



KENNEDY SPACE CENTER

20 | Annual 15 | Sustainability Report





**Kennedy Space Center is
GO for GREEN!**

“AS SOMEONE WHO HAS BEEN FORTUNATE TO LAUNCH INTO SPACE MORE THAN ONCE, I CAN TELL YOU THAT WHEN VIEWED FROM OUT THERE, OUR BORDERLESS EARTH INSPIRES A SENSE OF HUMILITY, UNITY OF HUMANITY AND WONDER. IT ALSO BECKONS US TO BE GOOD STEWARDS.”

- NASA Administrator Charles Bolden
Veteran Space Shuttle Astronaut

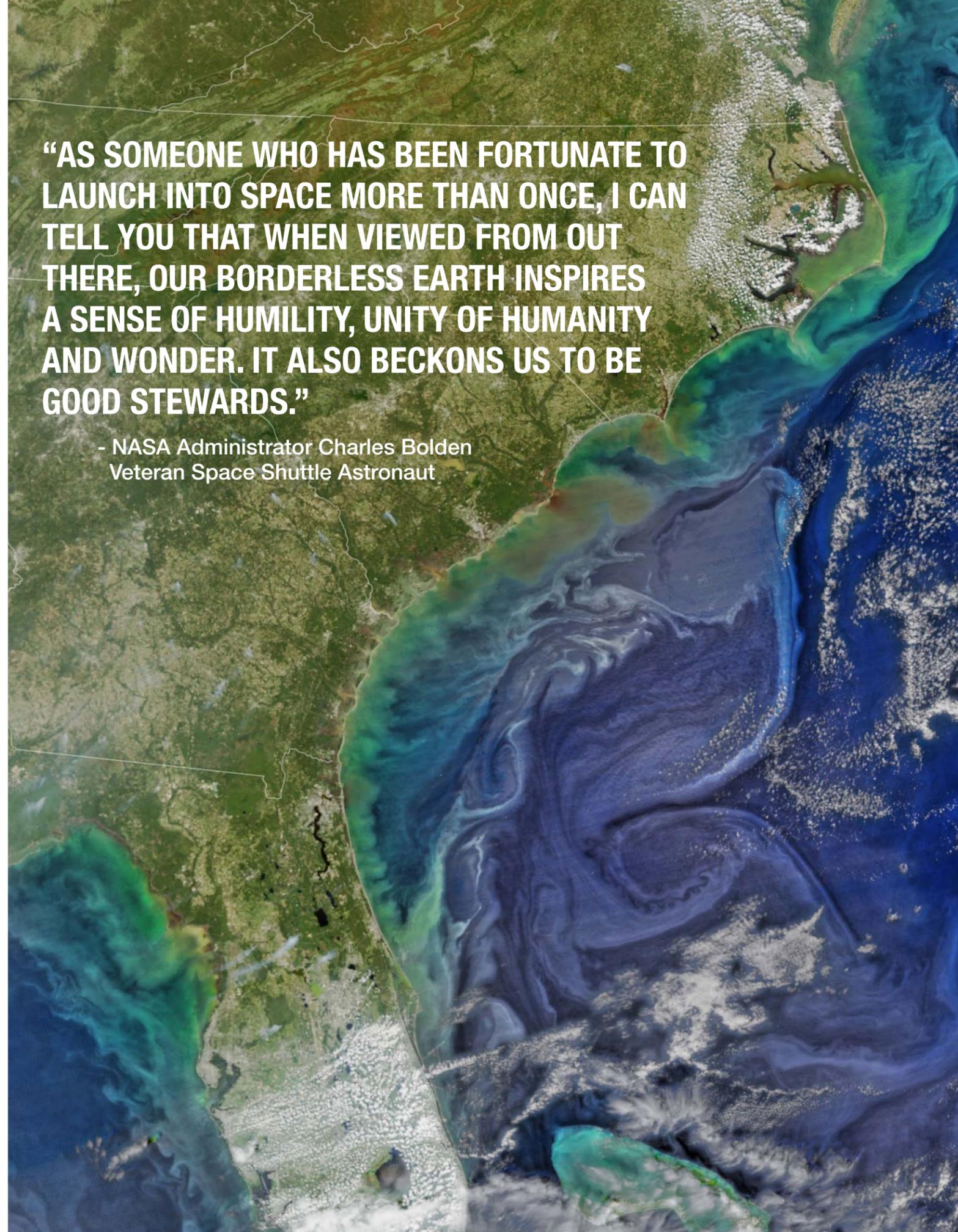


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Expedition 46 flight engineer Tim Peake of the European Space Agency (ESA) shared this stunning nighttime photograph with his social media followers on Jan. 25, 2016, writing, "Beautiful night pass over Italy, Alps and Mediterranean." Image Credit: ESA/NASA

GREEN ACROSS THE BOARD!

SUSTAINABILITY AND ENERGY SCORECARD

The Sustainability and Energy Scorecard provides a quick snapshot of Kennedy Space Center's performance in meeting the sustainability goals outlined in the KSC Sustainability Plan. It provides a status for the functional areas spanning greenhouse gas (GHG) emissions, energy intensity, renewable energy, potable water intensity, reduction in fleet petroleum use, green buildings, pollution prevention, waste management and sustainable acquisition, and climate change. The KSC Environmental Management Branch monitors the performance in each of these categories to achieve a "Go for Green" status and to identify continuous improvements.

Scope 1 & 2 GHG Emission Reduction

GOAL: Scope 1 and 2 Greenhouse gases (GHG) are gases produced directly by human activity that trap heat from the sun and warm the planet's surface. The goal is to reduce these gases that are produced by work related to NASA's mission by at least 10.7 percent in comparison to what was produced in 2008 and will reduce this amount by 18.3 percent by the year 2020.

Red	Yellow	Green
Did not reduce GHG Scopes 1 & 2 by 9.2 percent and is not on track to achieve its FY 2020 target	Reduce GHG Scopes 1 & 2 by at least 9.2 percent and is on track to meet the FY 2020 target of 18.3 percent	Reduce GHG Scopes 1 & 2 by at least 10.7 percent compared to the FY 2008 baseline and is on track to achieve its FY 2020 target goal of 8.3 percent

SCORE: ● Goal Met Reduced by – 10.7%

Scope 3 GHG Emission Reduction

GOAL: Scope 3 GHG is produced from sources not owned or controlled by NASA, but are produced by activities, such as employee business travel and commuting. The goal is to reduce GHG Scope 3 by at least 7.2 percent compared to the FY 2008 baseline and is on track to achieve its FY 2020 target of 12.3 percent.

Red	Yellow	Green
Did not reduce GHG Scope 3 by at least 6.2 percent and is not on track to achieve its FY 2020 target	Reduce GHG Scope 3 by at least 6.2 percent and is on track to achieve its FY 2020 target of 12.3 percent	Reduce GHG Scope 3 by at least 7.2 percent compared to the FY 2008 baseline and is on track to achieve its FY 2020 target of 12.3 percent

SCORE: ● Goal Met Reduced by – 7.2%

Reduction in Energy Intensity

GOAL: The goal is to reduce the amount of energy used per square foot in predetermined facilities (e.g. Headquarters, Neil Armstrong Operations and Checkout Building) by at least 30 percent in comparison to what was used in 2003.

Red	Yellow	Green
Did not reduce energy intensity (Btu/GSF) in Energy Independence and Security Act (EISA) goal-subject facilities by at least 27 percent compared with FY 2003	Reduce energy intensity (Btu/GSF) in EISA goal-subject facilities by at least 27 percent compared with FY 2003	Reduce energy intensity (Btu/GSF) in EISA goal-subject facilities by at least 30 percent compared with FY 2003

SCORE: ● Goal Met – Reduced by 50.9%

Use of Renewable Energy

GOAL: Of the energy used in facilities, 10 percent should be from renewable energy such as solar panels. Fifty percent of that renewable energy needs to be from a resource that has been built since 1999.

Red	Yellow	Green
Did not use at least 10 percent electricity from renewable sources as a percentage of facility electricity use	Use at least 10 percent electricity from renewable sources as a percentage of facility electricity use but less than half (5 percent) was obtained from new sources (post-FY 1999)	Use at least 10 percent electricity from renewable sources as a percentage of facility electricity use. Of this 10 percent at least half (5 percent) of facility electricity use comes from new sources (post-FY 1999)

SCORE: ● Goal Met – Used 11.9%

Reduction in Potable Water Intensity

GOAL: Reduce the gallons of water used per square foot by 16% as compared to 2007. In 2007 water intensity was 38.6 gal/sf. Therefore the water intensity goal is 32.4 gal/sf and continue working toward a reduction of 26% in 2020.

Red	Yellow	Green
Did not reduce water intensity by at least 12 percent from FY 2007 baseline	Reduce water intensity by at least 12 percent from FY 2007 baseline	Reduce water intensity by at least 14 percent from FY 2007 baseline and is on track for 26 percent reduction by FY 2020

SCORE: ● Goal Met – 22%

Increase in Alternative Fuel Usage to Overall Usage

GOAL: In 2015, 35 percent of the fuel used in vehicles on the center must be alternate fuel (ex. electric, natural gas, ethanol, etc.) and the center is working on the goal of 40 percent alternative fuel usage by the year 2020.

Red	Yellow	Green
Did not increase the ratio of Alternative Fuel Usage to Overall Fuel Usage by at least 0.5 percent annually in FY 2015 and is not on track to achieve its 40 percent target by FY 2020	Increase the ratio of Alternative Fuel Usage to Overall Fuel Usage by at least 0.5 percent annually compared to FY 2005 to achieve an overall 34.5 percent target in FY 2015 and is on track to achieve its 40 percent target by FY 2020	Increase the ratio of Alternative Fuel Usage to Overall Fuel Usage by at least 1 percent annually compared to FY 2005 to achieve an overall 35 percent target in FY 2015 and is on track to achieve its 40 percent target by FY 2020

SCORE: ● Goal Met – 46%

KSC PRIORITY MANAGEMENT PLANS

Metric Description: KSC establishes high priority environmental aspects (which can span multiple years) that require a Priority Management Plan (PMP).

The goals for each high priority aspect are listed in the metric below. These goals are reviewed and evaluated quarterly and given a score of Green, Yellow, or Red. Green indicates the goal has been met. Yellow indicates that there is a possible chance of not meeting the goal and requires the owner of the goal to further monitor or make adjustments on the PMPs. Red signifies that the goal has not been met for the fiscal year and requires the owner of the goal to provide an explanation for not meeting the goal and any corrective actions to be implemented.

Status	Goals	Priority Management Plan (PMP) Tasks
	Energy & Water Consumption - Energy Efficiency: <ol style="list-style-type: none"> Reduce energy intensity by 30% from FY03 baseline by 09/30/15 Meet 10% renewable energy use goal from renewable energy sources by 09/30/15 Evaluate/Audit 25% of facility infrastructure for energy saving opportunities by 09/30/15 	<ol style="list-style-type: none"> Keep KSC organizations participating in Energy Working Group meetings Identify energy conservation measures to pursue energy projects Promote energy awareness directed to the KSC workforce <ol style="list-style-type: none"> KSC designs sustainable and energy efficient facilities Develop priority listing for FY15 facility audits (03/31/15) <ol style="list-style-type: none"> Expand utility reporting system to provide a more user-friendly interface Complete FY15 facility audits evaluation (12/31/15)
	Natural Resources - Dune Restoration: <ol style="list-style-type: none"> Develop and implement task for Center-wide shoreline design and KSC climate adaptation study 	<ol style="list-style-type: none"> Long term monitoring of new secondary dune (9/30/15) Develop a forward plan to address: <ol style="list-style-type: none"> KSC Coastal Shoreline Design (4/30/15) KSC infrastructure Climate Adaptation Study (4/30/15)
	Solid Waste – Construction & Demolition Waste Disposal: <ol style="list-style-type: none"> Inform KSC Management approach to construction waste diversion for the KSC HQ & CIF deconstruction projects by 2/27/15 	<ol style="list-style-type: none"> Evaluate and determine cost of various approaches to asbestos abatement and construction solid waste diversion for the Headquarters and Central Instrumentation Facility deconstruction projects (1/30/15) Present a decisional package to KSC Management at a Center Operations Engineering Review Board which includes options for budgetary and environmental consideration

Green Buildings

GOAL: The Guiding Principles are a set of government established criteria for federal agencies to use in building and maintaining sustainable buildings. The goal is to have 15 percent of applicable buildings meet the Guiding Principles by 2015. The use of these Guiding Principles make buildings more energy-efficient and less dependent on natural resources for heating, cooling and other operations.

Red	Yellow	Green
Did not demonstrate that at least 15 percent of goal subject facilities, measured in either gross area or number of facilities, meet the GP	At least 15 percent of goal subject facilities, measured in either gross area or number of facilities (but not both), meet the GP	At least 15 percent of goal subject facilities, measured both in terms of gross area and number of facilities, meet Guiding Principles (GP) for Federal Leadership in High Performance and Sustainable Buildings

SCORE:  Goal Met – 21% by gross area and 16% by number of facilities

Pollution Prevention and Waste Management

GOAL: Keep 50 percent of every day, non-hazardous garbage and 50 percent of construction and demolition (C&D) garbage out of the landfill.

Red	Yellow	Green
Divert less than 50 percent of non-hazardous solid waste (excluding C&D waste) and divert less than 50 percent of C&D waste	Divert at least 50 percent of non-hazardous solid waste (excluding C&D waste) or divert at least 50 percent of C&D waste	Divert at least 50 percent of non-hazardous solid waste (excluding C&D waste) and divert at least 50 percent of C&D waste

SCORE:  Goal Met – 57% non-C&D, 52% C&D

Sustainable Acquisition

GOAL: 95 percent of new contract actions require the use of sustainable products and services. Some examples are the light bulbs used in your office, toilet paper and less toxic chemical used in your bathrooms.

Red	Yellow	Green
Less than 50 percent of new applicable contract actions contain requirements for sustainable products and services	At least 50 percent of new applicable contract actions contain requirements for sustainable products and services	At least 95 percent of new applicable contract actions contain requirements for sustainable products and services

SCORE:  Goal Met – 100%

Climate Change Resilience

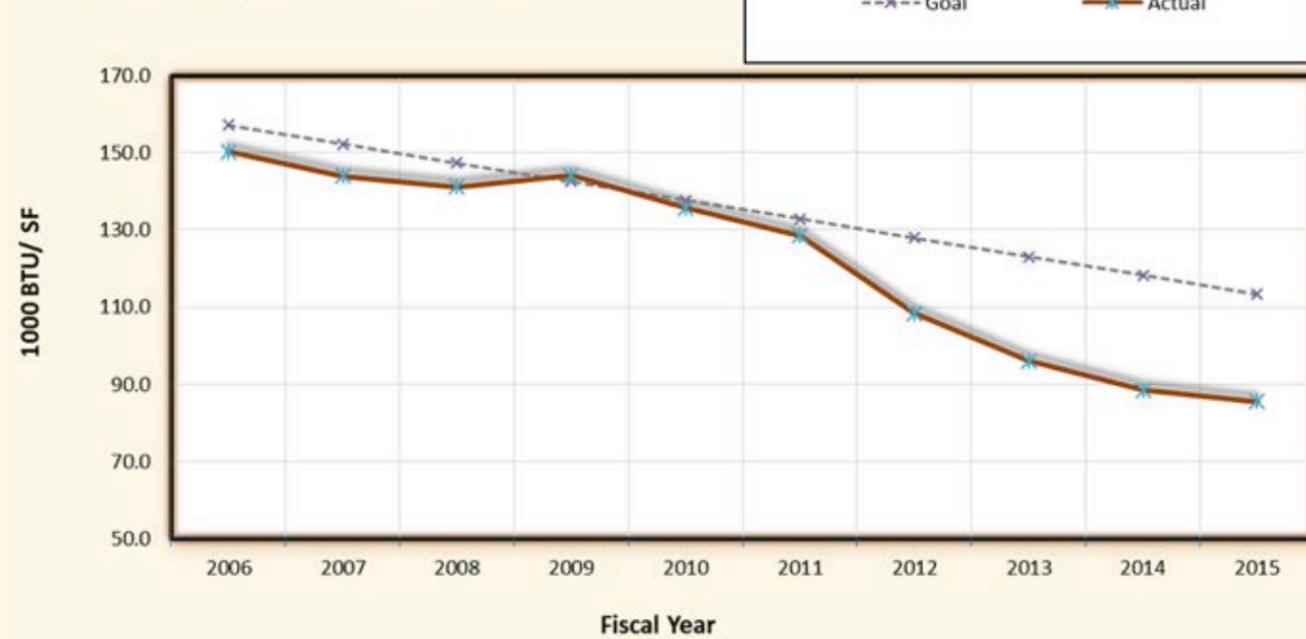
GOAL: Climate Adaptation Science Investigation (CASI) supports the ability to evaluate climate change risks and identify and manage the effects of climate change on the Agency's operations and mission in both the short and the long term. The goal is to achieve greater than 90 percent of planned tasks for the CASI participation plan.

Red	Yellow	Green
Achieved less than 80 percent of planned annual tasks for the CASI participation plan	Achieved between 80 percent and 90 percent of planned annual tasks for CASI participation plan	Achieved greater than 90 percent of planned tasks for the CASI participation plan

SCORE:  Goal Met – 95%

ENERGY METRICS

KSC Energy Intensity Metric

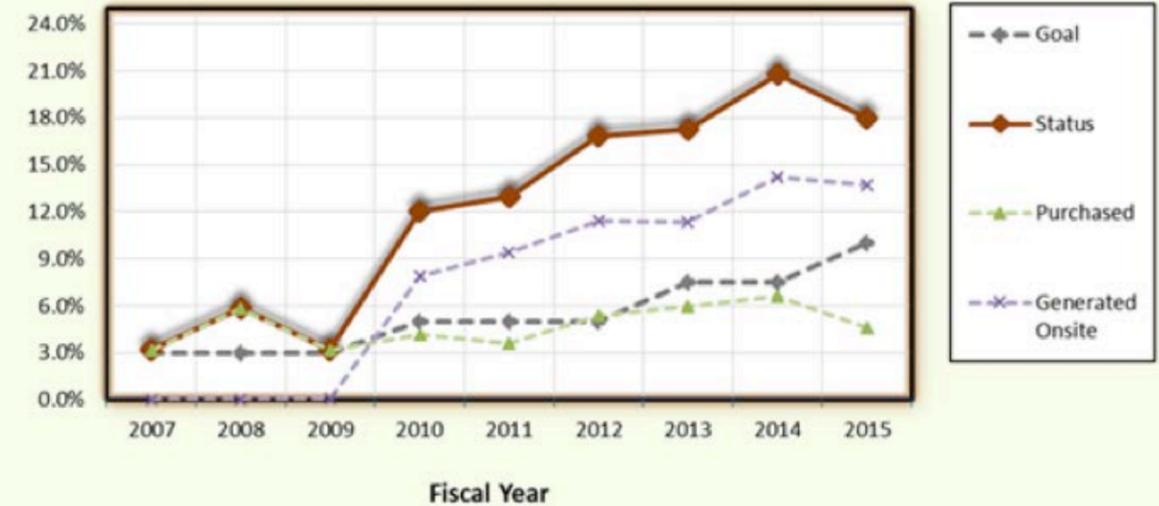


Metric Description: Measures energy intensity in BTUs per gross square foot at KSC’s Goal Subject facilities.

Goal: 30 % energy reduction compared to 2003 (see page 7 for more information).

Actual: The Center’s actual energy intensity values; KSC reduced its energy intensity more than what the goal called for.

KSC Renewable Energy Summary



Metric Description: Measures KSC’s renewable energy landscape.

Goal: 10 % renewable energy (see page 7 for more information).

Status: Add Purchased line to Generated Onsite line; KSC received credit for more renewable energy than what the goal called for.

Purchased: Renewable Energy Certificates Purchased from external resources.

Generated Onsite: As reported per standard federal renewable energy accounting practices.



Innovative Thinking Converts Repair Site Into Garden

As an innovative leader in Earth science, NASA encourages its people to find ways to enhance the environment. Earlier this year, Gloria Sylvia saw such an opportunity when water pipes were being replaced in front of the gate to the Vehicle Assembly Building (VAB). Her efforts to plant a small garden recently were rewarded with the Kennedy Space Center's Catch an Environmentalist Award.

NASA VAB Operations Manager Jim Bolton liked the improvements so much he nominated Sylvia and the F-Gate Garden Team for the recognition honoring their efforts to add plants and grass. The F-Gate includes a small building in which security monitors, such as Sylvia, provide access at the entrance of the facility.

"Gloria is one of the access control monitors here at F-Gate and she took the initiative," he said during a ceremony at the garden. "As the repair workers were finishing the water pipe project, she purchased a few plants on her own, placed them out there with some mulch."

One of the largest buildings in the world, the VAB originally was constructed to support stacking of the Apollo Saturn

V rockets that took American astronauts to the moon. The facility later was refurbished to support the 30-year Space Shuttle Program.

NASA now is modifying the facility to accommodate the Space Launch System advanced heavy-lift rocket which will provide a new capability for human exploration beyond low-Earth orbit. As employees come and go through the F-Gate each day, the idea of making the access more attractive quickly caught on and others wanted to help. "People started walking by thinking, 'what a cool idea,'" Bolton said. "Quite a few individuals started contributing to the effort."

In addition to the grass sod, plants and mulch, a pair of iconic plastic pink flamingos and a small garden gnome have been included.

"Ralph Gregory, with Jacobs Technology VAB Operations, bought the gnome," said Sylvia, who works in Security with Jacobs. "The gnome had been painted to appear to be wearing an Air Force uniform. I repainted it a bit and made the uniform into an astronaut flight suit."

She also noted that water is captured from the air conditioner on the side of the F-Gate building and recycled.

"We put the condensation in a watering can to irrigate the plants and new grass sod," she said.

Jacobs Vice President Andy Allen, who is general manager of the Test and Operations Support Contract team at Kennedy, congratulated the team effort for initiative, cooperation and pride. "This kind of esprit should be honored and it is certainly appreciated," said Allen, a former NASA astronaut. "Thanks for coming up with the idea. It looks great."

The Catch an Environmentalist Award recognizes individuals and teams that have notably contributed to environmental stewardship at the spaceport. The Catch an Environmentalist Award recognizes performance in several categories: Education and Awareness, Energy Conservation/Renewable Energy, Fuel, Efficiency/Renewable Fuels, Historic/Archeological Preservations, Natural Resources/Habitat Conservation, Sustainable Design/Construction, Sustainable Environment Management System (SEMS), Sustainable Operations, Use of Environmentally Preferable or Recycled-Content Products, Waste Prevention/Reduction/Recycling and Water Conservation.



Gloria Sylvia receives Kennedy Space Center's Catch an Environmentalist Award for her efforts in planting a small garden at the gate to the Vehicle Assembly Building (VAB). Also participating is Jacobs Technology Vice President Andrew Allen, who is general manager of the Test and Operations Support Contract Group at Kennedy.

Opposite: The small garden established at the gate to the Kennedy Space Center's Vehicle Assembly Building includes grass sod, plants, mulch, stepping stones, a pair of iconic plastic pink flamingos and a small garden gnome.



NEW DATA CENTER STREAMLINES IT INFRASTRUCTURE AT KENNEDY

Kennedy Space Center's new data center is open for business.

Located in Kennedy's Industrial Area, the facility officially was opened with a ribbon-cutting ceremony attended by space center leaders and employees. The new data center marks another major milestone for Kennedy and is a key component in the spaceport's capability to support multiple users, Kennedy Space Center Associate Director Kelvin Manning told the audience.

"The data center will support multiple activities – and we have a lot going on," Manning said, citing the efforts of the Ground Systems Development and Operations Program, the Commercial Crew Program, the Launch Services Program, and Kennedy's research and technology projects.

At only 16,000 square feet, the data center will replace approximately 45,000 square feet previously dedicated to five "legacy" data centers and information technology (IT) support areas. Once the facility is fully operational, it will be three times more efficient than the legacy data centers, positioning the spaceport to take on even more work, according to Vanessa Stromer, director of IT and

Communications Services at Kennedy. Consolidating the data centers into a single new one provides streamlined IT operations, improved efficiency and round-the-clock support.

Nancy Bray, director of Spaceport Integration and Services at Kennedy, pointed out yet another benefit: reducing the Kennedy footprint enables the removal of aging buildings such as the 136,000-square-foot Central Instrumentation Facility, an Apollo-era building that for decades was the hub of instrumentation and data processing operations. "Completion of the data center allows us to demolish older facilities," said Bray, whose organization oversees the operations and maintenance of the spaceport's infrastructure.

The new Kennedy data center is part of the first phase of construction on the spaceport's new central campus and is on target to receive Silver certification under the U.S. Green Building Council's LEED rating system.

SERVER CONSOLIDATION



When a 2010 federal mandate urged agencies to reduce the overall energy and real-estate footprint of their data centers, Kennedy responded with a server-consolidation project aimed at reducing costs, increasing security and improving efficiency. Once all the spaceport's data centers were identified, consolidation efforts began. The Vehicle Assembly Building data center has been closed; data centers in the Central Instrumentation Facility and Space Station Processing Facility will be migrated to the newly built Kennedy Data Center in fiscal year 2016. Data centers serving the Operations and Checkout Building and Launch Control Center will be migrated next, with completion expected in fiscal year 2017.

Opposite: Participating in the Kennedy Data Center ribbon-cutting are, from left, Ronnie Jones, Vice President of Operations, Sauer Incorporated; Nancy Bray, Director, Spaceport Integration and Services; Kelvin Manning, Associate Director of KSC; Vanessa Stromer, Director, IT and Communication Services; and Steve Belflower, Vice President, HuntonBrady Architects

Kennedy Space Center employees tour the newly opened Kennedy Data Center.

DID YOU KNOW?

93%

of construction waste Kennedy Space Center kept out of the landfill during construction of the new KSC Data Center.

ENVIRONMENTAL ENGINEER AWARDED FOR SUSTAINABILITY IN FACILITY CONSTRUCTION

Lisa Ruffe has made a lasting impact on Kennedy Space Center

An environmental engineer with InoMedic Health Applications, Ruffe received the 2015 Keep Brevard Beautiful Sustainability Award for her outstanding work incorporating sustainability principles into the construction of facilities at the spaceport. She was presented with the award at the organization's 4th annual River Fest celebration in Cocoa Village, Florida, on Sept. 26, 2015. Ruffe was recognized for using her knowledge in the Leadership in Energy and Environmental Design (LEED) and Green Globes processes to incorporate sustainable principles such as source reduction, recycling, reuse practices and waste reduction programs in facility design and construction. In her work supporting Kennedy's Environmental and Medical Contract, Ruffe is renowned for discovering new uses or recycling opportunities for materials that would otherwise have been sent to landfills, including porcelain restroom fixtures, such as sinks and toilets, mirrors, plastic and glass light fixtures, reflector lenses, office supplies, plastic hard hats and parachute materials. Through her efforts, more than 50,000 pounds of ceiling tile and nearly 13 tons of carpet tile have been recycled. On one project alone, 164 pounds of paper, nearly 16 tons of wood, more than 5 tons of metal, more than 18 tons of asphalt and approximately 600 tons of concrete were diverted from landfills. Ruffe holds LEED certification and has assisted NASA in the construction of several LEED buildings at Kennedy, including the Ordnance Operations Facility and the Armstrong Operations and Checkout Building, both of which attained LEED Gold status, as well as the Propellants North Facility, which attained LEED Platinum status and is the agency's first carbon-neutral facility. Her influence on Kennedy facilities will be noticeable for years to come as the spaceport reduces its energy usage, conserves more water and sends less waste to landfills – sensible sustainability for the next chapter in space exploration.





2014
STAR Top User
Kimberly Moore

*Sustainable Tracking Tool for Automated Recycling (STAR) Award
 This star design was created using the plate glass windows from the
 KSC Launch Control Center (LCC) Firing Rooms.
 These windows were a permanent fixture in the LCC Facility from
 1963 until they were replaced in 2010.*



STAR

AWARD HONORS COMMITMENT TO RECYCLING

Kimberly Moore knows our planet is changing and she's on it. Since 2013, the Kennedy Space Center's recycling system has streamlined its efforts to reuse materials with a Web-based portal called the Sustainable tracking Tool for Automated Recycling, or STAR. An executive assistant with Wichita Tribal Enterprises, Moore was recently honored for her untiring work supporting efforts to preserve the environment by ensuring office material is recycled. NASA continues to make a difference in people's lives. One way is by saving resources as well as increasing recycling revenue with the STAR portal. The effort is designed to process requests for emptying recycle collection bins or ordering new ones. During a Kennedy Institutional Support Services III, or KISS

Above: Executive assistant Kimberly Moore, center, is presented the 2014 STAR Top User Award by Environmental Management Branch Chief Glenn Semmel, left, and NASA Environmental Protection Specialist Annie Williams. Moore was recognized for her support of the Kennedy Space Center recycling program by using the Sustainable tracking Tool for Automated Recycling (STAR) System.

Left: The star design on the plaque was created using the plate glass windows from the Kennedy Space Center's Launch Control Center, or LCC, Firing Rooms. The windows were a permanent fixture on the LCC from 1963 until they were replaced in 2010.

III, contract staff meeting on March 17, Glenn Semmel, NASA's Environmental Management Branch chief at Kennedy, joined Annie Williams, a NASA Environmental Protection specialist, in presenting Moore with the 2014 STAR Top User Award. Moore serves as a Wichita Tribal Enterprises executive assistant in the NASA Procurement Office at the Florida spaceport. As the KISS III contractor, Wichita Tribal

Enterprises provides institutional support services in areas such as technical training, employee development, clerical support, and financial management support.

The Environmental Management Branch of Spaceport Integration and Services created the STAR Award to honor efforts to support and use the recycling system.

According to Williams, the recycling program at Kennedy was originally established as a “milk run” process, with every recycle container emptied on a weekly or monthly basis. However, with the STAR Web-based portal, it is now an “on demand” process, with containers emptied only when a service request is submitted.

“To do this the Sustainable tracking Tool for Automated

“The revenue we receive from recycling also comes back to Kennedy and is used to fund Sustainability projects.”

Recycling portal was created,” she said. “Now employees submit a request when their recycling bin is about three-quarters full. Since we were looking for a way to both advertise the program and acknowledge employees who are using it, we came up with the STAR Award.”

The STAR Award is presented annually to the single top user based on how many times someone submits a request.

“The star design on the plaque was made of plate glass windows removed from the firing rooms of Kennedy’s Launch Control Center, or LCC,” said Williams. “The windows were a permanent fixture on the LCC from 1963 until they were removed during a 2010 renovation project.”

Semmel and Williams also presented three “Catch an Environmentalist” Awards to Moore, Cindy Pfeil of InoMedic Health Applications Inc. and James Larubio of the Brevard Achievement Center. Pfeil and Larubio were recognized at staff meetings for their areas of work.

According to Semmel, the three were recognized for focused efforts contributing to Kennedy’s recycling program. “Catch an Environmentalist” recipients are presented certificates recognizing both individuals and teams that have notably contributed to environmental stewardship at the space center based on frequency of STAR’s use.

“Your efforts for submitting recycling requests into the STAR system have earned you a spot in the 2014 Top STAR User category,” he said.

“Without these champions, we would not have a recycling program,” said Williams. “The revenue we receive from recycling also comes back to Kennedy and is used to fund Sustainability projects.”

Semmel explains that while recycling is an important part of protecting the environment, there is more to the overall effort.

“Many of us primarily associate sustainability with the task of recycling,” said Semmel. “In fact, recycling is the largest environmental movement the world has ever known, especially given its reach into our professional and private lives and the numerous municipalities that perform the work. However, sustainability is much more. It spans environmental, economic and social equities. Along that ‘triple bottom line,’ every directorate at Kennedy can help transform our center into a 21st century premier sustainable spaceport.”

DID YOU KNOW?

Kennedy Space Center recycled enough paper in fiscal year 2015 to save more than 1,500 trees.



STAR



KENNEDY SPACE CENTER

SUSTAINABILITY FACTS



KEEPING COOL:

Industrial Chiller Plant Upgrades

Extensive upgrades are in progress for the chiller plant serving the heart of Kennedy Space Center. The Industrial Area Chiller Plant, which supports spaceport and program processing, is undergoing a system replacement including the Neil Armstrong Operations and Checkout Building cooling tower, chillers, pumps, transformers and more. The project also includes construction of a new thermal energy chilled water storage tank that will enable cost savings through the production of chilled water outside the regular work shift.



KEEPING IT SUSTAINABLE:

Bio-based Purchasing

This program was developed to ensure that supplies and commodities purchased for Kennedy's Test and Operations Support Contract, or TOSC, are replaced with versions that meet federal guidelines for recycled content, bio-based materials and energy efficiency standards. TOSC supports launch processing operations for NASA's Space Launch System and commercial launch partners, as well as International Space Station payloads. Since the program's start in March 2013, more than 1,700 inventoried items have been evaluated, about half of which have recycled-content requirements. Nine inventoried commodities have been successfully replaced with compliant materials, with about 50 more undergoing analysis today. If an item doesn't yet have a cost-effective, compliant replacement, the team will reevaluate every three years, allowing time for technology to mature.



KEEPING CLEAN:

Changing Habits, Conserving Water

Water conservation helps reduce issues of wasted water and associated costs. During FY 2015, this pilot project focused on simple ways to conserve water, such as installation of low-flow fixtures and shut-off valves inside the Operations and Checkout Building locker room showers. Behavioral changes, including shutting off the flow of water while soaping up, aide in conservation as well. A survey confirmed employees' support for these efforts, and the pilot program saw an annual cost savings of more than \$1,600. Using the lessons learned from this project, KSC anticipates using similar fixtures in all future projects.

SWAMP SURVIVAL



Young Luke and Leia are newly hatched American alligators, part of an ongoing study that could shed light on environmental impacts at Kennedy Space Center and beyond.

A baby alligator emerges from its egg inside a nesting container filled with sphagnum moss.

The spaceport shares boundaries with the 140,000-acre Merritt Island National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service.

Here, alligators are “apex predators,” meaning they’re at the top of the food chain. Researchers study alligators at Kennedy and across the sunshine state because at each stage of life, the animals provide vital clues about the health of the ecosystem and shed light on the physiological effects of an unhealthy environment.

“Our endocrine systems are nearly identical,” explained Lynne Phillips, a NASA physical scientist in Kennedy’s Environmental Management branch. She oversees Kennedy’s Ecological Program, which manages several wildlife research programs at the spaceport, including alligator studies. “If there is an impact to alligators’ endocrine system, we can relate it directly to human health.”

Endocrine disrupting contaminants can have a dramatic effect on fertility and reproductive development. Monitoring the development and hatch rates of gator embryos and tracking temperatures at nests across the refuge will help researchers understand these effects.

Kennedy’s Ecological Program began studying alligators in 2006. The program was set up with the help of Dr. Louis Guillette, a world-renowned biologist with the Medical University of South Carolina in Charleston. Guillette, a co-investigator, contributed time and expertise in studying the impacts of environmental contamination on wildlife and regularly collaborated with the Kennedy team until his death Aug. 6, 2015.

The Ecological Program partners with the U.S. Fish and Wildlife Service, Florida Fish and Wildlife Conservation Commission, the Medical University of South Carolina and the South Carolina Department of Natural Resources.

There also are contributing team members across the U.S., as well as Central America, Africa and Japan.

No one knows how many alligators call the refuge home. Adult females at Kennedy reproduce every three years or so, laying a clutch of 30 to 40 eggs in late June. Biologists trek through marsh grass and muck to reach nests. Typically, the mother alligator isn’t home; she only checks on her nest periodically.

Some nests are outfitted with wireless sensors, called thermistors, which log the temperature every five minutes throughout the 60-day nesting cycle. Temperatures above 31.5 degrees Celsius (about 89 degrees Fahrenheit) result in more males; temperatures below that level produce more females. Biologists track these temperatures year after year to watch for trends and monitor the balance of males to females.

A few eggs are collected from these nests, although most are left in place. At other nests, including Luke and Leia’s,

all eggs are removed and incubated at 31.5 degrees Celsius inside the Ecological Program’s wildlife laboratory. Luke and Leia made their debut on Aug. 21 and were joined by their newly hatched siblings during the next five days. Of the 33 eggs collected from their nest, 24 hatched. The team collected a total of 352 eggs for the study in 2015. More than 2,600 eggs have been collected since the program’s inception, with an overall hatch rate of 77 percent.

Luke, Leia and their brothers and sisters were returned to their nest two days later, calling out for their mother as they scrambled toward the nearby waterway. Less than one percent of baby alligators make it through their first four years. But one glance across almost any body of water at the spaceport reveals multiple grown gators. Clearly, even with the odds stacked against them, many manage to survive.



Members of NASA Kennedy Space Center’s Ecological Program gather around an alligator nest. From left are Lynne Phillips, a NASA physical scientist in Kennedy’s Environmental Management branch; Russ Lowers, wildlife biologist with Integrated Mission Support Services (IMSS); Dr. Louis Guillette of the Medical University of South Carolina; Matt Guillette, also of the Medical University of South Carolina; and Stephanie Weiss, wildlife biologist with IMSS.

Wayward Green Sea Turtle Rescued, Returned to Lagoon

A thin, dark line – the track of a green turtle – winds across the mud of an impoundment between the Banana River, below right, and the Atlantic Ocean, top left, at NASA's Kennedy Space Center in Florida.

A routine helicopter flight to survey manatees at the Merritt Island National Wildlife Refuge took an unusual turn July 8. From their viewpoint in the air above NASA's Kennedy Space Center in Florida, which shares boundaries with the wildlife refuge, team members with the spaceport's Ecological Program spotted a lengthy trail of turtle tracks meandering across a dried-out pond between the Banana River Lagoon and the Atlantic Ocean.

The pilot lowered the helicopter, giving the wildlife scientists on board a better view. The tracks led to an adult female green sea turtle who apparently had emerged from the Banana River and wandered at least 500 meters across the dry sand in an attempt to nest. The team concluded the manatee survey, then took to an airboat to help the wayward turtle.

Kennedy's Ecological Program team coordinated the rescue effort with the refuge, Cape Canaveral Air Force Station,

the U.S. Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission.

Although the turtle was relatively healthy, she was exhausted from her journey and far from the water, and might not have survived without help. It took five staffers to lift her onto a backboard and into the airboat. She was returned to the waters of the Banana River.

The endangered green turtle is one of several species found along the Florida coast. The large reptiles are known to inhabit the lagoon during the early stages of their life cycle and outside of nesting season once they become adults. Since adults normally nest from the ocean, it's unusual for one to nest from the river. Disoriented females typically are discovered when tracks are found on the beach during routine surveys conducted during nesting season.



Biologists Russ Lowers, left, and Tim Kozuko of Integrated Mission Support Services assist the disoriented turtle.



National Aeronautics and Space Administration

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This Earth observation of southwestern Africa was taken by NASA astronaut Scott Kelly of Expedition 43 on board the International Space Station, on June 4, 2015. The image is of the "Namib Sand Sea."