified in the CCAP vulnerability assessment. It will evaluate these resources for applicability to the Smithsonian’s circumstances. Where gaps exist, the Smithsonian will develop new resources that encourage creative thinking about how to minimize impacts.

Information will be delivered through climate change adaptation workshops tailored to each unit’s mission, circumstances, and specific challenges. Resources will also be made accessible through communication platforms such as PRISM. Ideally, relevant adaptation resources, including vulnerability assessments undertaken as part of the CCAP process, will be collected in a single (online) location and made easily accessible to users as a “climate change adaptation tool kit.”

The Smithsonian will track the effectiveness of awareness-raising by capturing examples of how it influences specific decisions or projects. For example, during the vulnerability assessment, discussions with Smithsonian staff regarding flood vulnerabilities at NASM led to a decision to avoid relocation of library space into the lower level of the facility.

## II. Adapt

Structural and non-structural adaptation measures can minimize the risks associated with climate change, but can be costly. The Smithsonian will need to prioritize measures that have the greatest benefit per dollar invested. Identifying these measures is not always straightforward, because of the uncertainty about the future impacts of climate change, as well as the absence of technical guidance for Smithsonian decision makers that reflects what is currently known.

### ***Adapt Strategy 1:***

*Systematically integrate best-available information on the impact of climate change into guidelines and decision-making practices.*

Current Smithsonian facilities-related guidelines and decision-making practices are, for the most part, based on historic data, with the implicit assumption that these will carry forward into the future. But climate change projections indicate this assumption is no longer valid. The Smithsonian will need to review and, when appropriate, modify or develop new guidelines and practices so that ultimately all decisions about acquiring, building, maintaining, and improving physical assets systematically incorporate the best-available information. Effective guidelines will need to account for:

- *Local variation.* Because different Smithsonian operations face different types and levels of risk, the guidelines must allow for site-specific factors.
- *Uncertainty.* Scientific understanding of climate change and its impacts is constantly evolving, and future factors such as levels of greenhouse gas emissions caused by human activity cannot be known. Because uncertainty is inherent, guidelines must encourage consideration of a range of possible outcomes, and favor flexible solutions that can be modified as new information becomes available.
- *Vulnerability.* As a bottom-line proposition, decision makers should seek to limit the expansion of assets in areas that are highly vulnerable to climate change impacts. Guidelines should reflect this basic principle.

### Strategy 1 Implementation

The development and application of guidance, criteria, and best practices are essential to building the Smithsonian's capacity to incorporate the best current information on climate change impacts into project decisions. Guidance would address issues such as:

- Selection and application of climate change projection scenarios to specific projects based on factors such as project criticality, prioritization of assets, and target protection levels.
- Matching projection scenario timeframes with project life cycles for decision support.<sup>11</sup>
- The development of flexible strategies to account for inherent uncertainty and unknown variables.

The first step will be to review and, when appropriate, modify guidelines, criteria, plans, and operational processes to integrate up-to-date climate change information across all stages of asset life cycles. Determining appropriate changes will require participation by personnel from a range of professional areas, and the Smithsonian will subsequently need to train relevant staff how to effectively integrate climate change-related considerations into planning and decision making. Examples of guidelines and plans that might be reassessed in this way include the Smithsonian's:

- Facilities Design Standards.
- Sustainable Buildings Implementation Plan.

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<sup>11</sup> For example, if a building has a 60-year life span, it is imperative to consider projections for storm surge and precipitation levels 60 years out, not just for today.



- Sustainability Requirements Related to Design and Construction.
- Disaster Management Response Plans.

Examples of processes to be reassessed include:

- Prioritization methodology of the Facility Requirements Database.<sup>12</sup>
- Capital planning.
- Facilities Condition Assessment.
- Comprehensive long-term maintenance planning.<sup>13</sup>

***Adapt Strategy 2:***  
*Begin to expand the climate change vulnerability assessment to include other properties and threats.*

The Smithsonian has opted for an incremental approach to climate change vulnerability assessment, starting with the present analysis of flood risks to the Mall and Zoo. The vulnerability assessment process needs to be expanded to other types of climate change-related threats and to additional facilities.

### **Strategy 2 Implementation**

The initial focus of an expanded vulnerability assessment will continue to center on flood risks (via sea-level rise, storm surge, and precipitation). It will include both a refinement of our present understanding of the risks to Mall and Zoo properties and expansion of the scope to consider other properties. Later vulnerability assessments will be expanded to look at other types of climate change-related threats, such as wind damage from intensified storm activity and effects on building systems of increasing temperatures. The Smithsonian will initially conduct assessments for owned properties, and will eventually move on to leased properties.

As with this initial phase, continued vulnerability assessments will survey and draw upon the wealth of existing data, information, and resources, as well as identify gaps where more

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<sup>12</sup> The Facility Requirements Database manages pre-project data on project scope, execution plans, work categorization, scheduling, impacts, priority, available funding, and cost estimates. Information in the database is used to develop the Smithsonian’s long-range strategic project plan.

<sup>13</sup> Climate change will force existing facilities systems to operate under a wider range of conditions, resulting in faster deterioration and increased maintenance costs. The Smithsonian will need to study maintenance trends and perform degradation modeling to better understand the impact of climate change on infrastructure systems, and thus inform maintenance operations, long-range maintenance strategy decisions, and budgetary requests.

work needs to be done. Assessments will follow the framework developed during Phase 1, but will evolve as lessons are learned.

***Adapt Strategy 3:***  
***Identify and address data gaps.***

The vulnerability assessment has revealed and will continue to reveal gaps in the data needed to accurately evaluate threats to Smithsonian assets and operations. Where necessary, the Smithsonian—with partners when appropriate, and always with an eye on existing data and research efforts—will support research to fill these gaps.

**Strategy 3 Implementation**

The Smithsonian aims to support research related to the following information gaps identified in the Phase 1 assessment:

- Limited understanding of the impact of changing precipitation trends on the magnitude of interior drainage and inland riverine flooding on the National Mall, as well as limited understanding of the cumulative effects of combined events (for example, storm surge plus extreme local precipitation) on Mall flood levels. Potential partners in this research include federal agencies located in the vicinity of the Mall, along with D.C. government agencies.
- Inadequate quantification of the impact of climate change on groundwater conditions in the vicinity of the Mall. In addition to the organizations listed in the previous bullet, potential partners on this research include the U.S. Department of Agriculture’s Agricultural Research Service (ARS).
- Limited understanding of the impact of changes in precipitation patterns on flood conditions along Rock Creek. Potential partners here include the U.S. Geological Survey (USGS), which monitors conditions along Rock Creek, as well as the National Park Service (NPS) and the U.S. Department of Transportation (DOT).

***Adapt Strategy 4:***  
***Focus on the most vulnerable properties.***

Where feasible, climate change adaptation measures will be incorporated into future project decisions and processes, such as facility master planning. However, highly vulnerable sites will require additional attention to address issues that cannot wait until climate change is fully integrated into projects and planning decisions in coming years.

Some of these sites have been identified in this document, and others will come to light as the risk assessment process continues.

### **Strategy 4 Implementation**

The Smithsonian will incorporate climate change considerations into all campus, facility, and landscape master plans, to include recommendations for:

- Building system upgrades based on climate change projection data.
- Steps to protect facilities and infrastructure from water intrusion at vulnerable entrance points.
- Water management strategies to deal with projected increases in storm water runoff.

The Smithsonian will also integrate climate change considerations into all collections space planning efforts, and refine the data in the collections space database to reflect expected climate change-related changes in flood risk, temperature and humidity, storm intensity, and other areas.<sup>14</sup>

Likewise, the Smithsonian will develop an NZP Rock Creek campus Comprehensive Water Management Plan that will evaluate existing water management systems in light of future projections for flood risk, and inform long-range planning of capital improvements to improve drainage and minimize facilities' vulnerability to flood events.

The Smithsonian will undertake, as funds allow, the following facility-specific analyses of pressing concerns, building on the risk assessment in this document and other relevant studies:<sup>15</sup>

- National Museum of Natural History flood control feasibility study.
- National Museum of American History flood control feasibility study.

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<sup>14</sup> The Smithsonian's Collections Framework Plan addresses issues related to developing new collections space; renovating existing space; informing space-related management and policy decisions; sustainability; security; accessibility; and mapping out short-, intermediate- and long-term projects. As part of developing the Framework, the Smithsonian has monitored impacts to collections during planned system shutdowns. These data will allow better understanding of how to adapt without increasing the risk to collections from temperature and humidity fluctuations, as well as how system failures may affect collections.

<sup>15</sup> In 2013, the Smithsonian completed flood assessment studies for NMNH and NMAH based on 15-year, 100-year, and 500-year events, using data compiled from the Federal Triangle Storm Water Drainage Study and NOAA. However, these studies were based on historic data only. Because climate change will increase flood vulnerability, the recommendations in these studies must be reevaluated based on best-available predictions of how threats will evolve in the future. Likewise, in 2014 the Smithsonian completed the Mall-Wide Water Reclamation Initiatives Study, but its recommendations were based on data for historic rainfall trends only.

- National Air and Space Museum loading dock flood control study.
- National Zoological Park Boiler Plant and Propagation Building flood control protection cost-benefit analysis study.
- National Zoological Park General Services Building water management plan.

These site-specific studies will explore alternatives for controlling storm water runoff and preventing water intrusion into sensitive facilities over the short, medium, and long terms, weighing them in terms of relevant cost and non-cost factors.

### III. Enhance Sustainability

The trajectory of climate change depends on what humankind does to reduce greenhouse gas emissions. The Smithsonian can set an example by continuing and expanding the already aggressive emissions mitigation efforts at its facilities. However, further progress will require greater coordination among units and central offices.

***Enhance Sustainability Strategy 1:***  
*Develop a Smithsonian-wide Sustainability Action Plan*

The Smithsonian will craft an Institution-wide Sustainability Action Plan that will set sustainability priorities, establish short- and long-term goals, focus resources on targeted initiatives, and establish the direction for sustainability efforts across the Institution.

#### Strategy 1 Implementation

Identify and evaluate sustainability needs across the Smithsonian by conducting interviews, undertaking site visits, reviewing facility performance data, and leveraging ongoing sustainability efforts.

***Enhance Sustainability Strategy 2:***  
*Further reduce greenhouse gas emissions of facilities, vehicles, and operations.*

By fiscal year 2025, the Smithsonian is committed to reducing greenhouse gas emissions by 40% from its fiscal year 2008 baseline through steps to conserve energy, fuel, water, and other valuable resources.

## Strategy 2 Implementation

Through the OFMR Energy Management Branch, continue to evaluate facilities and operations to identify opportunities to reduce emissions and pursue renewable energy options where cost effective.

## IV. Enhance Governance

Climate change adaptation efforts are currently scattered across units, offices, levels, and personnel, and receive little central guidance or coordination. Central policies and organizational support structures would help to focus and leverage these efforts.

***Enhance Governance Strategy 1:***  
*Develop central policies to guide climate change adaptation planning and implementation across the Smithsonian.*

Creating appropriate policies at the Institutional level is an important step toward rationalizing and focusing climate change adaptation measures.

## Strategy 1 Implementation

The Smithsonian will develop central climate change adaptation principles as a step toward formal policies. It will also review and, where appropriate, modify policies relevant to climate change efforts. Examples of policies that might be reassessed to this end could include:

- SD 108 (Insurance and Risk Management).
- SD 109 (Disaster Management Program).
- SD 104 (After Action Reporting).
- SD 422 (Sustainable Design of Smithsonian Facilities).
- SD 410 (Facility Construction and Improvement Projects).
- SD 600 (Collections Stewardship).
- SD 404 (Facilities Management).
- SD 414 (SI Energy Management Program and Water Supply Emergency Plan).

***Enhance Governance Strategy 2:***

*Identify and develop appropriate organizational structures to coordinate and support adaptation efforts across the Smithsonian.*

Assigning formal organizational responsibilities for guiding and supporting climate change adaptation efforts will increase efficiency and effectiveness. Responsibility for adaptation efforts is not always clear because adaptation strategies and programs overlap. Addressing these overlaps will require coordination that aims to avoid duplication and ensure alignment across programs.

**Strategy 2 Implementation**

In the near term, the Smithsonian will continue to coordinate adaptation efforts informally through the CCAP Working Group, facilitating communications among relevant parties from different parts of the Smithsonian who are engaged in overlapping or related efforts. The Working Group will also begin to explore more formal organizational structures for guiding and supporting climate change adaptation efforts. An initial step will be researching organizational structures adopted at federal agencies and other relevant organizations.

**V. Enhance Partnerships**

The Smithsonian should not and cannot go it alone. Many other local, regional, and federal organizations are grappling with the challenges of climate change adaptation, and partnerships will be essential to collective efficiency and effectiveness.

Pursuant to the EOs discussed above, multiple working groups have been established to coordinate the climate change work of federal agencies and other stakeholders. At various levels and in various capacities, the Smithsonian has participated in these and other collective efforts that contribute to climate change research, education, and adaptation. The Smithsonian recognizes the importance of continued participation in these efforts, as well as the need for expanded engagement with local and state agencies.

***Enhance Partnerships Strategy:***

*Maintain and expand collaboration with external organizations.*

The Smithsonian will enhance climate change collaboration through the expansion of existing partnerships, initiation of new partnerships, and increased involvement in collaborative efforts. The priority will be engagement in partnerships that leverage Smithsonian resources to produce concrete benefits.

In areas where the Smithsonian has particular experience or expertise, it will seek a leadership role in creating new partnerships and moving existing ones forward. More generally, the Smithsonian will leverage its role as an educator and convener to bring relevant partners together to address issues of mutual interest.

### **Strategy Implementation**

The Smithsonian will systematically collect and manage data on collaborations and collaborating organizations. To this end, it will create and maintain a central database of relevant collaborative initiatives (whether or not the Smithsonian participates), with entries that summarize initiative goals, participants, accomplishments, and other relevant information. It will track Smithsonian participation in such collaborative initiatives, including the positions, unit affiliations, and contact information of Smithsonian participants, and develop a central repository for materials related to collaborative efforts, such as reports and participant notes.

The Smithsonian will strengthen its participation in collaborative efforts in areas such as:

- Enhancing local climate change adaptation efforts relative to flood risks (e.g., the D.C. Silver Jackets).
- Promoting research that contributes to the growing body of knowledge about climate change and impact (e.g., NOAA's Sentinel Sites program).
- Coordinating climate change-related research efforts across the nation and beyond (e.g., the U.S. Global Change Research Program).
- Coordinating with federal and local stakeholders on local flood control measures and flood response operations.
- Collaborating with utility providers as well as federal and local stakeholders to further inform Smithsonian flood response operations.