National Aeronautics and Space Administration

Sustainability Report

NASA Ames Research Center

2016

NASA Ames Research Center Overview

NASA Ames Research Center, one of ten NASA field centers, is located in the heart of California's Silicon Valley. It is only 40 miles south of San Francisco and 12 miles north of San Jose, between Mountain View and Sunnyvale. For more than 75 years, Ames has led NASA in conducting world-class research and development in aeronautics, exploration technology and science aligned with the center's core capabilities.

Ames was established on December 20, 1939, as part of the National Advisory Committee for Aeronautics (NACA), and in 1958 absorbed into the National Aeronautics and Space Administration (NASA). Ames' Key Goals are to maintain expertise in information technology, aerospace and aeronautics research and engineering, conduct research in space, Earth, lunar and biological sciences, develop lead status for NASA in small spacecraft missions, expand public and private partnerships, and contribute innovative, high performance and reliable exploration technologies.

<u>The core areas of expertise include:</u>

Entry systems: Safely delivering spacecraft to Earth & other celestial bodies

Supercomputing: Enabling NASA's advanced modeling and simulation

NextGen air transportation: Transforming the way we fly

Airborne science: Examining our own world & beyond from the sky

Low-cost missions: Enabling high value science to low Earth orbit & the moon

Biology & astrobiology: Understanding life on Earth - and in space

Exoplanets: Finding worlds beyond our own

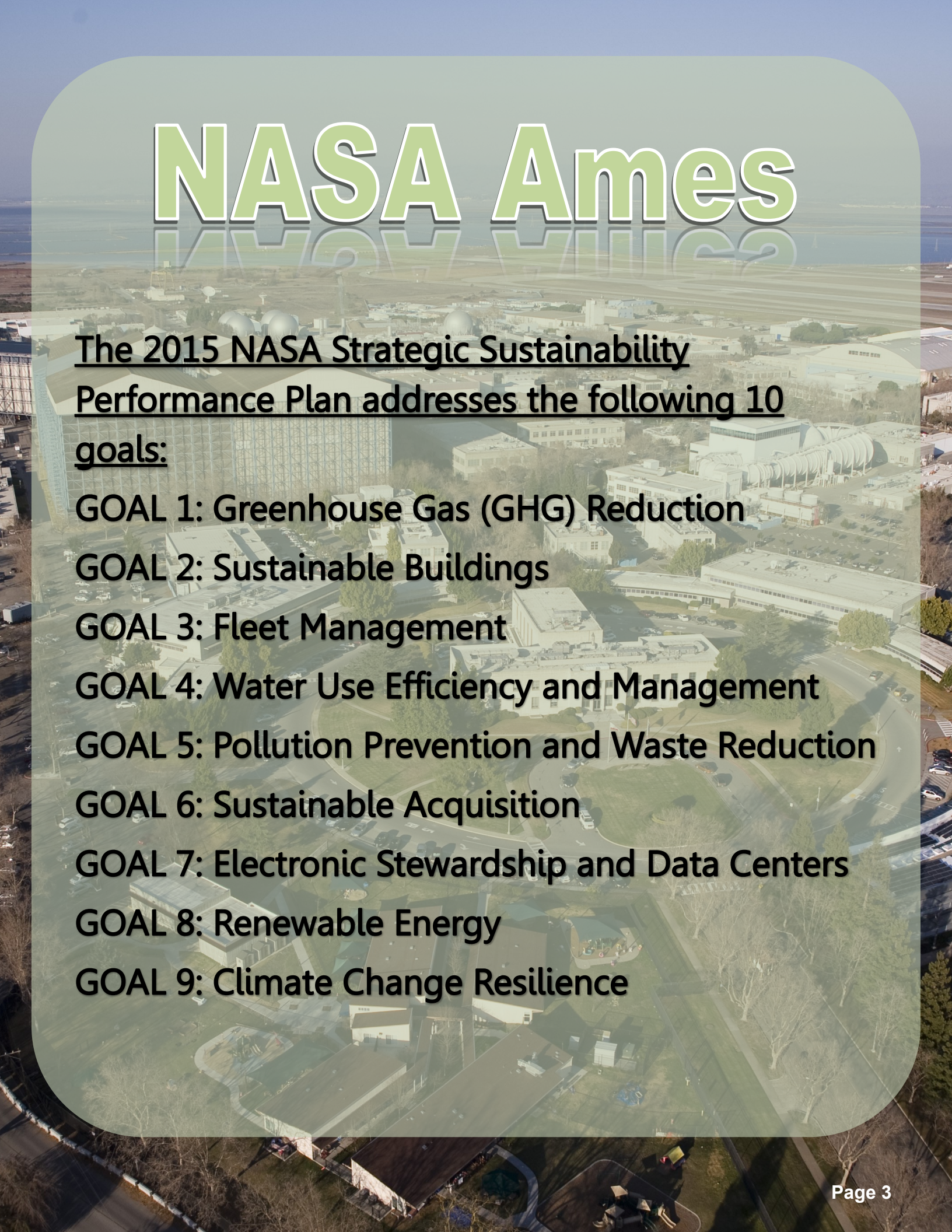
Autonomy & robotics: Complementing humans in space

Lunar science: Rediscovering our moon

Human factors: Advancing human-technology interaction for NASA missions

Wind tunnels: Testing on the ground before you take to the sky

NASA Ames



The 2015 NASA Strategic Sustainability Performance Plan addresses the following 10 goals:

GOAL 1: Greenhouse Gas (GHG) Reduction

GOAL 2: Sustainable Buildings

GOAL 3: Fleet Management

GOAL 4: Water Use Efficiency and Management

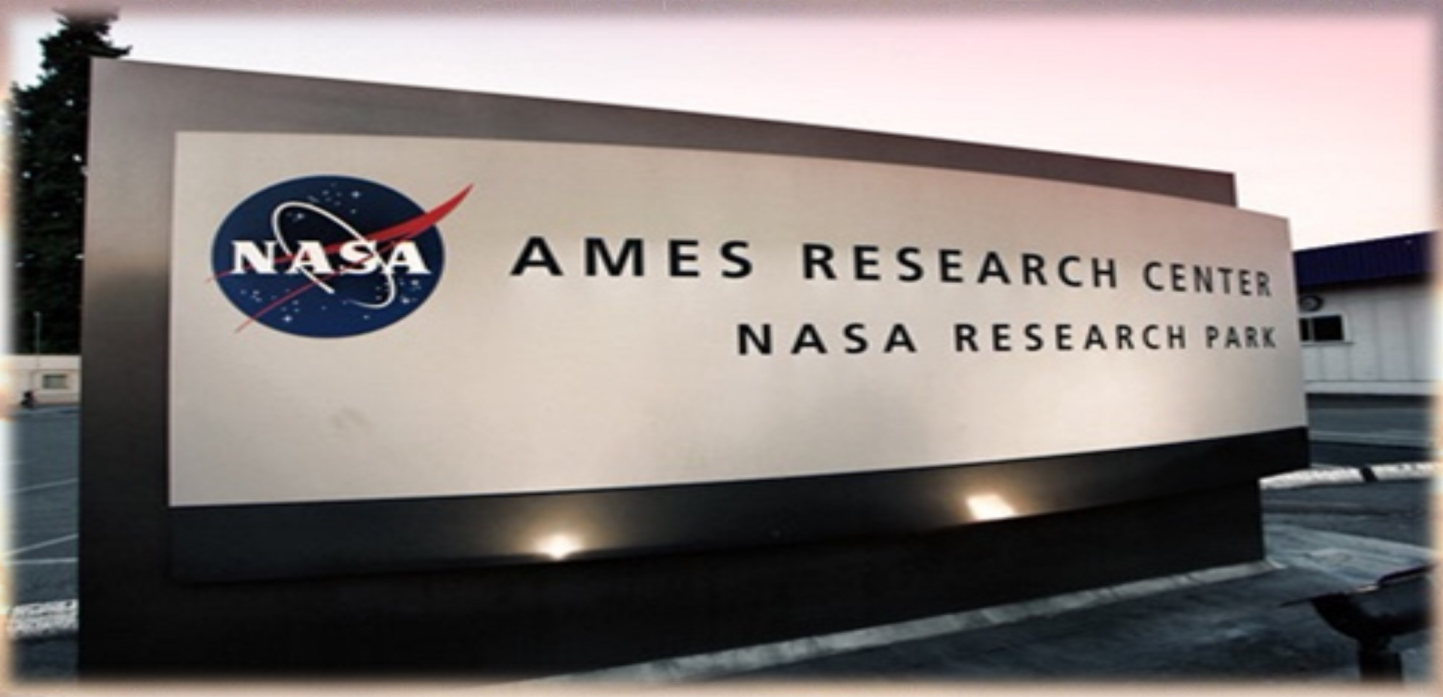
GOAL 5: Pollution Prevention and Waste Reduction

GOAL 6: Sustainable Acquisition

GOAL 7: Electronic Stewardship and Data Centers

GOAL 8: Renewable Energy

GOAL 9: Climate Change Resilience



Ames Sustainability Goal Status Summary

Goal 1: GHG Reduction

✓Supporting Agency goals through energy efficiency, NASA/contractor fleet and alternative commuting.

Goal 2: Sustainable Buildings

✓Met target in FY2015 with respect to energy intensity

×Did not meet the target of 15% of the agency's existing buildings meeting the guiding principles by 2015.

Goal 3: Fleet Management

✓Met the target for 2% reduction in petroleum use.

×Did not meet the target for alternative fuel use.

Goal 4: Water Use Efficiency

×Ames missed the potable water intensity reduction goal in FY2015.

○There was insufficient data available to estimate landscaping, industrial and agricultural water use

Goal 5: P2 & Waste Reduction

✓Met Goal for C&D and Non C&D waste recycling in FY2015.

Goal 6: Sustainable Acquisition

✓100% of applicable actions met criteria in FY2015.

Goal 7: Electronic Stewardship & Data Centers:

✓On Target in FY2015 - Recycled 99,091 lb. e-waste.

Goal 8: Renewable Energy

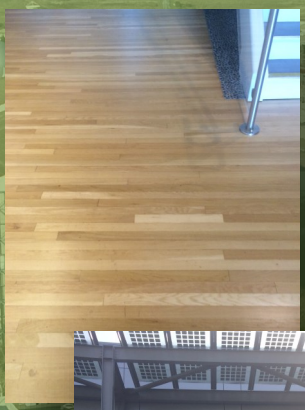
✓On Target in FY2015- 10.12% renewable.

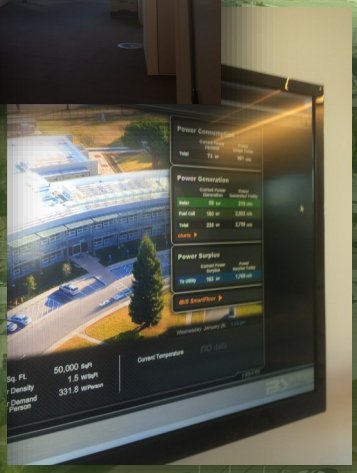
Goal 9: Climate Change Resilience

✓On Target

WHAT IS A GREEN BUILDING?

A “green” building is one that has been constructed or renovated to incorporate design techniques, technologies, and materials that lessen its dependence on fossil fuels and minimize its overall negative environmental impact. One of the greatest benefits of green buildings is their decreased electricity and energy usage, which helps reduce our dependence on fossil fuels.





Sustainability Base (NASA's green building)

The Sustainability Base, building N-232, is NASA Ames’s first new construction in 20+ years. It is 50,000 square feet and houses about 200 staff. It is "net energy positive," meaning it generates more energy than it consumes. Water is recycled in a closed loop, just like in the International Space Station. Water used for hygienic purposes is reclaimed solely for toilet flushing, reducing potable water use. The facility is presently utilizing less than 3 gallons of potable water per person per day (industry standard is approximately 7). Drought tolerant native plants minimize watering requirements and landscaped bio-swales maximize absorption of rainwater by vegetation, and minimize freshwater run-off while providing natural filtering through soil and vegetation. The building is built with nontoxic and recycled materials, including salvaged wood. One example of this is the oak floor in the central atrium—which was recovered from the demolition of the 14-Foot Wind Tunnel. The building also features employee controlled air vents in cubicles so fresh air can be utilized, plenty of windows for natural lighting, and a TV that displays the energy usage of the building.

LEED Platinum Status Award

The $25 million sustainability building integrates a host of clean-energy components, including fuel cells from Bloom Energy, solar panels, a water recovery system and building controls that can react to subtle changes in sunlight, temperature, wind and occupancy. The building is LEED Platinum certified.

Lighting

Intelligent, automated windows, window shades, and efficient lighting modified by individually addressable ballasts, intensity pre-sets, and integrated light sensors contribute layers of responsive optimization options. The automated shades allow the sunlight in while preventing glare and limiting additional heat load. Overhead are both high-efficiency fluorescent lighting and LEDs. Residents on the ground floor have extra-high ceilings while those on the second floor enjoy skylights; both design choices maximize sunlight.

Heating and Cooling

The heating and cooling systems combine passive (hydronic geothermal) and active (heat exchangers and radiant ceiling tiles) strategies to optimize energy use. The facility's two wings are off-set to maximize natural ventilation from wind.

The Bloombox®

The Bloombox®, can more than provide for the facility's electricity demand. This solid oxide fuel cell produces about 200kW of electrical power by chemical reaction with steam and air, rather than combustion, reducing CO2 greenhouse gas emissions by 40%. The fuel cell's efficiency is estimated at 55%, roughly twice that of a conventional gas-fired power plant. Sustainability Base also harnesses the sun, with 432 SunPower® E-19 photovoltaic panels distributed across the building's roof. These arrays have 19% efficiency in converting incident photons to harvested electrons, among the highest conversion efficiencies commercially available. At peak output, the arrays will produce 87kW. This may be at or above Sustainability Base's peak demand. Over the course of a year, PV-generation can account for approximately 30% of the building's electricity needs. Also located up on the white polyvinylchloride (PVC) 'cool roof' is another solar collection assembly, solar thermal. The Sun heats water for sinks, further reducing the building's need for electricity or natural gas.

Goal 1: GHG Reduction

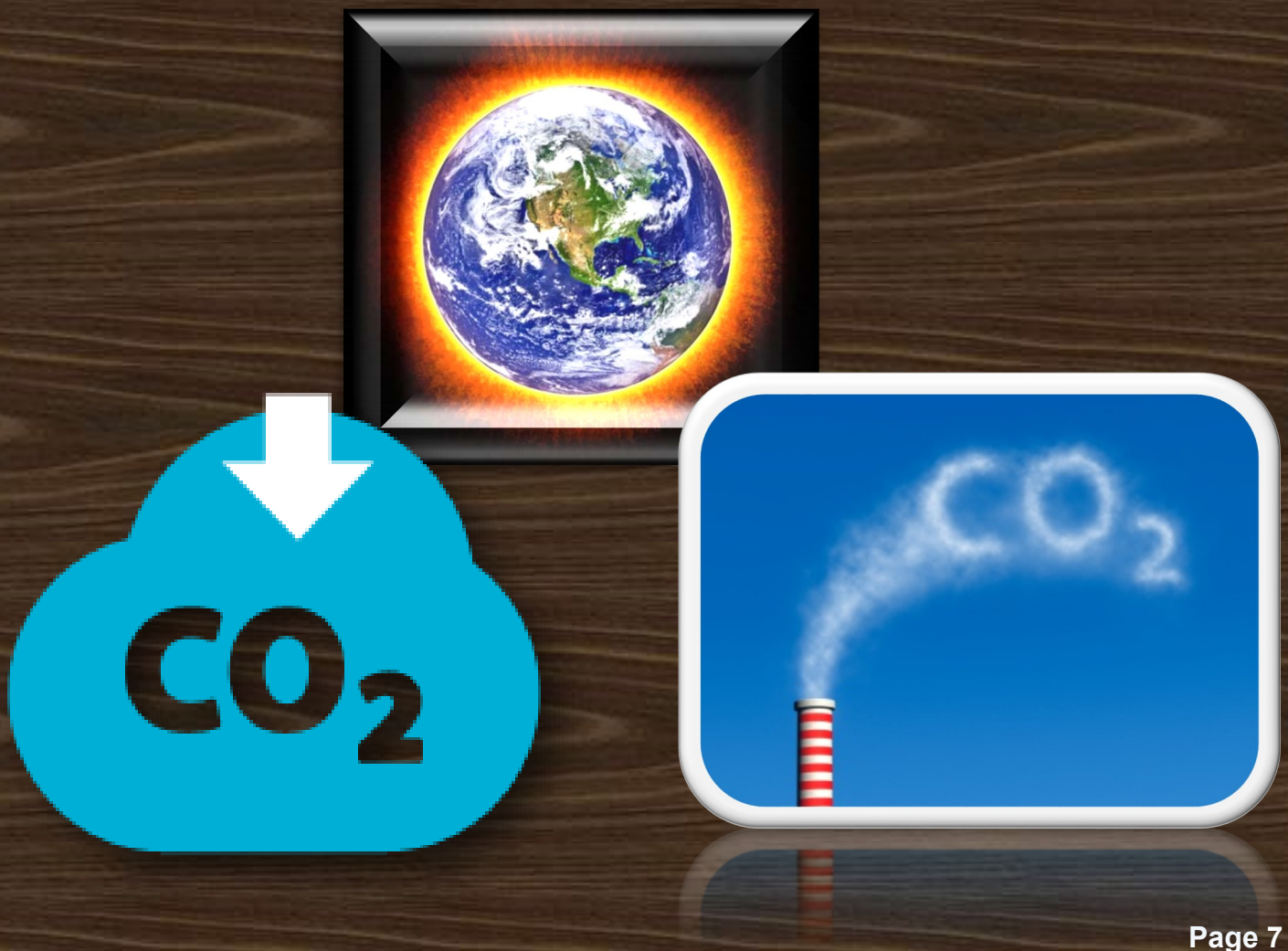
✓Supporting Agency goals through energy efficiency, NASA/contractor fleet and alternative commuting.

GOAL

Reduce direct GHG emissions (onsite or offsite) by 18.3% and indirect emissions (e.g., commuting, travel) by 12.3% by FY2020, compared to 2008.

Summary

NASA GHG emission reduction targets reflect: identified reductions in energy use and intensity; reduced use of fossil fuels and increased use of alternative fuels in fleet vehicles; increased application of green building principles and sustainable design; and innovative energy technologies and funding strategies that promote conservation and renewable energy use.



Goal 2: Sustainable Buildings

✓Met target in FY2015 with respect to energy intensity

×Did not meet the target of 15% of the agency's existing buildings meeting the guiding principles by 2015.

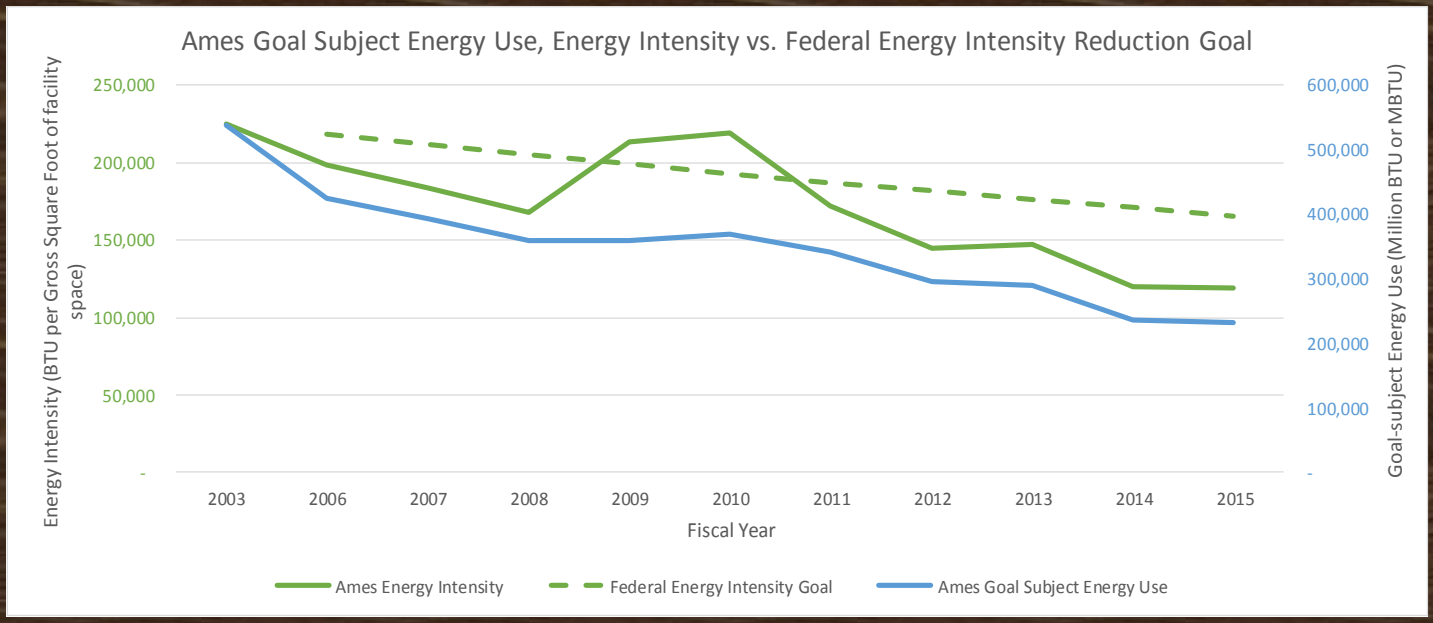
GOAL

Facility Energy Intensity: Reduce energy consumption per gross square foot (GSF) of building area by 3% annually from FY2003 baseline for FY2006-FY2015 (30% total).

Sustainable buildings: At least 15% of agency's existing buildings meet guideline principles by FY2015.

Summary

The FY2003 energy intensity was 224,890 btu/gsf while the FY2015 energy intensity was 118,839 btu/gsf. The goal was a 30% reduction in energy intensity but Ames achieved a 47% reduction, clearly exceeding the goal. The FY2015 gross square footage (GSF) of the Ames facilities is 1,945,863, while the Sustainability Base is only 50,000 square feet. Therefore, only about 3% of Ames' existing buildings meet the guiding principles of a sustainable building. NASA continues to make progress on its energy intensity and sustainable building goals. There is already one sustainable building, N232, and a plan in the future to build a sustainable lab. NASA tracks its energy goals through the Annual DOE Energy/Water report, Semi-Annual OMB Scorecard, DOE Compliance System reporting on energy/water consumption, ECM implementation and tracking, and building benchmarking.



Goal 3: Fleet Management

✓Met the target for 2% reduction in petroleum use.

×Did not meet the target for alternative fuel use.

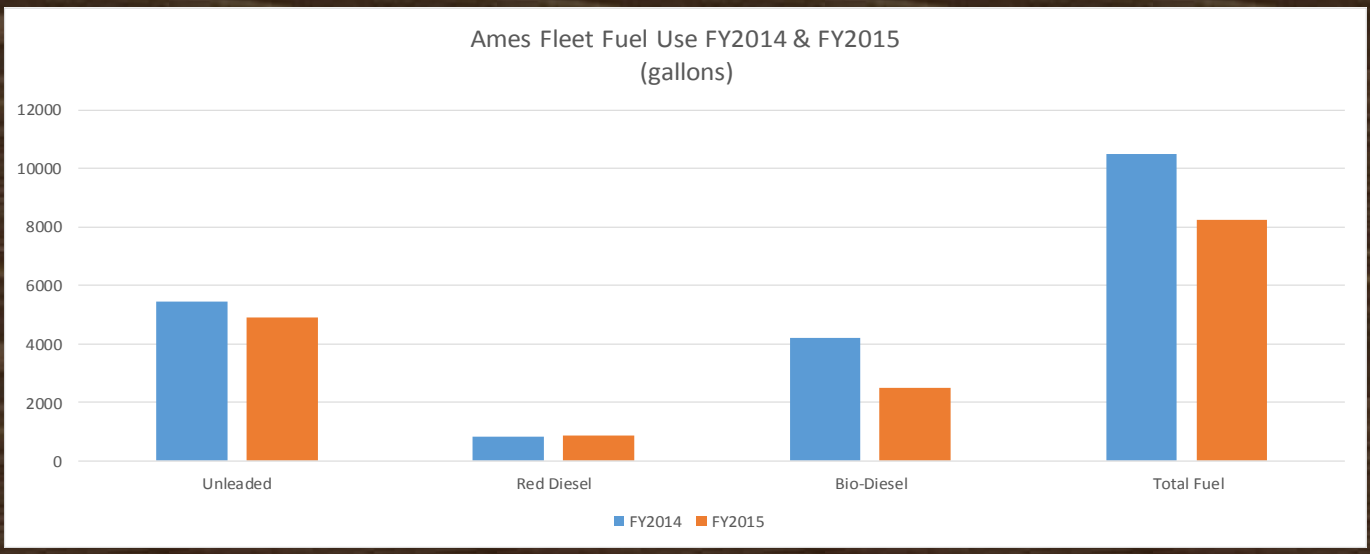
GOAL

Reduce petroleum use by 2% annually, compared to 2005; increase use of alternative fuels by 10% annually through FY2015.

Summary

NASA updates its Fleet Management Plan each fiscal year to ensure actions support the Petroleum Reduction and Alternative Fuel usage goals. Continued execution of its Fleet Management Plan maintains the following objectives: a) acquire and/or adjust the size and functional utility of each vehicle to match the program's needs and/or mission's requirement (right sizing the vehicle fleet); and b) acquire Alternative Fuel Vehicles (AFVs), Flex Fuel Vehicles (FFVs) or Low Greenhouse Gas (GHG) emitting vehicles during "end of life cycle" replacements, for current vehicle requirements. NASA Center Transportation Officers (CTOs) manage and control all assigned vehicles and annually evaluate NASA's vehicle fleet for both existing vehicle assignments and new requests for transportation support. One challenge to the use of alternative-fueled vehicles is the lack of commercial infrastructure. NASA is considering increasing alternative fueling infrastructure within the Ames Center's campus.

Additionally, one of the reasons Ames failed to meet this goal is because in FY2015, Ames retired some older fleet vehicles, some of which used biofuels. Newer petroleum-fuel buses were leased from the GSA to replenish the fleet. These leased buses are fueled and maintained by the GSA, and so the fuel consumption is not counted towards Ames' goal.



Goal 4: Water Use Efficiency

×Ames missed the potable water intensity reduction goal in FY2015.

○There was insufficient data available to estimate landscaping, industrial and agricultural water use

GOAL

Reduce potable intensity (gallons/square ft) by 2% each year, compared to 2007; reduce use for industrial, landscaping, and agricultural by 2% each year, compared to 2010.

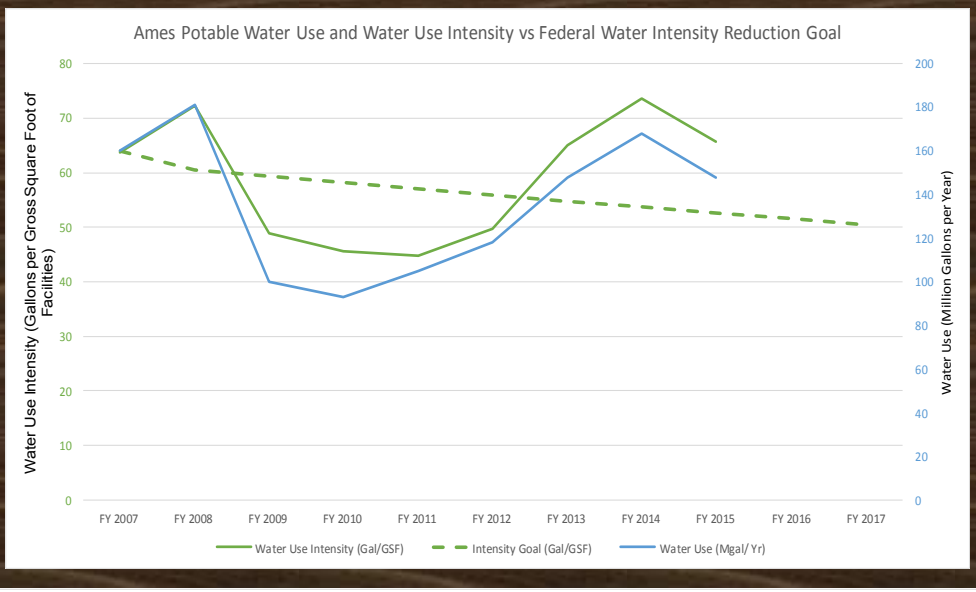
Summary

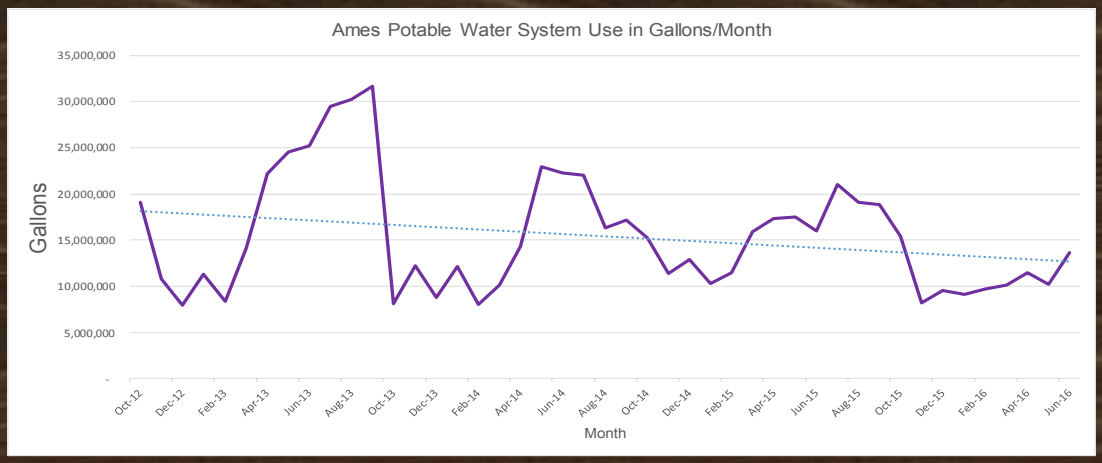
NASA uses meter reading data to track water use. Centers are responsible for installing water efficient technologies in all new buildings and for upgrades and maintenance of existing buildings. The Ames facilities maintenance group conducts water conservation audits and leak detection programs and these efforts have resulted in water distribution system repairs. NASA Ames is responsible for reducing the use of landscape irrigation to reduce potable water use—while also considering safety (e.g., fire protection) and mission requirements. Ames is also responsible for reviewing industrial and landscaping uses (no agricultural water uses) and installing meters where needed. Most industrial and landscaping water used is potable water. Additionally, landscaping is usually associated with a building and is accounted as a part of that's building's potable water use. In 2013, Ames opened the groundwater filtration facility to supply high quality water for Arc Jet Facility operations. This facility uses the stream of treated groundwater generated through the clean-up of contaminated groundwater. Previously some of this water was discharged to Stevens Creek and the Arc Jet was fed by potable water from the Hetch Hetchy Aqueduct. A portion of this water is used for irrigation at Sustainability Base. A large percentage of treated groundwater is treated by reverse osmosis and the purified water is used to feed the boiler and cooling towers at the Arc Jet facility. This replaces almost all the potable water use in the Arc Jet with water that used to be disposed into the creek.

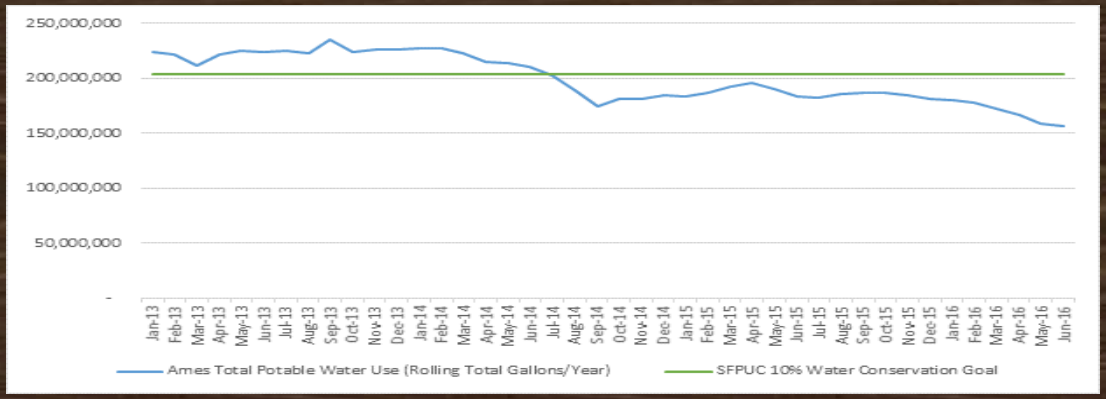
Although Ames missed the target for potable water use reduction in FY2015, the overall trend is that potable water use has steadily declined in the last three years. This is shown in the figure on the next page.

Goal 4: Water Use Efficiency Data

Water Use Intensity is the measure of water use per gross square foot of Ames' goal subject facilities. Compared with water use, water use intensity is a better measure. The intensity measure allows objective comparison of Ames water use with water use of other NASA centers with larger or smaller overall area. Although Ames does not meet the federal goal for water conservation, Ames met the San Francisco Public Utilities' (SFPUC's) 10% water conservation goal.







Ames Water Use Rolling Total vs. SFPUC 10% Water Conservation Goal

Goal 5: Pollution Prevention & Waste Reduction

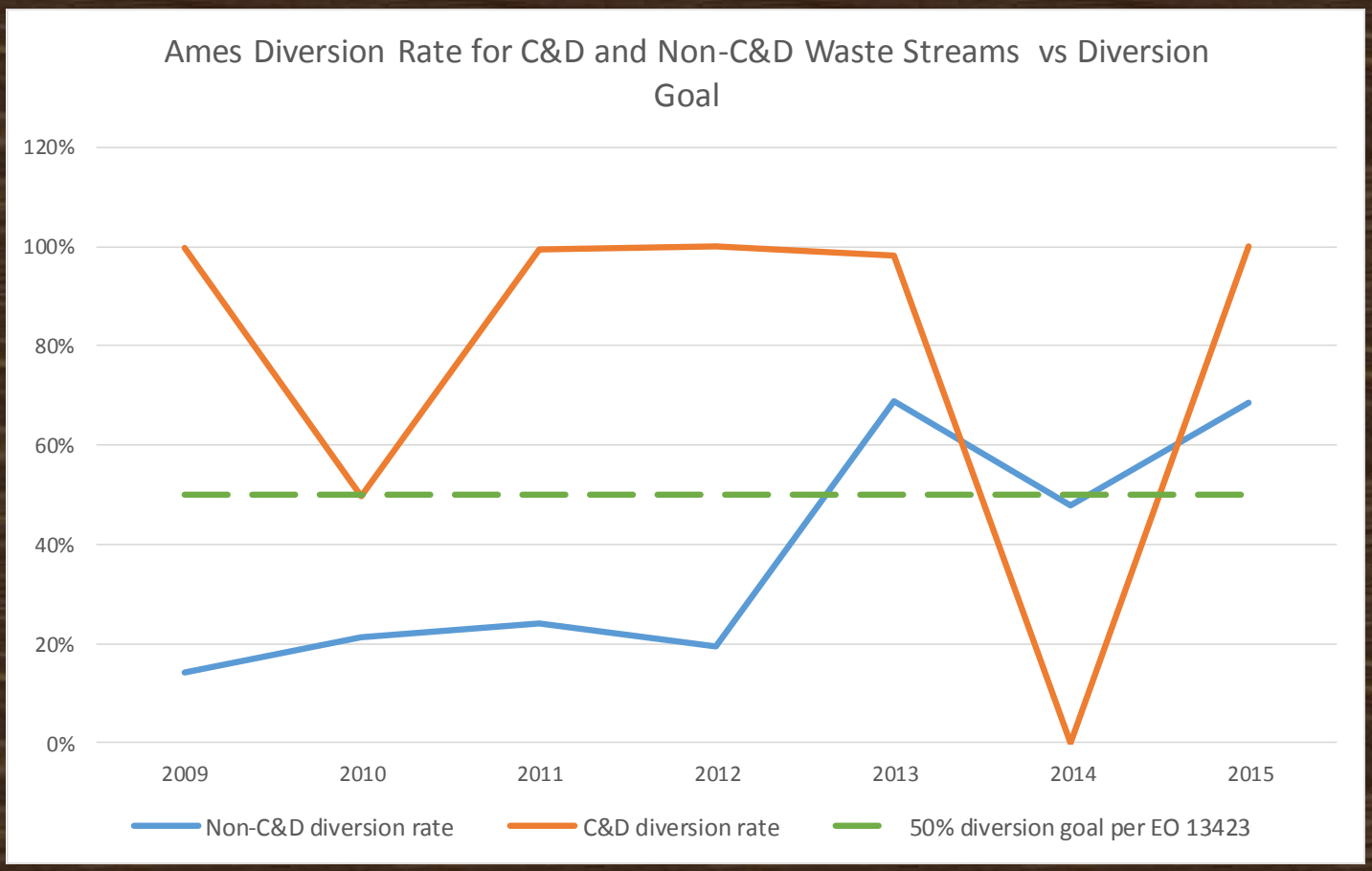
✓Met Goal for C&D and Non C&D waste recycling in FY2015.

GOAL

Divert 50% of solid waste (excluding construction and demolition debris); divert 50% of construction and demolition debris.

Summary

NASA continued to exceed the Executive Order diversion goals for construction and demolition debris and non-construction solid waste. Currently, the Agency tracks waste generation and disposition rates through the NASA Environmental Tracking System (NETS).



****No data was available for C&D recycling for 2014****

Goal 6: Sustainable Acquisition

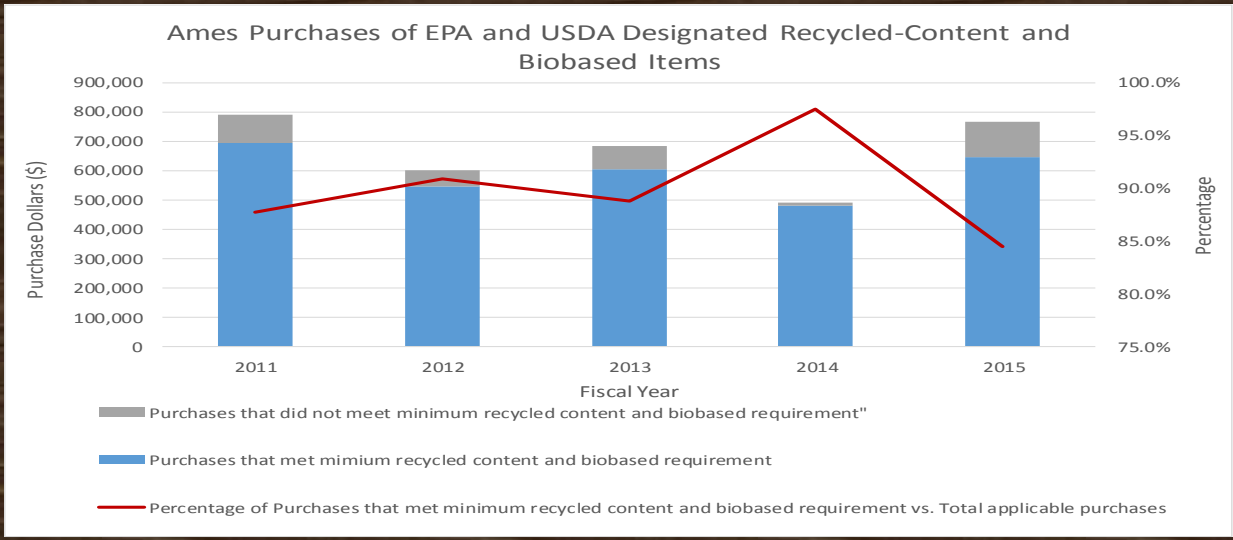
✓100% of applicable actions met criteria in FY2015.

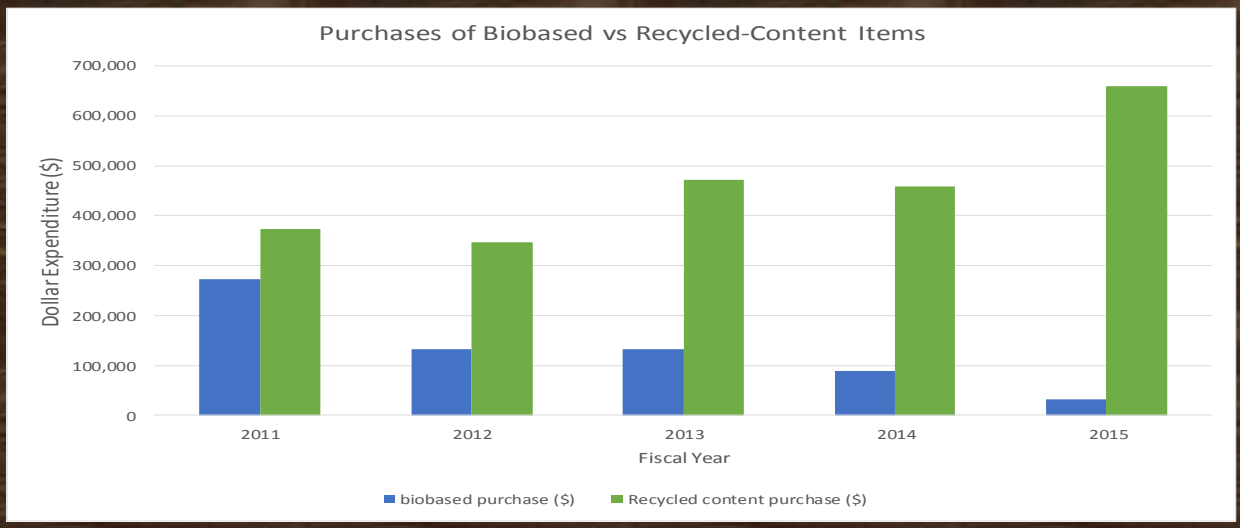
GOAL

>95% of applicable new contract actions meet federal mandates for acquiring products that are energy efficient, water efficient, bio-based, environmentally preferable, non-ozone depleting, recycled content, or are non-toxic or less toxic alternatives, where these products meet performance requirements

Summary

NASA Ames ensured the environmental performance and sustainability factors were considered to the maximum extent practicable for all applicable procurements.





Goal 7: Electronic Stewardship & Data Centers:

✓On Target in FY2015 - Recycled 99,091 lb. e-waste.

GOAL

Procure energy-efficient equipment rated per Electronic Product Environmental Assessment Tool (EPEAT); use best practices for computer operation and disposal.

Summary

NASA maintains a 'green' status for its Electronic Stewardship and Data Center goal, measured by: ensuring procurement preference for EPEAT-registered products; implementing policies to enable power management, duplex printing, and other energy-efficient features; employing environmentally sound practices with respect to the disposition of electronic products; procuring Energy Star and FEMP designated electronics; and implementing best management practices for data center operations. Strategic planning for data center consolidation is done at the agency level and data center consolidation and data center power monitoring is linked to the OMB's 25 Point Plan for Shift to a Cloud First and Develop a Strategy for Shared Services. The data center power monitoring initiative has largely been abandoned due to budget reductions.

Goal 8: Renewable Energy

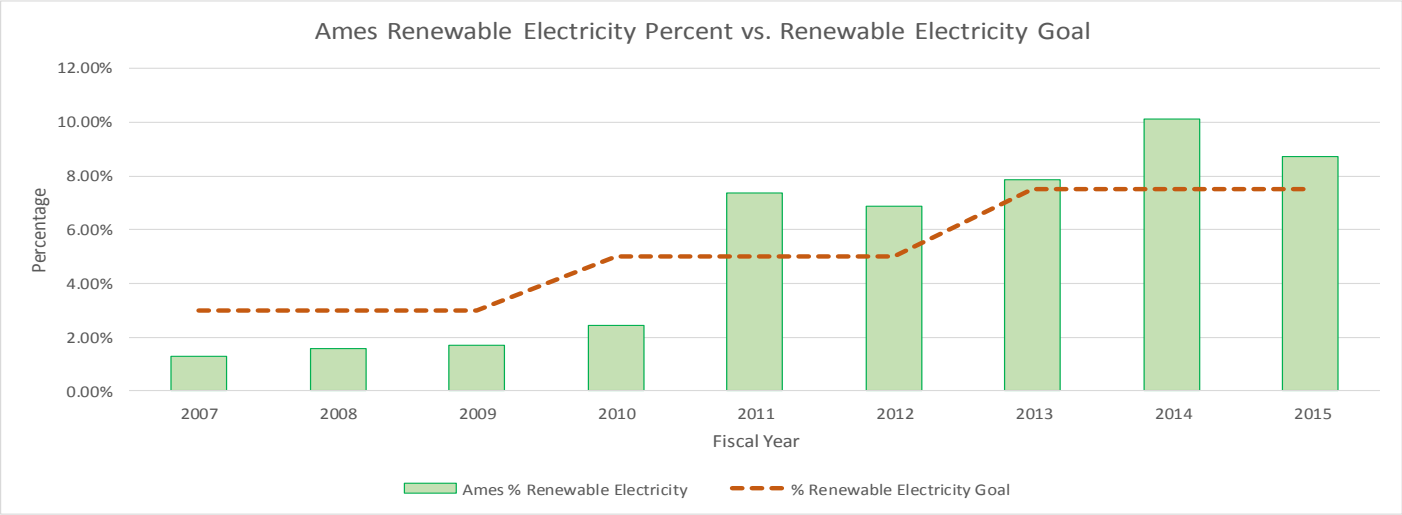
✓On Target in FY2015- 10.12% renewable.

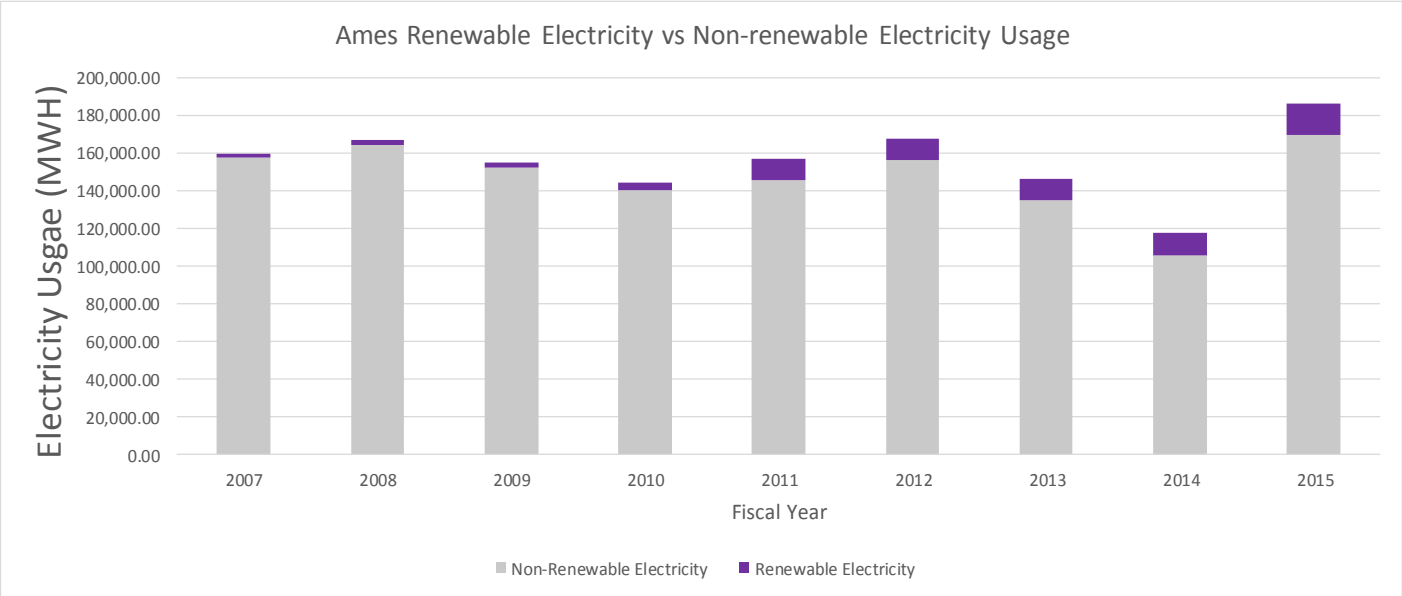
GOAL

For FY2013 and beyond, 7.5% of agency's total electricity consumption is from renewable energy sources.

Summary

There was an 8.74% renewable energy purchase in FY2015 renewable energy was 8.74% of Ames' total electricity consumption.





Goal 9: Climate Change Resilience

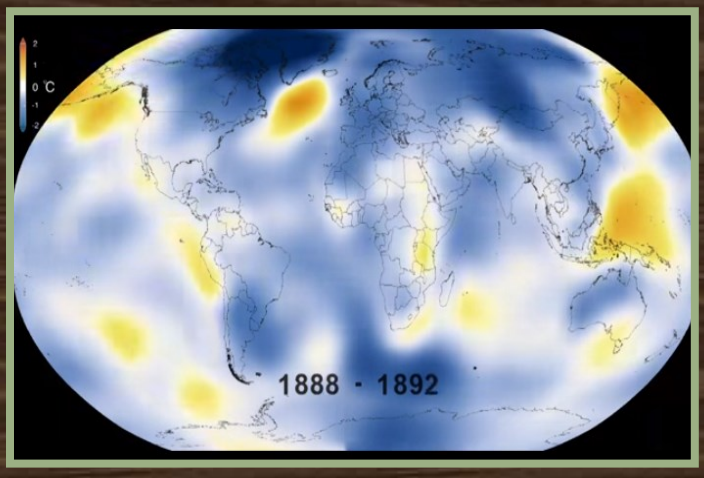
✓On Target

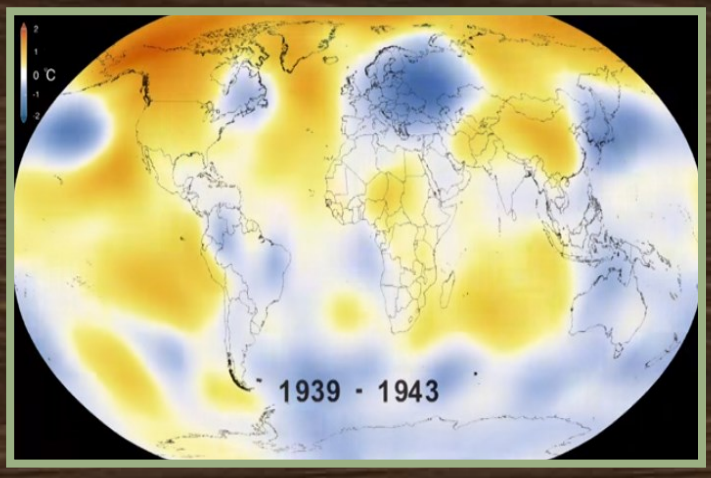
GOAL

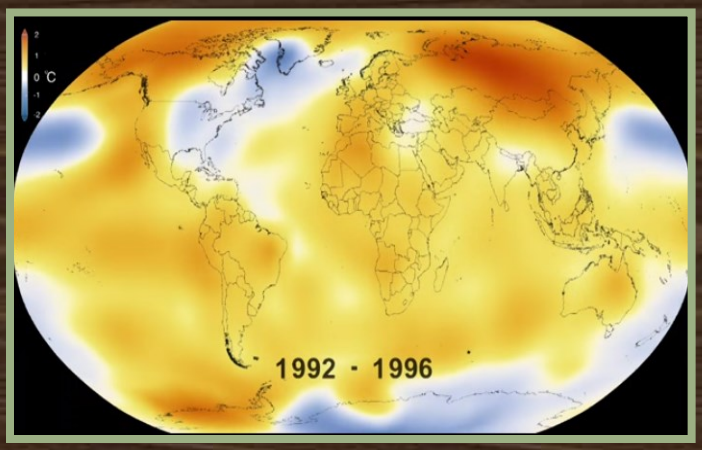
Evaluate climate change risks to identify and manage the effects of climate change on the agency's operation and mission in both the short and long term.

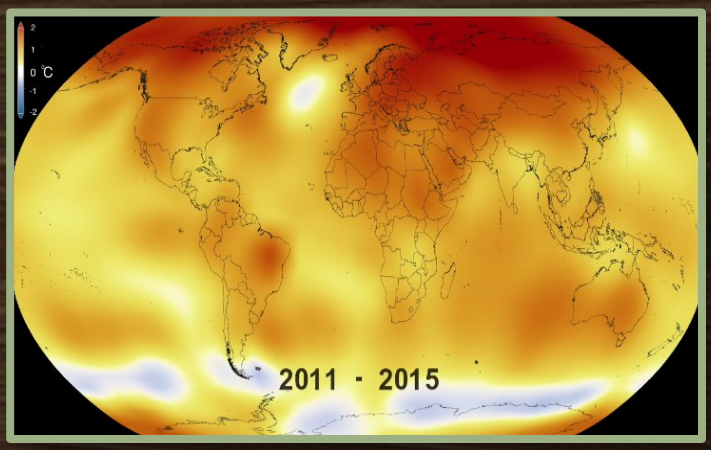
Summary

NASA Ames achieves this by recognizing climate risks as a potential impediment to a sustainable NASA and the importance of driving culture change. Science and institutional leaders have made adapting to climate risks a focus by participating actively in workshops, advocating for applicable research, and advancing relevant policies. NASA remains on the forefront of climate science, research, and computational modeling—providing vital information to the public and NASA institutional managers.









FY 2016 Planning

Goal 2: Sustainable Buildings

×May miss target in FY2016 if current trends persist.

Ames is projected to miss the target in FY2016 for the following reasons:

○The energy intensity reduction goal in FY2016 is more aggressive than in FY2015.

○Ames's Goal Subject Area is likely to be smaller in FY2016.

Note that FY2016 projection is based on a rolling total of goal subject energy use for the last three quarters (Q2, Q3 and Q4) of FY2015 and the Q1 of FY2016 as reported in NETS.

Goal 4: Water Use Efficiency

✓Projected to meet the goal in FY2016 if current trends persist.

Ames is projected to meet the water intensity goal in FY2016, or at least miss the goal by a smaller margin compared to FY2015:

○Water use in Q1 of FY2016 is roughly 42% less than water us in Q1 of FY2015.

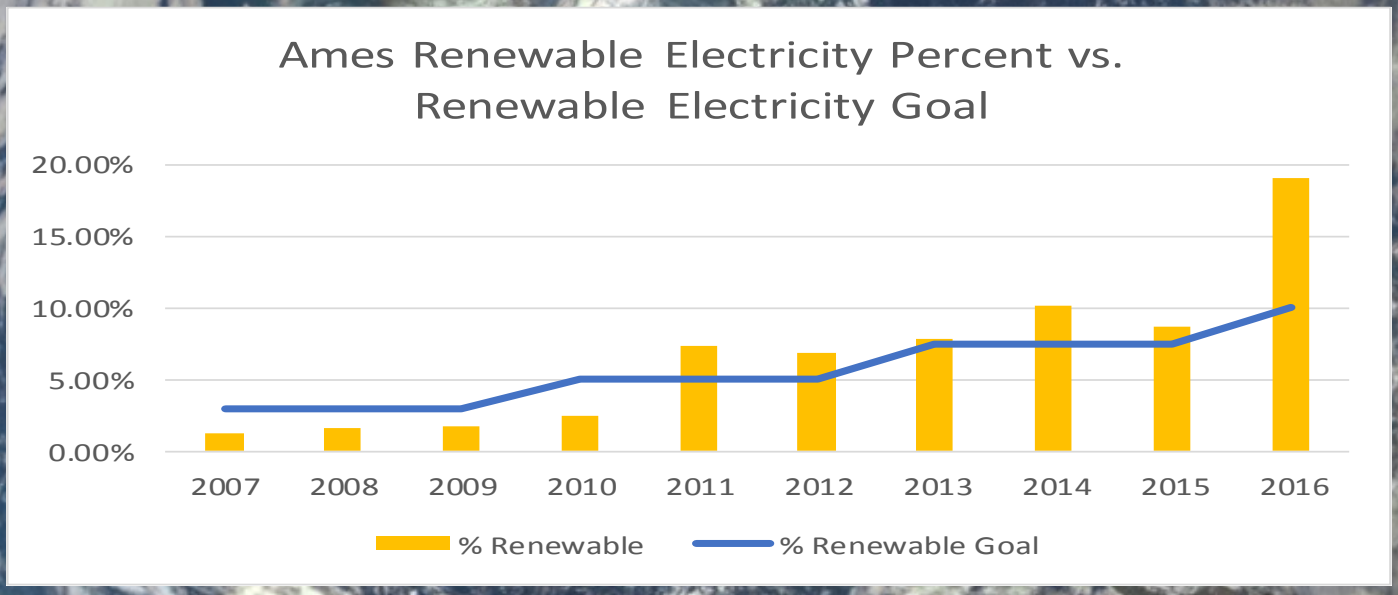
○Recent revisions to the formula for calculating input water may further lower water use for Ames Goal Subject Area.

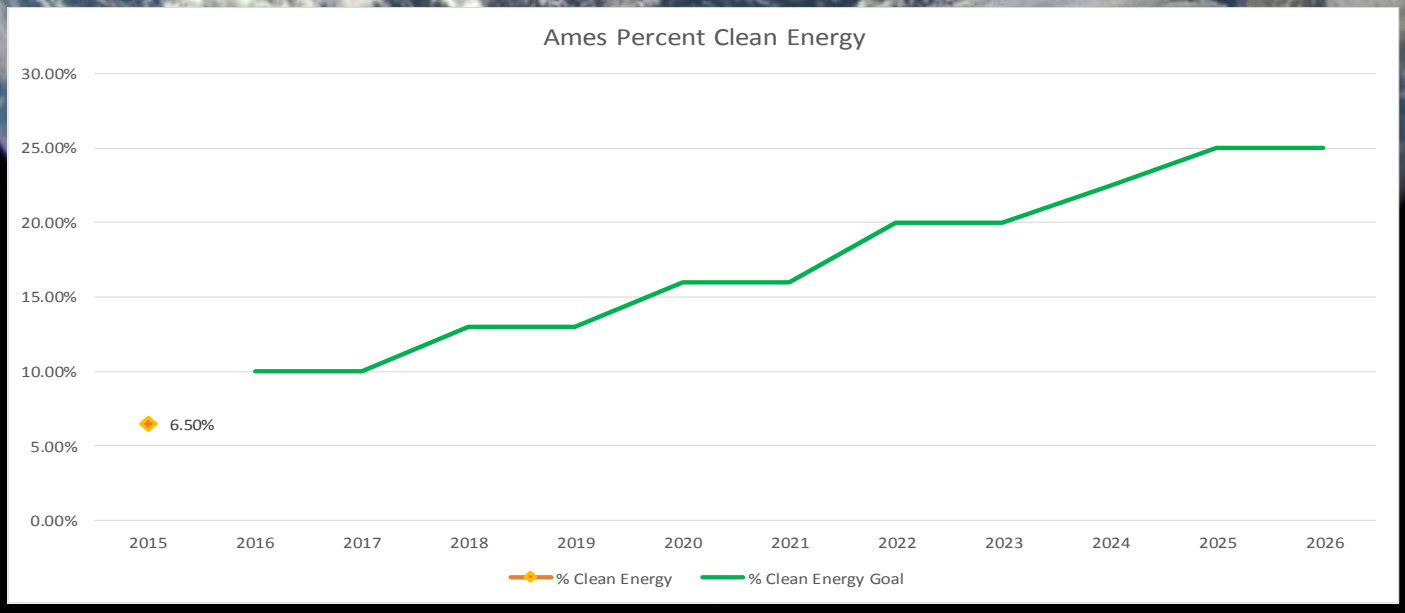
Note that FY2016 projection is based on a rolling total of goal subject water use for the last three quarters (Q2, Q3 and Q4) of FY2015 and the Q1 of FY2016 as reported in NETS.

FY 2016 Planning

Renewable Energy

✓Projected to meet target in FY2016





"Because NASA Earth Science is teaching us about our own planet's oceans, atmosphere, surface, energy cycle, water cycle, carbon cycle, weather and changing climate ... the state of our NASA is strong."

- Charles Bolden