

# Annual Sustainability Report

6.13 tons of nitrogen oxides (NO<sub>x</sub>) generated

15.2 tons of particulate matter (pm) generated

17.9 tons of volatile organic compounds (vocs) generated

1,045,459 mmbtu of energy used

4.5+ million gross square feet

130,926 metric tons of carbon dioxide (CO<sub>2</sub>) generated

0.15 tons of sulfur dioxide (SO<sub>2</sub>) generated

7.43 tons of carbon monoxide (CO) generated

18 tons of hazardous waste disposed of

98% of construction and demolition waste diverted

**FY 2016**  
**Johnson Space Center**

**9 LEED-certified buildings**

302 million gallons of water consumed

365,929 kwh of renewable energy produced onsite

5,387 tons of material recycled

184 tons of material composted

1,230 tons of non-hazardous waste disposed

7,000+ employees

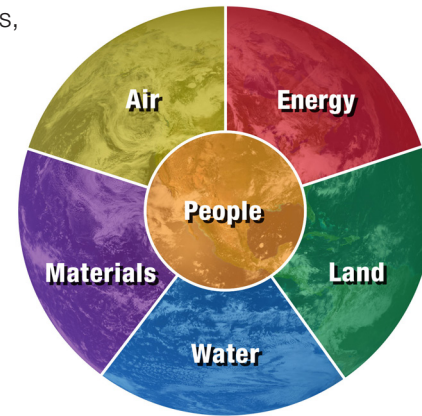
# Sustainability at JSC

According to the National Aeronautics and Space Administration (NASA) Strategic Sustainability Performance Plan (SSPP), NASA's sustainability policy is to **“execute the mission without compromising our planet’s resources so that future generations can meet their needs.”** To that end, NASA is taking action now to “provide a future where the environment and living conditions are protected and enhanced.”

Sustainability is a mindset that demonstrates a balance between economic vitality, environmental stewardship, and social responsibility when considering short and long-term planning. Businesses refer to this concept as the “The Triple Bottom Line.” The NASA Johnson Space Center (JSC) has been implementing aspects of sustainability for over 20 years. With the NASA SSPP providing specific sustainability goals and targets, JSC can provide a coordinated effort to reach and even surpass these goals.

JSC’s sustainability program includes six major resource areas: Energy, Materials, Water, Land, Air, and People. Each resource group identifies ways to meet Agency and Center sustainability goals within their purview.

The Fiscal Year (FY) 2016 Annual Sustainability Report documents these efforts over the past year and brings awareness to the JSC community. Each section documents the applicable sustainability goals, interesting facts about the resource, what individuals can do to help, JSC’s goal status, success stories for FY 2016, and upcoming center efforts relating to the resource area. This is by no means an exhaustive list of accomplishments, and more information is available on the [JSC Sustainability Website](#).



## Get Involved

- 1 Know the goals – What is NASA aiming for?
- 2 Make a difference – How can you make a difference in your work area?
- 3 Join the JSC Sustainability Team – How do you want to get involved and share your ideas?
- 4 Keep informed – What’s happening onsite and on the JSC Sustainability Website?

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# NASA and JSC Sustainability Goals

Each year, JSC makes strides towards achieving Agency and Center sustainability goals, and here is our status as of FY 2016 for the goals listed in Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*. Grey statuses indicate that data is not available to make a status determination, efforts are for future endeavors, or that this goal is an Agency-level initiative that is indirectly related to Center efforts.

<b>1</b> Greenhouse Gases (GHG)	Reduce direct GHG emissions by 47% and indirect emissions (e.g., commuting, travel) by 32% by FY 2025 compared to FY 2008.	
<b>2</b> Sustainable Buildings	Reduce Energy intensity (energy consumption per gross square feet) by 2.5% annually compared to FY 2015. Ensure that 1% of existing buildings above 5,000 gross square feet are energy, waste, or water net-zero buildings by FY 2025. Ensure that at least 23% of buildings or 30% of gross square footage will meet Guiding Principles for High Performance Buildings* by FY 2025.	
<b>3</b> Clean and Renewable Energy	Ensure that at least 10% of total electricity consumption is from renewable energy sources for FY 2016 through FY 2017. Ensure that at least 10% of total electricity consumption and thermal energy is from clean energy sources for FY 2016 and FY 2017.	
<b>4</b> Water Use	Reduce potable water intensity (gallons per square foot) by 2% each year, compared to FY 2007, and reduce industrial, landscaping, and agricultural water use by 2% each year compared to FY 2010. Install appropriate green infrastructure to improve storm water and wastewater management.	
<b>5</b> Fleet Management	Reduce per-mile GHG emissions by 4% by 2017, 15% by 2021, and 30% by 2025, compared to FY 2014.	
<b>6</b> Sustainable Acquisition	Ensure that environmental performance and sustainability factors are considered for all applicable procurements. Award contracts with BioPreferred and biobased criteria to be delivered in FY 2016 (Agency-level goal).	
<b>7</b> Pollution Prevention and Waste Reduction	Divert 50% of solid waste and 50% of construction and demolition debris from landfill. Reduce the acquisition, use, and disposal of toxic and hazardous materials, particularly when helpful in meeting GHG reduction goals.	
<b>8</b> Energy Performance Contracts	Award Energy Savings Performance Contracts and Utility Energy Service Contracts by the end of 2016 (Agency-level goal).	
<b>9</b> Electronic Stewardship and Data Centers	Ensure 95% of monitors, PCs, and laptops acquired meet environmentally sustainable electronics criteria (EPEAT registered) and all have power management features enabled. Ensure that environmentally sound methods for disposal are followed.	
<b>10</b> Climate Change Resilience	Evaluate climate change risks to identify and manage the effects of climate change on operations and mission in both the short and long term (Agency-level goal).	

\* The Guiding Principles for High Performance Buildings are principles that guide facilities in improving performance and efficiency. These can be found at <https://energy.gov/eere/femp/guiding-principles-sustainable-federal-buildings>.

# Energy

Energy resources include a variety of energy sources that JSC uses to operate the site. The JSC goal for Energy is to reduce energy consumption while still accomplishing the mission. Utilities consumed at JSC include electricity, natural gas, and fuel oil. Energy resources also include renewable sources and increasing building efficiency.

## Related Federal Goals:

- **Goal 2 – Sustainable Buildings:**  
Reduce Energy intensity (energy consumption per gross square feet) by 2.5% annually compared to FY 2015.
- **Goal 3 – Clean & Renewable Energy:**  
Ensure that at least 10% of total electricity consumption is from renewable energy sources for FY 2016 through FY 2017.
- **Goal 3 – Clean & Renewable Energy:**  
Ensure that at least 10% of total electricity consumption and thermal energy is from clean energy sources for FY 2016 and FY 2017.
- **Goal 8 – Energy Performance Contracts:**  
Award Energy Savings Performance Contracts and Utility Energy Service Contracts by the end of 2016.

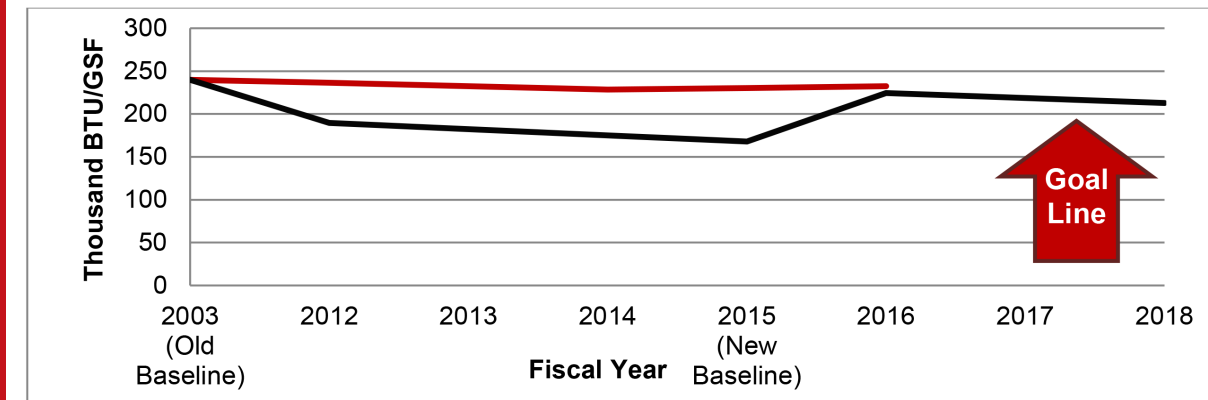
## Did You Know?

- **Watt's Up?**  
In FY 2016 JSC, SCTF and NASA's Ellington Field (EF) facilities consumed 163 million kWh of electricity at a cost of \$8.5M and 486k MCF (million cubic feet) of natural gas at a cost of \$2.2M.
- **Cutting Costs**  
JSC, SCTF, and EF used enough electricity to power over 14,000 average Texas homes, yet JSC paid about one third the cost of those homeowner bills.

## What You Can Do:

- Remove personal refrigerators, especially older, compact refrigerators. These refrigerators use electricity and generate heat constantly, and they are a significant source of energy use in our offices.
- Turn off lights, computers, and auxiliary devices when leaving offices and conference rooms.
- Adjust window shades to block sun during the brightest times of the day to keep the heat to a minimum, and close shades at night.
- Use task lighting in your work areas, and coordinate with your building's Facility Manager to reduce any unnecessary lighting.
- Choose energy saving (Energy Star or FEMP-designated) products when purchasing electricity consuming devices.

## JSC Energy Intensity



## Highlights:

- **Awesome Audits**  
JSC audits 25% of the center's square footage annually, amounting to over 1.2 million square feet per year. These audits result in Energy Conservation Measures (ECMs) that increase efficiency, such as lighting replacements and maintenance requests.
- **Busting the BTUs**  
JSC implemented several ECMs in several buildings across the site. These projects included replacing lighting, improving ventilation, and other conservation efforts. Not only do these improvements reduce onsite energy usage, they save over \$200,000 per year in energy costs.
- **Powering Up**  
Through an energy performance contract, JSC started construction on the Combined Heat and Power (CHP) installation at Building 24 in FY 2016. The CHP will provide a consistent and efficient way to generate electricity onsite, which decreases JSC's overall energy usage and adds to the steam, chilled water, and other utilities the JSC Central Plant provides for the site.

## What's Coming Up for the Center:

- 1 Complete several HQ funded small, energy conservation projects for tasks identified during onsite energy audits, with priority on projects that have the highest return on investment.
- 2 Initiate window replacements in Buildings 1, 4N, and 45 to increase energy efficiency by helping to reduce glare, solar heat transfer, and infiltration of hot, moist air into the buildings.
- 3 Complete the Combined Heat and Power (CHP) facility, and bring it online to start operation. This will increase efficiency and reduce overall greenhouse gas generation for JSC.
- 4 Continue educating the JSC community about energy awareness and smart energy usage behavior. Onsite energy users have the potential to significantly reduce energy usage and associated power costs.



# Land

Land resources include all physical structures, infrastructure, and land-based natural resources that the Center owns, maintains, builds, uses, and protects. The JSC goal for Land is to develop and maintain sustainable landscapes and high-performing facilities. Land resources include landscaping, wildlife, vegetation, roads, planning, and buildings, including sustainable buildings and historic facilities.

## Related Federal Goals:

- **Goal 2 – Sustainable Buildings:** Ensure that 1% of existing buildings above 5,000 gross square feet are energy, waste, or water net-zero buildings by FY 2025.
- **Goal 2 – Sustainable Buildings:** Ensure that at least 23% of buildings or 30% of gross square footage will meet [Guiding Principles for High Performance and Sustainable Buildings](#) by FY 2025.
- **Goal 10 – Climate Change Resilience:** Evaluate climate change risks to identify and manage the effects of climate change on operations and mission in both the short and long term.

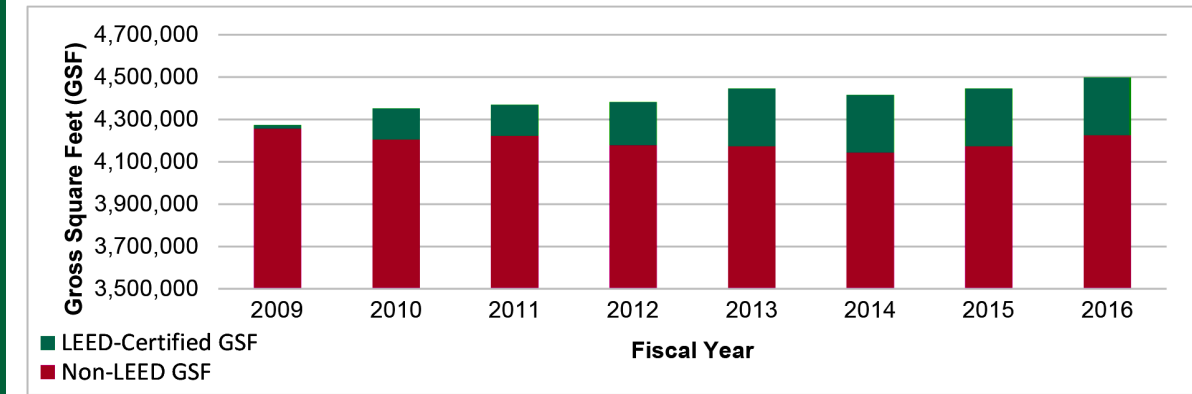
## Did You Know?

- **Collaboration is Key**  
Collaboration areas are scattered throughout the Center to inspire productivity, creativity, and problem-solving. Buildings 30, 56, and 57 have multiple collaboration areas to help inspire new ideas.
- **Lean and Green**  
In FY 2016, NASA as an agency surpassed 3 million square feet of space that meet the [Guiding Principles for High Performance and Sustainable Buildings](#).

## What You Can Do:

- Avoid interactions with wildlife. If a wildlife-human conflict occurs, call Work Control (x32038) to get assistance from a trained professional.
- Coordinate with the Historic Preservation Officer to avoid impacts to historical landmarks, buildings, and districts when planning projects.
- Take a moment to find out about the sustainable features of your building, so you can use these features as they were designed. This will help increase building efficiency. Leadership in Energy and Environmental Design (LEED) buildings, especially, have new technology to operate more efficiently.
- Report problems in your building to the Facility Manager immediately. Maintaining buildings helps sustain a basic level of efficiency.

## JSC Gross Square Footage



## Highlights:

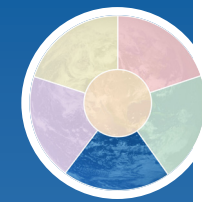
- **Pieces of History**  
JSC submitted the 50-Year Historic Survey to the Texas State Historic Preservation Office. The survey designated historic districts at JSC and EF.
- **Planning Like a Master**  
JSC prepared the new Center-wide Master Plan, which aims to aggressively reduce building square footage and increase efficiency.
- **Efficiency in Space Utilization**  
JSC has spent the last several years increasing efficiency in space utilization across the Center. As a result of these efforts, JSC improved space utilization per employee by 7%.
- **Natives for the Green Roof**  
JSC replanted the green roof on Building 12, replacing the struggling, non-native plants with Texas natives. The native plants are growing better since they are more acclimated to local climates and weather conditions.



## What's Coming Up for the Center:

1. Revise the Wildlife Management Plan for the next five years.
2. Demolish the majority of facilities in the flood-prone 200 area and return the area to natural habitat to increase efficiency, resilience, and land stewardship.
3. Develop protection measures for onsite historical landmarks to preserve our cultural heritage (i.e., both Mission Controls, etc.).





# Water

Water resources include the water that flows in and out of the site. The JSC goal for Water is to reduce consumption and protect local water resources from potential pollutants. Topics covered in this area include potable water, water reuse, fire suppression water, wastewater, and stormwater. Because JSC is close to several bodies of water, it is critical that we manage our water resources appropriately and operate sustainably.

## Related Federal Goals:

- **Goal 4 – Water Use:**  
Reduce potable water intensity (gallons per square foot) by 2% each year, compared to FY 2007, and reduce industrial, landscaping, and agricultural water used by 2% each year compared to FY 2010.
- **Goal 4 – Water Use:**  
Install appropriate green infrastructure to improve storm water and wastewater management.

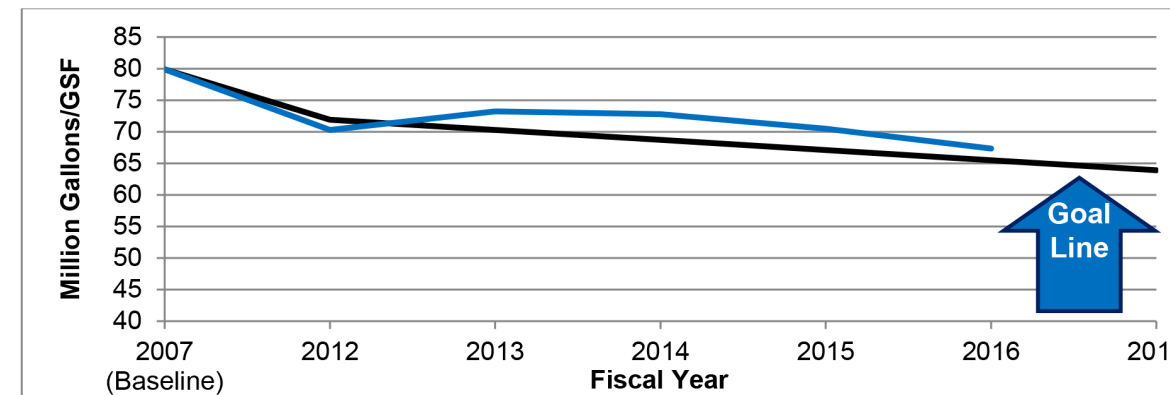
## Did You Know?

- **Water Usage**  
According to the Environmental Protection Agency (EPA), it takes six and a half years for the average American residence to use the amount of water required to fill an Olympic-sized swimming pool. JSC used enough water to fill over 450 Olympic-sized swimming pools in FY 2016.
- **Treated or Not?**  
Wastewater (transported through the sanitary sewer) is treated before being released into the environment. Stormwater (water from rainfall that goes into storm drains and ditches) is not treated before being released into the environment.

## What You Can Do:

- Listen for “dry water flow” around site when it is not raining. If heard, report the incident to the Environmental Office ([JSC-Environmental-Office@nasa.gov](mailto:JSC-Environmental-Office@nasa.gov)).
- Report leaky faucets and fixtures to the appropriate Facility Manager as soon as possible.
- When designing or implementing projects, be sure to use low-flow or WaterSense appliances, equipment, and fixtures.
- When designing systems, consider recirculating water systems and other types of water saving infrastructure instead of systems with single-pass through infrastructure.

## Water Consumption



## Highlights:

- **Saving the Gallons**  
JSC reduced water usage from 313 million gallons to 303 million gallons, a 3% reduction in potable water usage in one year!
- **Fixing the Drips**  
At 1 drip per second, a faucet can leak 3,000 gallons per year. In 2016, JSC repaired 482 leaks around site, helping to save water and utility costs.
- **The Cost of Savings**  
With the cost of water being so low at JSC, water savings projects are very hard to fund. The savings from reducing water usage usually does not pay back the cost of implementing improvements. Employee water conservation initiatives are essential to help JSC meet federal water goals.



## What's Coming Up for the Center:

- 1 Design and construct several sanitary sewer lift stations as funds become available.
- 2 Begin rehabilitation of JSC's sanitary sewer lines in FY 2018.
- 3 Continue identifying water conservation and recycling opportunities at JSC to reduce consumption.
- 4 Encourage employees to utilize JSC's potable water instead of purchasing costly bottled water.



# Materials

Materials resources include anything that JSC buys, uses, sells, or disposes of to keep JSC running and to accomplish the NASA mission. The JSC goal for Materials is to reduce unnecessary material purchases, reduce toxic material use, reduce waste generation, and convert waste into new materials, resulting in procurement and disposal savings. Specific topics include green purchasing, reuse, recycling, and pollution prevention.

## Related Federal Goals:

- **Goal 6 – Sustainable Acquisitions:**  
Ensure that environmental performance and sustainability factors are considered for all applicable procurements.
- **Goal 7 – Pollution Prevention and Waste Reduction:**  
Divert 50% of solid waste and 50% of construction and demolition debris from landfill. Reduce the acquisition, use, and disposal of toxic and hazardous materials, particularly when helpful in meeting GHG reduction goals.
- **Goal 9 – Electronic Stewardship and Data Centers:**  
Ensure that environmentally sound methods for disposal are followed.

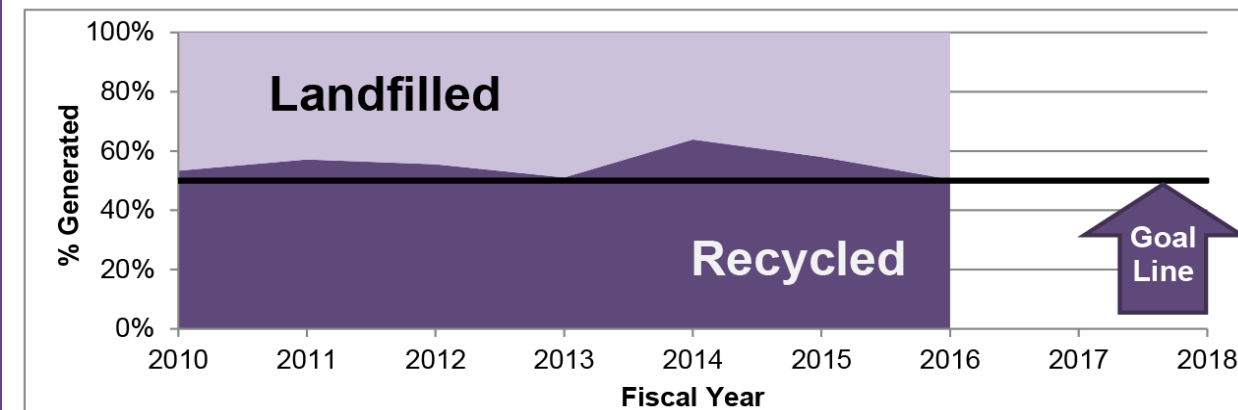
## Did You Know?

- **Food Going to Waste**  
According to the EPA, the US sends over 29 million tons of food waste to landfill annually. That is enough to feed over 11 million families for a year.
- **Total Generation Decreasing**  
JSC decreased total waste generation by 19% since FY 2014. The approximately 500-ton reduction is equivalent to the weight of 82 elephants.

## What You Can Do:

- Use the Sustainable Facilities Tool ([www.sftool.gov/greenprocurement](http://www.sftool.gov/greenprocurement)) to identify federal purchasing requirements for designated products and services. The site even has links to examples of compliant products to help reduce research time.
- Participate in all of JSC's reuse, recycling, and composting programs to maximize the center's diversion from landfill. JSC diverts over 30 waste streams from landfill through recycling, reuse, and composting.
- Reduce costly waste disposal and air emissions by using less toxic materials.
- Excess NASA-owned electronics and equipment through R&U to help JSC ensure proper disposal.

## Waste Diversion from Landfill



## Highlights:

- **Where the Rubber Meets ... Mars?**  
One of JSC's labs installed a 50-meter indoor track made from 100% recycled rubber to allow for human endurance testing on a simulated Mars surface. Once the simulations and tests are complete, the material will be relocated for future reuse.
- **Get An Upgrade!**  
Some of JSC's labs reduced their hazardous waste generation by replacing old equipment with more efficient machinery. One lab went from generating 600 liters of waste per month to 1.5 liters of waste per month.
- **Container Size Matters**  
JSC Environmental Staff worked with labs to provide right-sized containers for hazardous waste collection. This allows for JSC to reduce the number and cost of drums for disposal.



## What's Coming Up for the Center:

- 1 Inform and encourage employees to find onsite resources for reuse rather than purchasing new products.
- 2 Ensure that JSC contracts include clauses requiring compliance with federal purchasing and reporting requirements.
- 3 Encourage the use, tracking, and reporting of designated biobased products (i.e., products made from plants instead of petroleum).
- 4 Incorporate the new NASA HQ requirement for waivers for designated energy consuming devices that are non-compliant.

# Air

Air resources include both indoor and outdoor air quality. The JSC goal for Air is to maintain regulatory compliance with air regulations and work with regional efforts to reduce the release of specific air pollutants. Topics covered in this area mainly focus on outdoor air quality, greenhouse gas emissions, and reductions in toxic chemical use. Air quality is a topic that affects the whole Houston area, and JSC works with neighboring cities to improve air quality throughout the region.

## Related Federal Goals:

- **Goal 1 – Greenhouse Gases (GHGs):**  
Reduce direct GHG emissions by 47% and indirect emissions (e.g., commuting, travel) by 32% by FY 2025 compared to FY 2008.
- **Goal 5 – Fleet Management:**  
Reduce per-mile GHG emissions by 4% by 2017, 15% by 2021, and 30% by 2025, compared to FY 2014.
- **Goal 7 – Pollution Prevention and Waste Reduction:**  
Reduce the acquisition, use, and disposal of toxic and hazardous materials, particularly when helpful in meeting GHG reduction goals.

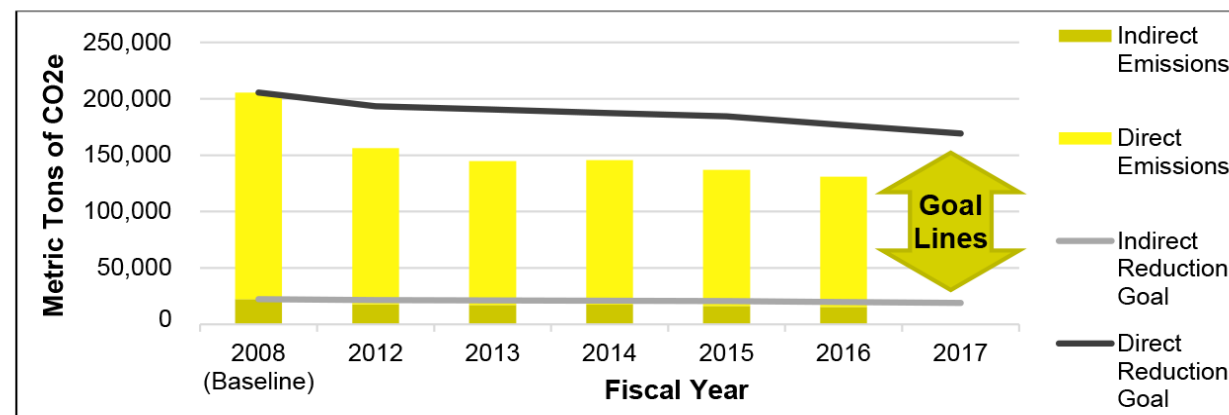
## Did You Know?

- **Cleaning Up U.S. Air**  
Even with economic growth and population increases, national air pollutant concentrations are significantly lower since the Clean Air Act passed in 1990. The EPA determined that lead dropped by 99% and sulfur dioxide dropped by 85% as of 2016.
- **Ozone Improvement**  
In 2016, the EPA re-designated the Houston/ Galveston area as a Moderate Non-Attainment area for National Ambient Air Quality Standards for ground-level ozone, a significant improvement from the previous designation as a Serious Non-Attainment area.

## What You Can Do:

- Choose paints, solvents, and other chemicals that have less or no Volatile Organic Compounds (VOCs).
- Submit a JF 1138 prior to purchasing or modifying equipment that has the potential to produce air emissions or use refrigerants (i.e., combustion sources, generators, chillers, boilers, etc.).
- Use equipment or refrigerants that have less greenhouse gas potential and are less ozone depleting. The Environmental Office has a list of alternatives that help meet these requirements.
- Avoid vehicle idling and keep combustion sources properly tuned to avoid generating additional air pollutants that can cause health impacts.
- Conserve energy. Cutting electricity usage reduces the demand on power plants and subsequently reduces air pollutant emissions.

## JSC Greenhouse Gases (GHG)

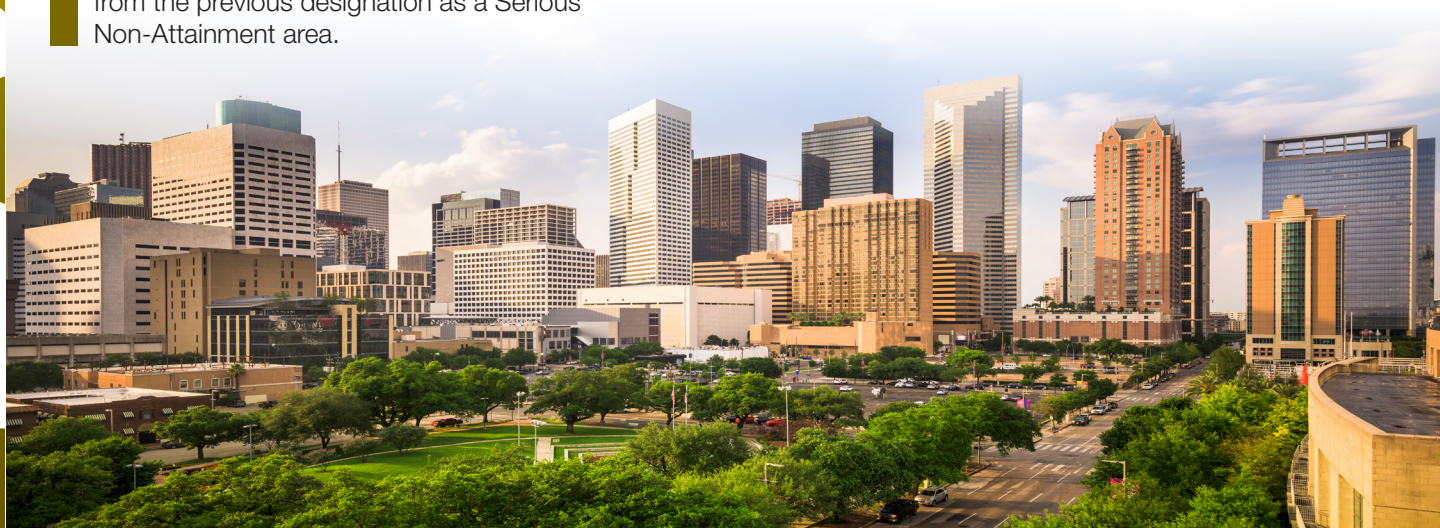


## Highlights:

- **Cutting Out the VOCs**  
JSC and EF reduced VOC emissions by 13% in FY 2016. VOCs combined with nitrogen oxides and sunlight cause ground-level ozone to develop, which is the main ingredient in smog. The sites also reduced particulate matter by 2% and nitrogen oxide emissions by 9%.
- **Updating Equipment**  
JSC installed a replacement steam generation boiler with a Low-NOx burner that significantly reduces the emissions of nitrous oxides and other air pollutants.
- **Catching Up with Technology**  
In the new Building 21, JSC purchased a pre-certified emergency power generator that avoids the need for performance testing to demonstrate compliance with air regulations.

## What's Coming Up for the Center:

- 1 Continue providing air permitting and regulatory compliance support during procurement and construction phases of significant Facilities projects.
- 2 Initiate operations at the Combined Heat and Power Facility in late 2017, which will significantly reduce net GHG emissions.
- 3 Replace five old generators in B48 with two new, more efficient emergency generators in FY 2018, which will significantly reduce air emissions.
- 4 Develop a tracking system for Sulfur Hexafluoride (SF6), an extremely potent greenhouse gas used primarily in electrical equipment, to better monitor use, detect releases, and evaluate alternatives.
- 5 Identify additional opportunities to add electric vehicles to the JSC fleet.



# People

People affect every element of sustainability at JSC. Your decisions on how to accomplish tasks either use or save resources. Decisions like remembering to turn off lights and equipment when leaving for the day, following sustainable acquisition requirements, carpooling, or teleworking all make a positive difference. Increased awareness and communication, recognition and awards, strategic and environmental planning, and technology transfers all affect how individuals can get involved in making JSC more sustainable.

## Resources:

JSC offers a variety of resources for personal and professional development, including the following:

- **Employee Resource Groups (ERGs):**
  - Connecting Veterans (ConVERG)
  - No Boundaries (NoBo)
  - Women Excelling in Life and leadership (WELL)
  - African American ERG (AAERG)
  - Asians Succeeding in Innovation and Aerospace (ASIA)
  - Emerge; Hispanic ERG (HERG)
  - Human Systems Integration (HIS)
  - Out & Allied ERG (OAERG)
- **JSC Clinic**
- **Ergonomic Assessments**
- **Teleworking Capabilities**
- **Employee Assistance Program**
- **Gilruth Fitness Center**

## What You Can Do:

- Join the Sustainability Team to implement your ideas for sustainable technology and practices onsite. Email [JSC-Sustainability@mail.nasa.gov](mailto:JSC-Sustainability@mail.nasa.gov) for more information or to submit success stories.
- Check out what is happening onsite and nearby each month by visiting the [JSC Sustainability Website](#).
- Find ways to integrate sustainable practices into your work every day.
- Find ways to carpool or vanpool, some of which may be subsidized as a benefit by your employer.
- Participate in the next Bike to Work Day in the spring.

## Highlights:

- **Bike to Work Day**  
In April 2016, JSC hosted the first annual Bike to Work Day. Experienced cyclists led groups of riders through various routes to JSC, demonstrating safe routes and riding practices. Over 40 participants joined in the fun, even with rain on the day of the event.
- **Living Lab**  
The Sustainability Partnership Team partnered with over 30 students from Rice University in Houston and the University of Chalmers in Sweden to host a Living Lab workshop on reimagining efficient storage for small spaces.
- **Fighting the Energy Vampires**  
The JSC Green Team hosted another energy vampire slaying competition from August to October of 2016. Buildings 12 and 321 swept aside the competition by having the greatest reduction in energy usage during the competition. Winners were awarded trophies made from repurposed and recycled materials from onsite.
- **Going Green**  
As a result of onsite sustainability efforts in 2016, JSC won the Houston Green Office Challenge for Property Management. JSC received this distinction for site-wide efforts to integrate sustainable practices into management of more than 4.2 million square feet of buildings



## What's Coming Up for the Center:

- 1 Coordinate the next Bike to Work Day event in the spring.
- 2 Coordinate outreach for LEED building occupants to understand sustainable features of new buildings and how to properly request changes to settings, such as temperature, lighting, etc.
- 3 Encourage participation from JSC employees and management in sustainable and environmentally friendly behaviors.
- 4 Identify opportunities for the Sustainability Team to assist in projects that will help JSC achieve sustainability goals.
- 5 Coordinate additional opportunities for collaboration and innovation, such as Living Labs.







Are you interested in more about the JSC and NASA Sustainability Programs? Check out the latest on the [JSC Sustainability Website](#).

Do you have questions, suggestions, ideas, or success stories? Tell us about it! E-mail [JSC-Sustainability@mail.nasa.gov](mailto:JSC-Sustainability@mail.nasa.gov) with your story.

Join the JSC sustainability movement. Find out how you can help, and make a change.

***Why? Because Every Effort Makes a Difference!***