Kennedy Space Center's Energy and Water Conservation Program

By:

Jenni Hill, PE, LEED AP

KSC Energy Manager

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For:

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

Space Coast Section

Photo credit: NASA/Kim Shiflett

Celebrate Energy Awareness Month with NASA's Energy and Water Management Program!

Speaker - Jenni Hill, PE, LEED AP

- Serves as Energy and Water Conservation Program Lead at NASA's Kennedy Space Center (KSC)
- Designated Energy Manager at KSC in January of 2020
- Over 18 years of diverse work experience in facility and civil water resources design, construction management, environmental & energy management and compliance
- Received Bachelor of Science in Environmental Engineering from the University of Florida, go gators!
- Cancer survivor!

Agenda

- About Kennedy
- About Kennedy's Energy Program
- Energy Projects
  - Energy and Water Efficiency
  - Renewable energy
  - Resilience

ABOUT KENNEDY

Kennedy Space Center

ABOUT KENNEDY'S ENERGY PROGRAM

Energy Program Vision

Our vision is to secure America's future in space with an energy and water efficient and resilient multi-user spaceport.

Power Team

- Energy and Water Conservation Program
  - Program Lead, KSC Energy Manager
  - Energy and Water Specialist
- BOSS Energy Management Office
  - Certified Energy Manager (CEM) & support
- Energy and Water Working Groups
  - Local to KSC
  - Made up of Center operations and maintenance personnel, engineering, support contractors, neighbors, utility
- Energy Efficiency Panel
  - Agency-wide
  - Made up of Headquarters and Center energy managers/personnel and energy program support

Customers, Neighbors and Partners

- You! - U.S. Taxpayers
- NASA Agency
- KSC
  - Institutional Services
    - Operations and Maintenance (O&M)
  - Programs
    - International Space Station
    - Exploration Ground Systems
    - Launch Services Program
    - More…
- Cape Canaveral Space Force
- Commercial Industry Partners
  - Florida Power and Light (FPL)

Energy Program

- Department of Energy (DOE) 50001 Ready (based on ISO 50001)
- Identify energy and water conservation opportunities
  - Facility Comprehensive Evaluations (energy audits)
  - Re/retro-commissioning
  - Operations and Maintenance observations/needs
  - New technology/innovation
- Collect utility cost and consumption historical data
- Report consumption data in NASA Headquarters and Portfolio Manager
- Develop energy efficiency and renewable energy projects
- Seek and manage several funding programs
  - Performance Contracts
  - Appropriated funds, grants, rebates, etc..
- Advisor for KSC energy and water policy
- Promote and advocate for energy and water efficiency, renewable energy generation and increased utility resiliency

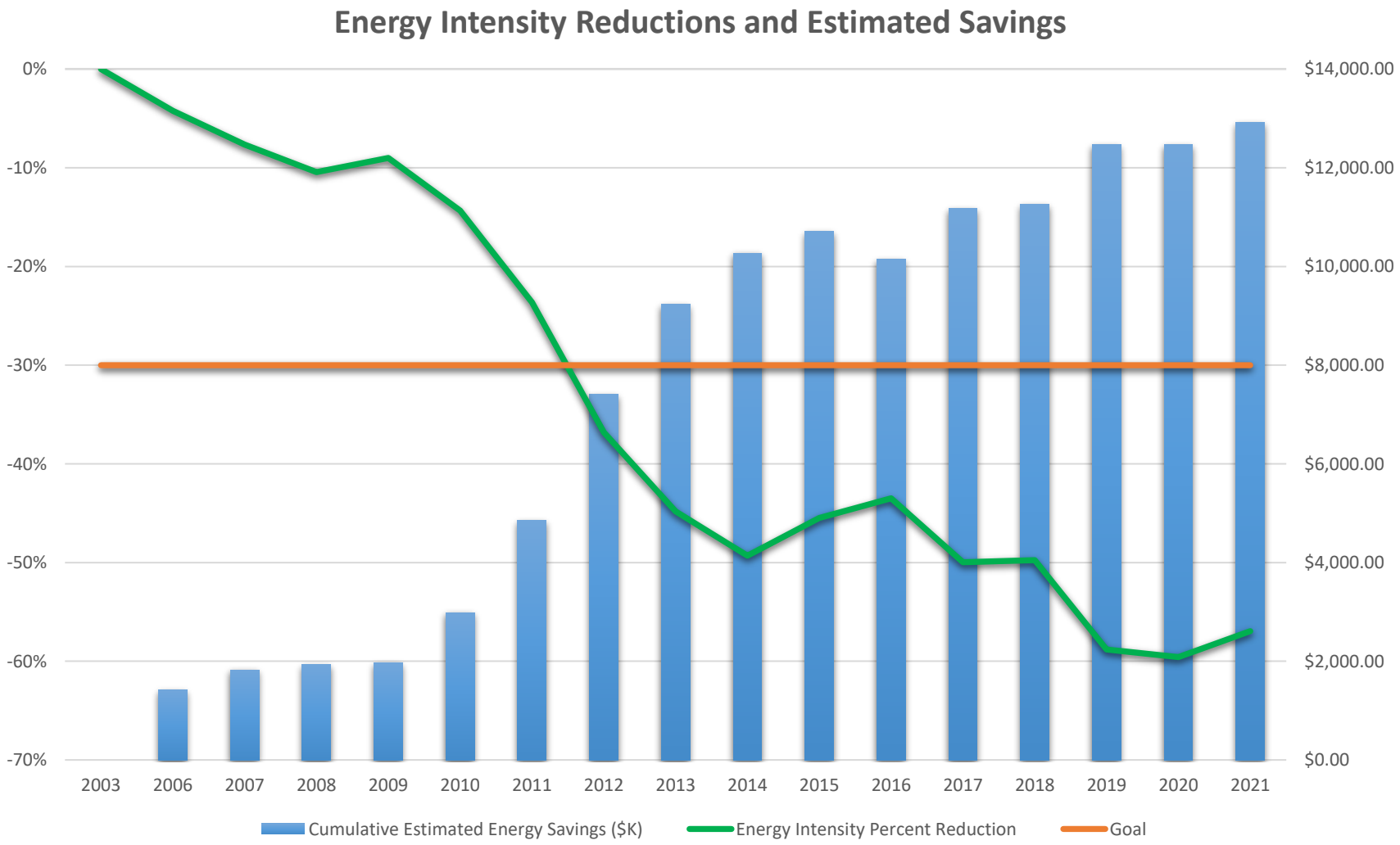
Goals of the Program

- Public Law and Executive Orders (EO)
  - Energy Independence and Security Act (EISA)
  - Executive Orders
    - EO 13834 *Efficient Federal Operations (revoked)*
    - EO 14057 *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability*
- NASA's Procedural Requirements (NPR) and Plans
  - NPR 8570.1B NASA Energy Management Program
  - Kennedy (K)NPR 8500.1 KSC Environmental Requirements
  - Sustainability Plans
- Program Goals
  - Energy Efficiency/Resiliency
  - Clean and Renewable Energy
  - Water Use Efficiency and Management
  - Energy Performance Contracts

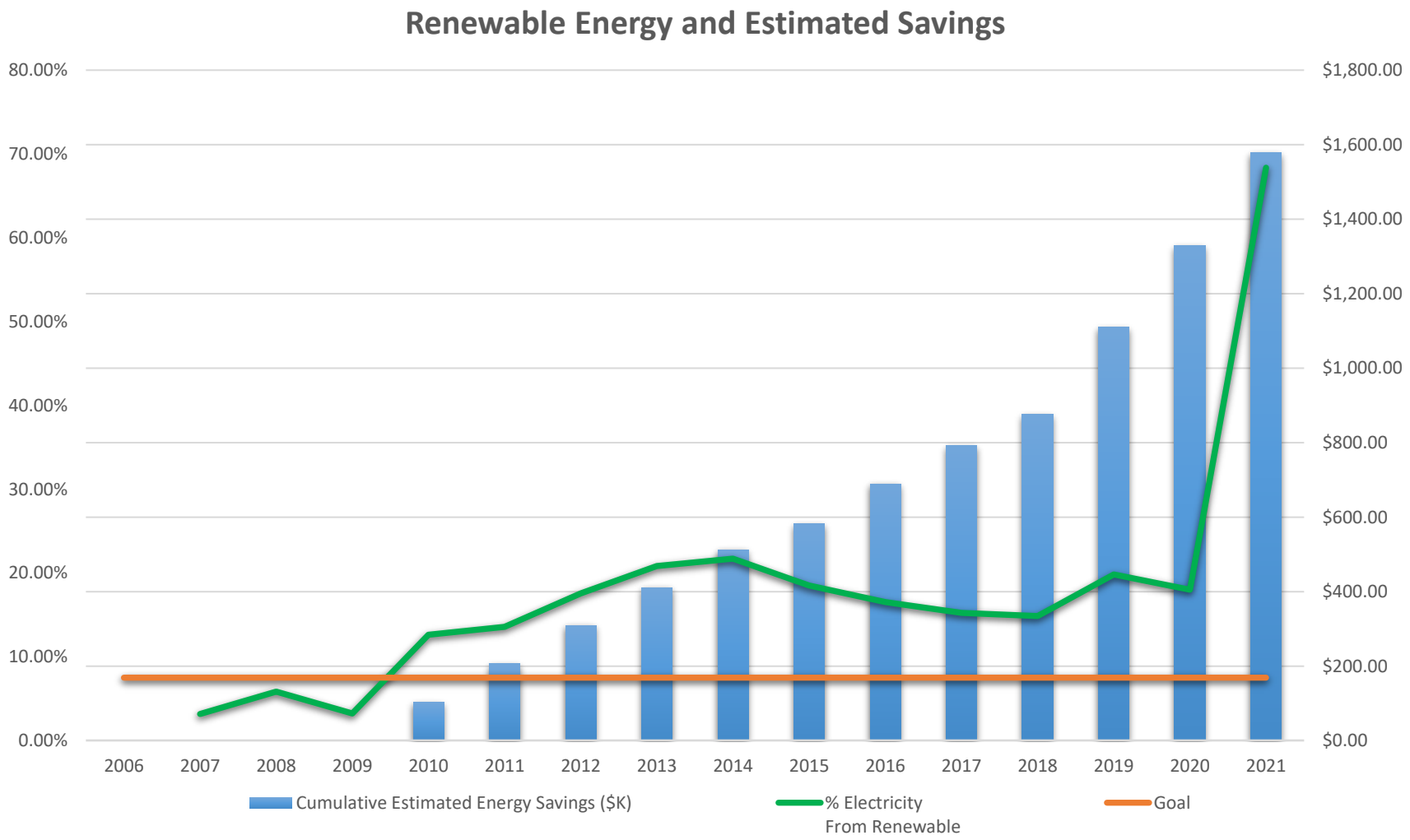
Benefits of the Program

- Assist Center with utility (electric, natural gas and water) and O&M long-term cost reductions
- Provide trending of utility cost and consumption data
  - Forecasting utility consumption and costs
  - Identify variances to be further investigated by the O&M technical community
- Assist the Center and Agency in meeting Sustainability goals:
  - Greenhouse Gas (GHG) Emissions Reduction
  - Clean and Renewable Energy
  - Water Use Efficiency and Management
  - Energy Performance Contracts
  - Sustainable Buildings (Energy Conservation)

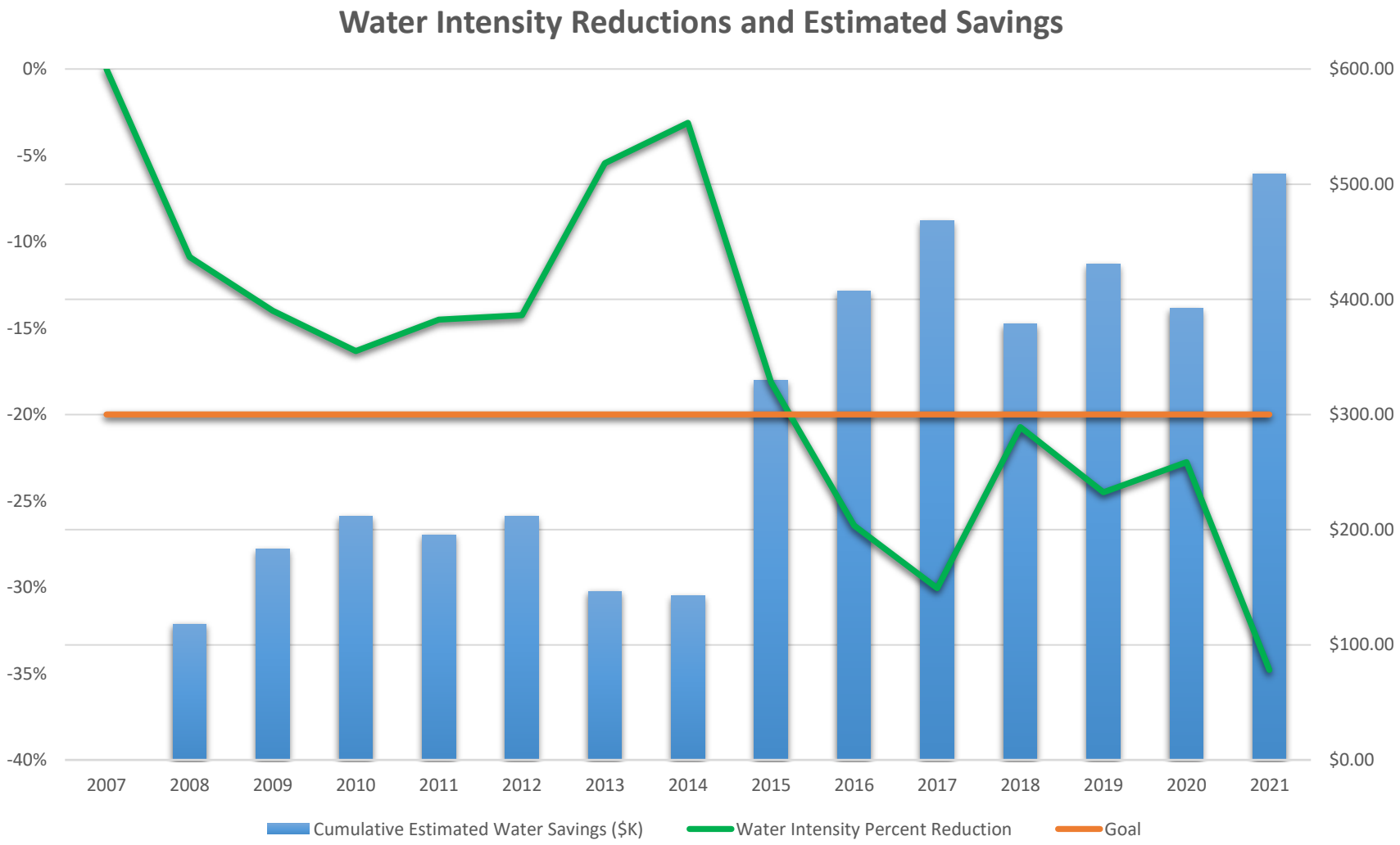
Energy Reduction



Renewable Energy



Water Management



Energy Program Fast Facts

- KSC used 416,445 mbtu of energy (electricity and gas) in Fiscal Year (FY) 2021
- KSC's total power demand is close to 130 Gigawatt-hours (GWh)
- KSC used 173 million-gallons of water in FY2021
- KSC generated about 4,131 mega-watt hours, about 3% of the total power demand, of clean energy per year from Center-owned photovoltaic systems in FY2021
- KSC has 9 Leadership in Energy and Environmental Design (LEED) certified facilities

Energy Projects

ENERGY AND WATER EFFICIENCY

Energy and Water Efficiency

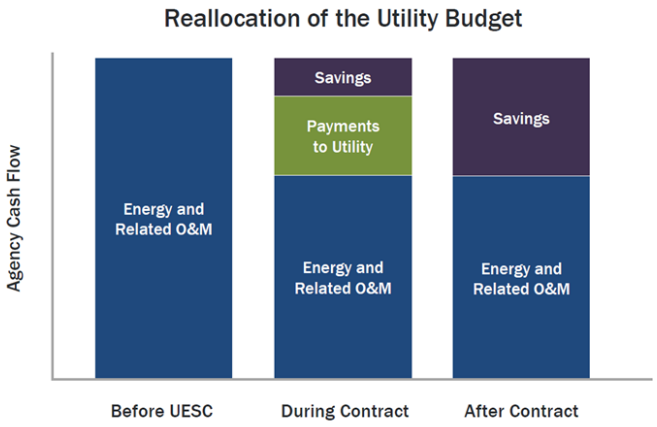
- Execute energy and water efficiency and renewable energy projects
  - Issue projects call and define scope of energy project(s)
  - Bundle energy and water conservation measures
  - Determine funding path
    - Performance Contracting, appropriated funds, grants, rebates
- Perform energy project follow-up
  - Measurement and Verification
- Commissioning and Re/Retro-Commissioning

Utility Energy Services Contract

- What is a Utility Energy Services Contract (UESC)?
  - A performance contract that allows utilities to provide Federal customers with energy and water efficiency improvements and demand-reduction services
- Authorization
  - Energy Policy Act of 1992
    - Federal customers are authorized and encouraged to participate in utility programs generally available to non-federal customers
    - May accept utility financial incentives, goods, and services generally available to non-federal customers
    - Are encouraged to enter into negotiations with utilities to design cost effective programs to address unique needs of federal customers
- Goals/Benefits
  - Reduce energy and water intensity
  - Lower utility bills, proactive replacement and modernization

Utility Energy Services Contract

- Advantages
  - Can finance energy and water conservation project(s) up to 25 years
    - Project payments come from “avoided energy/maintenance costs”
  - Utility is established and familiar with the center’s energy needs
  - It’s a partnership that is mutually beneficial
    - Reducing energy consumption reduces the need for new energy generation
  - The utility refines the project scope by conducting assessments and designs
  - DOE available for support throughout process



Utility Energy Services Contract

- UESC Overall Process/Schedule
  - ✓ Acquisition Planning
  - ✓ Preliminary Assessment
  - ✓ Feasibility Study (Investment Grade Audit)
  - ➢ Design/Implementation
  - ➢ Post Acceptance Performance
- Past performance contract were for a single project or one type of energy conservation measure
- KSC has established an internal process for continuous implementation of bundled conservation measures
  - ➢ Master checklist, Gantt schedule
  - ➢ Lessons learned
  - ➢ Stakeholder lists

UESC Phase 1

- Scope of Work, 34+ facilities/locations
  - Lighting (high bay, low bay, office, wall packs, exterior street/parking)
  - Mechanical (air handling units, chillers, controls, boilers)
  - 2 Mega-watt (MW) Solar
  - Water Fixtures
  - Transformers

Installed Cost ($)	Total Utility and Maintenance Savings ($/yr)	Payback (yrs)
$18.4M	$1.4M	~12

Energy projects

RENEWABLE ENERGY

Renewable Energy

- Main source is solar
  - Ground mounted
  - Roof top
  - Awnings/Canopy
- Site examples
  - Propellants North, 84 Kilo-Watt (KW) (2010)
  - Electrical Maintenance Facility, 125 KW (2019)
  - Central Campus, 1.87 MW (2019) and 1 MW (2010)
- Future
  - 2 MW ground mounted (UESC)
  - Assessing roof top and canopy

Propellants North

Electrical Maintenance Facility

Central Campus

1MW FPL In-Kind

Renewable Energy – Grid Supplied

- Space Coast Next Generation Solar Center
  - 10 MW solar plant built 2010 at KSC through public-private partnership with NASA and FPL
  - 30-year enhanced use lease (EUL) agreement, In-Kind
- Discovery Solar Energy Center
  - 74.5 MW of solar plant built 2021 at KSC through public-private partnership with NASA and FPL
  - 32-year EUL, cash consideration

Space Coast Next Generation Solar Center

Discovery Solar Energy center
Image curtesy of Florida Power and Light

Energy projects

RESILIENCE

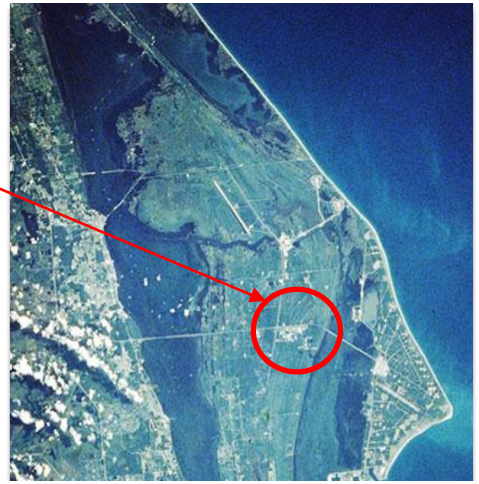
Energy & Water Resiliency

- Unanticipated catastrophic events can have major impacts on mission critical systems and infrastructure
- KSC enhances resiliency through planning, assessments and project implementation
- National Renewable Energy Laboratory (NREL) performed Resiliency Assessment and Systems Analysis
- NREL assessed…
  - Center documents, policies, procedures
  - Critical Infrastructure and Mission Essential Functions
  - Hazards, vulnerabilities and threats
- NREL produced…
  - Resilience Assessment identifying risk and mitigation strategies

Thermal Energy Storage

- Industrial Area Chiller Plant
  - Chilled water and dry compressed air 24 hours a day/7 days a week to mission critical facilities
- Needs
  - Modernize aging infrastructure
  - More efficient system
    - Reduce operation and maintenance costs
    - Reduce energy use
  - Increase reliability and resilience
    - Plant outages
    - Low maintenance
  - Utility incentive - rebate

KSC Industrial Area



Industrial Area Chiller Plant

Thermal Energy Storage Tank

- 91-foot high, 78-foot diameter concrete stratified chilled water thermal energy storage tank system
- 10-inch diameter diffuser pipes
- Concrete base and dome
- 26-gauge steel diaphragm tank with exterior shotcrete and external 4-inch-thick thermal insulation board, exterior finish

Construction

Interior Bottom Diffuser

Interior Top Diffuser

Tank Being Wrapped

Tank Being Insulated

Closing and Questions

Contact Information

Jennifer Hill, PE, LEED AP
NASA KSC Energy Manager
Jennifer.m.hill@nasa.gov

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