AIR COMBAT COMMAND

INSTALLATION SUSTAINABILITY ASSESSMENT REPORT

Education Center

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Seymour Johnson Air Force Base
North Carolina

Sustainability assessment summary of Seymour Johnson Air Force Base to establish baseline metrics, to identify actionable opportunities and investment strategies, and year-over-year comparisons.

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"So we have a choice to make. We can remain one of the world's leading importers of foreign oil, or we can make the investments that would allow us to become the world's leading exporter of renewable energy. We can let climate change continue to go unchecked, or we can help stop it. We can let the jobs of tomorrow be created abroad, or we can create those jobs right here in America and lay the foundation for lasting prosperity."–President Obama, March 19, 2009

EXECUTIVE SUMMARY

Due to expanding requirements and diminishing resources as well as lacking holistic/integrated design approaches, HQ ACC/A7PS has formulated a process for measuring sustainability at Air Combat Command (ACC) installations. This process will establish baseline metrics to identify actionable opportunities and investment strategies, and facilitate year-to-year comparisons. There are many individual efforts already in place at HQ ACC/A7PS and at the installation level. It is within this context that the ACC Installation Sustainability Assessment (ISA) process and report was developed. This report summarizes the current and recommended sustainability efforts at Seymour Johnson Air Force Base (AFB) and provides a basis for comparison and benchmarking.

Numbers have been calculated for the five sustainability indicators at Seymour Johnson AFB for their mission support functions. Additionally, flying mission numbers have been established for the total carbon footprint and energy intensity to show their additional effect on the installation's overall impact on sustainability. The arrow indicators, as shown in the chart below, represent how Seymour Johnson AFB compares to industry-recognized benchmarks[1]. Green indicates a metric is on target or better than target. Yellow indicates a metric is slightly off target. Red indicates a metric is off target.

MISSION SUPPORT			
Carbon Footprint:	17,161	mTons	Green
Energy Usage:	436.463	MMBTU	Green
Water Conservation:	166.45	Mg	Yellow
Waste Production[1]:	3,760	tons	Green
Land Utilization:	6,348	SF/acre	Yellow

FLYING MISSION			
Carbon Footprint:	442,992	mTons	Red
Energy Usage:	6,240,920	MMBTU	Red

[1]765 tons of this waste is recycled.
SF = square feet; mTons = metric tons; Mg = million gallons; MMBTU = million British thermal units

Fiscal year (FY) 08 is the inaugural year for the ISA report; therefore, this report does not provide year-to-year comparisons but it does establish a baseline for all future measurements.

ACC has a solid history of successes with sustainability initiatives; however, progressive action must continue. This report outlines a concise, measurable, and repeatable process that can be utilized year to year. Upon this installation's yearly assessment and data analysis, recommendations and actionable items will be established and monitored. ACC HQ/A7PS's role includes identifying synergies between installations to implement new and bridge existing sustainability initiatives. The ACC HQ/A7PS ISA will deliver a positive return on investment sustainable initiatives.

[1]Industry recognized benchmarks are noted where referenced within the report.

I. INTRODUCTION

A. Installation Sustainability Assessment (ISA) Definition

The ISA is a process by which an installation's relative level of sustainability can be measured, identifies and recommends installation-specific improvement strategies, and it is expressed in five key indicators: (1) Carbon Footprint, (2) Energy Usage, (3) Waste Conservation, (4) Waste Reduction, and (5) Land Utilization. Identified improvement strategies will allow for the bridging of diverse sustainable initiatives (i.e., energy, heat island effect, water conservation, habitat/watershed protection and restoration, new construction practices) and a more efficient implementation of these initiatives as it will account for installation-wide conditions. Additionally, overall review of completed ISAs will provide valuable trend analysis across installations. Direct comparison of installations is not the focus due to differing missions, climate variations, and unique installation attributes.

Sustainable design is a design philosophy that seeks to maximize the quality of the community and the built environment while minimizing or eliminating the negative impact to the natural environment. The word installation is defined as the grounds and buildings that belong to a given institution, and specifically refers to the Air Force installation in this document. Sustainability initiatives include conscious efforts to protect habitats, optimize land use, produce zero waste, reduce heat islands, improve air quality, reduce light pollution, use energy efficiently, and maintain the health and well-being for a community.

Initiatives to improve on a particular established indicator typically will also have an effect on other indicators. In determining and prioritizing actionable items, it is important to take into account this interaction to determine which initiatives will result in the most positive outcome and highest return on investment.

B. ISA and the DoD Strategic Sustainability Performance Plan

The *Installation Sustainability Assessment* (ISA) process, metrics, and indicators were initially developed in 2009 by HQ ACC as a means for measuring the overall "green posture" of the installation. In late 2010, the Department of Defense (DoD) published the Strategic Sustainability Performance Plan (SSPP) which identified department wide goals.

HQ ACC reevaluated the ISA process, metrics, and indicators in light of policy established in the SSPP in order to determine if there were conflicts or if changes were needed in the ISA.

The following table provides a summary of the evaluation. The ISA anticipated and aligned favorably with the broad goals and policy in the SSPP. Few modifications in the ISA data collection were needed and those have been fully incorporated into this updated ISA. The SSPP identified some goals that are completely outside the ability of the ISA to collect and report as, to the best of our knowledge, this information is not currently being collected (recall that the ISA relies on collecting data from existing sources).

Bottom Line: The ISA will remain ACC's tool for evaluating the progress of an installation towards the goals and performance expectations of the SSPP.

The following headers are provided in the table below.

- *SSPP Goals* are the goals and sub-goals taken directly from DoD's SSPP.
- *Changes to Align ISAs with SSPP Goals* shows three categories addressing how the ISA aligned with the SSPP.
  - *Few/No ISA Changes* indicates that the original data collect and the data input format of the ISA aligned very closely with the SSPP. *Modifications* that were needed have been incorporated into the ISA.
  - *ISA Additions (data available)* means that the ISA did not originally collect or have a data input format for these goals that were eventually identified in the SSPP. For the most part the data is available *for* collection. However, some of the data may not be easily accessible. Modifications to the ISA spreadsheet have been made for inputting the new data.
  - *Goals outside the ability of the ISA to collect and report* refer to goals that are not applicable to ACC *installations*. It also includes goals for which installations do not have the ability to collect the data for measuring progress against the goal.
- *Data Status and Location* addresses the location within the electronic ISA worksheet where data can be found and inputted in order to calculate progress towards meeting the SSPP goals. It also identifies what data has been collected for each goal.

COMPARISON AND ALIGNMENT OF ISA AND SSPP

SSPP Goals		Changes to Align ISAs with SSPP Goals			Data Status and Location
		Few/No ISA Changes	ISA Additions (Data Available)	Goals Outside the Ability of the ISA to Collect and Report	
Goal 1	**Use of Fossil Fuels Reduced**				
Sub-Goal 1.1	Energy intensity of facilities reduced by 30% of FY03 levels by FY15 and 37.5% by FY20	●			• Data collected in the ISA is acceptable. • Data input under the Energy Tab Spreadsheets.
Sub-Goal 1.2	18.3% of energy consumed by facilities is produced or procured from renewable sources by FY20	●			• Data collected in the ISA is acceptable. • Data input under the Energy Tab Spreadsheets. • Sustainable Measures Tab worksheet shows a separate table for facilities with the energy intensity bar chart showing the renewable component.
Sub-Goal 1.3	Use of petroleum products by vehicle fleets reduced by 30% by FY20 relative to FY05	●			• Data collected in the ISA acceptable. • Data input under the Energy Tab Spreadsheets. • Sustainable Measures tab shows reduction in transportation energy use and separates petroleum and renewable sources.
Goal 2	**Water Resources Management Improved**				
Sub-Goal 2.1	Potable water consumption intensity by facilities reduced by 26% of FY07 levels by FY20 Assessment of ISA	●			• Data collected in the ISA is acceptable. • Data input under the Water Tab Spreadsheets. • Sustainable Measures Tab shows the percent improvement from baseline in the per built SF table.
Sub-Goal 2.2	Reduce industrial and irrigation water consumption 20% by FY20 from FY10 baseline			●	• Water Tab spreadsheet updated to provide data entry points for when data becomes available. • Data not currently available for input in the ISA for this metric. No separate metering for industrial uses.
Sub-Goal 2.3	All development and redevelopment projects of 5,000 square feet or greater maintaining pre-development hydrology to the maximum extent technically feasible		●		• Water Tab spreadsheet modified to add a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Goal 3	**Greenhouse Gas Emission from Scope 1 and 2 Sources Reduced 34% by FY20, Relative to FY08**	●			• Data collected in the ISA is acceptable. • Data input under the Energy Tab Spreadsheets.
Goal 4	**Greenhouse Gas Emission from Scope 3 Sources Reduced 13.5% by FY20, Relative to FY08**				
Sub-Goal 4.1	Greenhouse gas emission from employee air travel reduced 15% FY20 relative to FY11		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Sub-Goal 4.2	30% of eligible employees teleworking at least once a week, on a regular, recurring basis, by FY20		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Sub-Goal 4.3	50% of non-hazardous waste diverted from disposal in landfills not owned by DoD by FY15, and thereafter through FY20	●			• Data collected in the ISA is acceptable. • Waste Management Tab has a check box for verification of the waste is going to non-DoD landfill.

COMPARISON AND ALIGNMENT OF ISA AND SSPP

SSPP Goals		Changes to Align ISAs with SSPP Goals: Few/No ISA Changes	Changes to Align ISAs with SSPP Goals: ISA Additions (Data Available)	Changes to Align ISAs with SSPP Goals: Goals Outside the Ability of the ISA to Collect and Report	Data Status and Location
Goal 5	**Solid Waste Minimized and Optimally Managed**				
Sub-Goal 5.1	All DoD organizations implementing policies by FY14 to reduce the use of printing paper		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Sub-Goal 5.2	50% of non-hazardous solid waste diverted from the waste stream by FY15, and thereafter through FY20—not including construction and demolition debris	●			• Data collected in the ISA is acceptable. • Data input under the Waste Management Tab Spreadsheets.
Sub-Goal 5.3	60% of construction and demolition debris diverted from the waste stream by FY15, and thereafter through FY20		●		• Waste Management Tab spreadsheet modified to add a header for C&D debris. • Data not originally collected for sub-goal.
Sub-Goal 5.4	Ten landfills recovering landfill gas for use by DoD by FY20			●	• Not applicable to ACC installations.
Goal 6	**The Use and Release of Chemicals of Environmental Concern Minimized**				
Sub-Goal 6.1	On-site releases and off-site transfers of toxic chemicals reduced 15% by FY20, relative to FY07		●		• Waste Management Tab spreadsheet modified for listing reportable quantities. • Data not originally collected for sub-goal.
Sub-Goal 6.2	100% of excess or surplus electronic products disposed of in environmentally sound manner		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Sub-Goal 6.3	100% of DoD personnel and contractors who apply pesticides are properly certified through FY20		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Goal 7	**Sustainability Practices Become the Norm**				
Sub-Goal 7.1	95% of procurement conducted sustainably				• Operations Tab spreadsheet modified to a yes/no box with a percent compliance.
Sub-Goal 7.2	15% of existing buildings conform to the guiding principles on high performance and sustainable buildings by FY15, holding through FY20			●	• ACC/A7PS is evaluating how to implement this goal.
Goal 8	**Sustainability Built into DoD Management Systems**				
Sub-Goal 8.1	All environmental management systems effectively implemented and maintained		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal. Data is available.
Sub-Goal 8.2	Sustainability of transportation and energy choices in surrounding areas optimized by coordinating with related regional and local planning		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal. Data is available.
Sub-Goal 8.3	All DoD installations have Integrated Pest Management Plans prepared, reviewed, and updated annually by pest management professionals		●		• Operations Tab spreadsheet modified to include a year and review date. • Data not originally collected for sub-goal. Data is available.

C. Goals and Objectives

The ISA has been established to formulate a process for measuring sustainability at the installation level. ISAs take a comprehensive look at ACC installations and will address, at a minimum, current use of renewable energy, green procurement practices, infrastructure systems, existing facility operations, conservation plans, environmental compliance, biological resources, habitat protection, watershed restoration, land use, and environmental stewardship.

The ISA will be used to:

- Report the findings
- Establish a baseline for year-to-year comparisons
- Define sustainable initiatives
- Identify synergistic opportunities between diverse initiatives
- Support the Mission, improve the quality of life, and conserve resources over time
- Create an awareness of impacts and a catalyst for cultural change

D. Setting the Context

Flying Mission:

Flying Mission includes anything that directly affects or has direct participation in flight. The flying mission calculations take into account aircraft fuel usage only.

Mission Support:

Mission Support includes all other activities on the installation. Mission support calculations include resources consumption for everything except flying mission fuel consumption.

E. Process

1. Data Collection Categories

The ISA categories are a way of grouping data that was collected and used to calculate a set of sustainability criteria. In summary, the ISA data collection categories are:

1. **Development—**Includes land use, building utilization, transportation, noise, and light emissions.
2. **Energy—**Includes electrical, gas, oil, and liquid propane gas consumption; power purchased from utility or generated on site; and transportation and mission fuels for government vehicles and support equipment.
3. **Water—**Includes domestic, irrigation, and storm water as well as its source and its usage.
4. **Waste—**Includes solid and liquid waste production and its usage.
5. **Operations—**Includes best management practices (BMPs) such as procurement, training, maintenance, and purchasing program for energy efficient equipment.

The following defines the five data collection categories in more detail:

Development:

Expanding human requirements and economic activities are placing ever-increasing pressures on land resources, creating competition and conflicts and resulting in suboptimal use of resources. By examining all land uses in an integrated manner, it is possible to minimize conflicts, make the most efficient tradeoffs, and link social and economic development with environmental protection and enhancement, thus helping to achieve the objectives of sustainable development.

Land use refers to the activities practiced by humans on land. Land supports uses such as residential, industrial, and commercial facilities; recreational areas; natural infrastructure areas; and transportation functions. Integrating a green infrastructure with community connectivity in land use planning is essential to achieving sustainable developments as they incorporate multiple environmental benefits including:

- Reducing storm water runoff volumes and reducing peak flows by using the natural retention and absorption capabilities of vegetation and soils.

  The capacity of the land can be generally categorized as either pervious or impervious. Pervious includes areas that allow rainwater to pass through them and soak into the ground instead of flowing into storm drains. Impervious includes areas that are mainly constructed surfaces covered by impenetrable materials such as asphalt, concrete, brick, and stone. These materials seal surfaces, repel water, and prevent precipitation and melt water from infiltrating soils. Impervious surface areas include rooftops, sidewalks, roads, and parking lots. The impacts of increased impervious surfaces to storm water runoff should be controlled to mimic natural conditions and to protect water quality. Increasing the amount of pervious ground cover increases storm water infiltration rates that reduces the volume of runoff entering our combined or separate sewer systems, and ultimately our lakes, rivers, and streams.

- Improving the rate at which groundwater aquifers are recharged or replenished.

  Groundwater provides approximately 40 percent of the water needed to maintain normal base flow rates in our rivers and streams. Enhanced groundwater recharge can also boost the supply of drinking water for private and public uses.

- Preventing pollutants from being transported to nearby surface waters.

  Once runoff is infiltrated into soils, plants and microbes can naturally filter and break down many common pollutants found in storm water.

- Limiting the frequency of sewer overflow events by using the natural retention and infiltration capabilities of plants and soils that will reduce runoff volumes and delay storm water discharges.

- Capturing and removing carbon dioxide (CO_2) from the atmosphere via photosynthesis and other natural processes of plants and soils that serve as sources of carbon sequestration.

- Mitigating the effects of urban heat islands and reducing energy demands by providing increased amounts of urban green space and vegetation.

  Urban heat islands form as communities replace natural land cover with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat. Heat from the sun is absorbed by impervious surface areas and is radiated back into the atmosphere, increasing temperatures in the surrounding area. Additionally, buildings and streets trap and concentrate waste heat from vehicles, factories, and air conditioners. The displacement of trees and vegetation minimizes their natural cooling effects. Trees, green roofs, and other green infrastructure lower the demand for air conditioning energy, thereby decreasing emissions from power plants.

- Improving air quality by incorporating trees and vegetation in urban landscapes.

  Trees and vegetation absorb certain pollutants from the air through leaf uptake and contact removal. If widely planted throughout a community, trees and plants can even cool the air and slow the temperature-dependent reaction that forms ground-level ozone pollution.

- Providing increased access to recreational spaces and wildlife habitats including greenways, parks, urban forests, wetlands, and vegetated swales.

- Impacting overall human health by providing vegetation and green space.

  Research has linked the presence of trees, plants, and green space to a stronger sense of community, improved performance, and even reductions in physical and mental illnesses.

- Improving accessibility by reducing travel distances and improving transportation options by creating nodes such as rideshare and bus stops.

  Community connectivity, or clustering, refers to land use patterns in which related activities are located in proximity to one another. Clustering makes it easier to do things such as run several errands at the same time or socialize.

- Protecting greenfields and preserving habitat and natural resources by clustering buildings.

- Reducing greenhouse gas emissions contributing to the carbon footprint as a result of decreased vehicle use travelling to and from sites.

  Transportation fuel consumption and emissions contribute to climate change, smog, and particulate pollution, all of which have negative impacts on human health.

- Controlling noise levels below 65 decibels that is considered an acceptable level in suitable living environments.

  The Noise Control Act of 1972 (Public Law 92-574) directs federal agencies to comply with applicable federal, state, interstate, and local noise control regulations. Sound quality criteria disseminated by the U.S. Environmental Protection Agency (USEPA), the U.S. Department of Housing and Urban Development, and the Department of Defense (DoD) have identified noise levels to protect public health and welfare with an adequate margin of safety. Responses to noise vary depending on the type and characteristics of the noise, the expected level of noise, the distance between the noise source and the receptor, the receptor's sensitivity, and the time of day. These levels are considered acceptable guidelines for assessing noise conditions in an environmental setting.

- Reducing light pollution through fixture types, direction of light, lighting control, and improved airfield lighting.

Energy:

Energy is constantly consumed for the operations of every installation. Data is already being collected by installation personnel to capture all energy sources used at the installation, including transportation fuels and mission fuels. Energy sources may include petroleum, natural gas, electricity, coal, and renewable resources such as hydropower, solar, wind, geothermal, biomass, and ethanol. Using existing data, the amount and type of energy consumed is further analyzed to establish a baseline measure for year-to-year comparisons and to monitor the reduction of energy consumption.

Energy usage results in undesired emissions into the environment. Installations typically do not monitor all emissions. Collecting the installation energy data provides the opportunity to calculate a carbon footprint measure (Flying Mission and Mission Support) for the installation that can be monitored year to year.

Water:

The current water distribution systems at most installations and communities are designed to meet multiple supply needs:

- Potable requirements (e.g., drinking, cooking, cleaning, etc.)
- Firefighting
- Municipal, commercial, and industrial needs
- Non-potable applications (e.g., toilet flushing, landscape irrigation, heating, cooling, etc.)

In some areas of the United States, dual distribution systems have been implemented that provide a primary system for delivering high-quality drinking water and a secondary system for non-potable water applications. By using alternative sources for water supplies either to meet non-potable needs or to replenish existing water sources, higher-quality sources of drinking water can be preserved. Capacity and functionality of alternative infrastructure systems need to be considered in cases where separate systems are provided for potable and non-potable applications (e.g., water reuse and recovering gray water, rain water, or storm water).

Per the Energy Independence and Security Act of 2007, any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 SF shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to temperature, rate, volume, and duration of flow. As mentioned under the Development category, storm water is critical to sustainable development. The combination of reducing water consumption; reusing storm, gray, and waste water as water sources; and treating runoff are sustainability goals related to water/storm water.

Waste:

Solid and liquid waste on an installation consists of paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, and hazardous wastes, each of which take their own time to degenerate. The size of the annual waste stream is determined from monthly waste-hauling reports detailing the total tons and cost of the waste that has been hauled. Waste streams include landfill, recycling, hazardous, compost, and any others that are being used on the installation.

Responsible waste management of hazardous and nonhazardous waste is essential to protecting human health and the environment. This includes conserving resources by reducing waste, preventing future waste disposal problems by enforcing regulations, and cleaning up areas where waste may have been improperly disposed.

Wastewater is any water that has been adversely affected in quality by human influence. In the most common usage, it refers to the municipal wastewater that contains a broad spectrum of contaminants resulting from the mixing of wastewaters from different sources. Grey water comprises 50 to 80 percent of the wastewater produced from such activities as dish washing, laundry, and bathing. The amount of the annual wastewater produced on an installation is calculated as a percentage of the reported total monthly gallons and cost of the municipal domestic water consumption.

Treated wastewater can be used for irrigation, fire protection, toilet flushing, artificial wetlands, processing, and cooling towers. Reusing wastewater contributes to conserving water and protecting waterways.

Operations:

Operational BMPs that have been found to be an effective and practical means in protecting or enhancing the environment include such activities as green procurement of goods and services, training, maintenance, and purchasing programs for energy-efficient equipment.

Green procurement is the purchase of environmentally preferable products and services for things such as recycled paper, green cleaning supplies, office products, and printing services. In addition to being cost effective, green procurement reduces the amount of solid and hazardous waste generated and reduces consumption of energy and natural resources.

Proper training of operations and maintenance staff on the use of building systems results in energy savings with minimal upfront investment. The environment benefits from less energy being consumed and less emissions being put into the atmosphere and the building owner benefits from the cost savings associated with less energy being used.

In commercial buildings, use of equipment is the fastest-growing consumer of electricity. Purchasing and using energy-efficient equipment and appliances saves on the total energy being used and the costs associated with their use.

2. Preliminary Research and Data Collection

HQ ACC/A7PS obtained applicable data and reports for the installation from available resources. Examples of reports used as data sources include the Integrated Natural Resources Management Plan, Integrated Cultural Resources Management Plan, Storm Water Pollution Prevention Plan, Integrated Water Quality Management Plan, Drinking Water Management Plan, Pollution Prevention Management Plan, Hazardous Waste Management Plan, Solid and Hazardous Waste Compliance, Economic Impact Analysis, Environmental Restoration Program Site Summaries Report, Department of Energy Report, Transportation Fuel Reports, Real Property Reports, and Geographical Information System (GIS) database. Information gathered is from resources that already exist. Creation of new reports/data by installation personnel is not required.

3. On-Site Evaluation and Data Collection

A six-person A/E team consisting of a civil engineer, a sustainable design engineer, two urban and environmental planners, an architect, and a surveyor met with base personnel and surveyed and documented base assets the week of 19 April 2010. While at the installation, the A/E team interviewed available environmental, engineering, and operations flight staff, such as, but not limited to, natural and cultural resources; air, water, and solid and hazardous waste managers; civil, electrical, and mechanical engineering; community planning; energy and lighting, including HVAC maintenance; engineering; procurement; and real property personnel to supplement the data collected previously from HQ ACC/A7PS as well as to collect data not previously obtained.

4. Data Analysis

The data collected was entered in the pre-established spreadsheet form. Pre-established sustainability indicators were calculated that are quantifiable, repeatable, simple, and represent installation-wide sustainability conditions. The metrics establish a baseline for year-to-year comparison, and document compliance or non-compliance with Federal guidance and other applicable agency governances (e.g., Executive Orders, Energy Policy Act 2005, Energy Independence and Security Act 2007, MAJCOM directives, etc.).

5. Findings Summary

This report and supporting documentation is a compilation and summary of the information collected and the sustainability indicators calculated for Seymour Johnson AFB. The data was evaluated using criteria and protocol that is standard to this initiative and provides a consistent reporting structure. HQ ACC/A7PS will review these results and conclusions to identify potential projects, policy changes, incentives, and year-to-year comparisons.

The following defines the sustainability indicators and methodologies in more detail.

Carbon Footprint:

Carbon Footprint is the measure of the impact human activities have on the environment in terms of greenhouse gas emissions produced, measured in tons of CO_2.

Gases that trap heat in the atmosphere are referred to as greenhouse gases. Some greenhouse gases, such as CO_2, occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases are created and emitted solely through human activities. Human activities typically produce the following greenhouse gases:

- **CO_2—**CO_2 is produced through the burning of fossil fuels (oil, natural gas, and coal), solid waste, and trees and wood products. CO_2 is also produced as a result of other chemical reactions.
- **Methane (CH_4)—**CH_4 is emitted during the production and transport of coal, natural gas, and oil. CH_4 emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.
- **Nitrous Oxide (N_2O)—**N_2O is emitted during agricultural and industrial activities as well as during combustion of fossil fuels and solid waste.
- **Fluorinated Gases—**Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes.

In the U.S., energy-related activities account for three-quarters of our human-generated greenhouse gas emissions, mostly in the form of CO_2 emissions from burning fossil fuels. More than half the energy-related emissions come from large stationary sources such as power plants, while approximately one-third comes from transportation. Industrial processes (such as the production of cement, steel, and aluminum), agriculture, forestry, other land use, and waste management are also important sources of greenhouse gas emissions in the U.S. (USEPA).

For reporting carbon footprint, the General Reporting Protocol v1.1 May 2008 from The Climate Registry was used. This protocol was used to calculate the carbon footprint as it is one of the most widely accepted systems in the U.S. and offers a relatively simple approach that can be adapted to installation-wide systems. Where data was available, Scope I and Scope II emissions and some of Scope III emissions have been included. Scope I emissions are all direct greenhouse gases from combustion sources to refrigerant leaks. Scope II includes indirect greenhouse gas emissions from offsite power generation. For this report, Scope III includes an estimate of employee commuting greenhouse gas emissions. Where possible, direct calculations of materials consumed or released to calculate the equivalent greenhouse gas emissions have been used. In some cases, the use of generalized lookup figures and/or averages to generate quantities of emissions has been allowed. It is important to track the greenhouse gas emissions relative to mission fuels and transportation fuels to allow comparisons to other public and corporate entities.

Energy Usage:

Energy usage is integral to every facet of our daily lives and is a critical component of a sustainable installation. The long-term reliance on non-renewable resources can be decreased and renewable resources can be developed in an environmentally and economically responsible manner. This potential for improved energy usage is important as carbon-based energy sources are the most significant contributor to greenhouse gas emissions.

For reporting energy use, actual usage data from the base was captured from reporting practices in the government. For the purposes of this project, the energy usage data was separated into building/site energy and transportation categories. Transportation data was further broken down into flying mission and mission support categories along with quantifying which energy sources are from bio-based (green) and/or renewable sources. These numbers are used to provide energy consumption relative to full-time equivalent (FTE) and installation building square footages along with allowing analysis of green/renewable sources and Flying Mission versus Mission Support consumption. It was important to separate mission energy consumption from standard transportation due to the large amount of fuels required for aircraft. This separation also provides a fair comparison to other public campuses or corporate entities.

Water Conservation:

As the demand for fresh, clean water for irrigation and industry increases, underground aquifers are being drained faster than they can be refilled. Pollution and changing climatic conditions are adding to the burden on fresh water supplies. Poor land development creates more impervious surfaces which generate higher levels of runoff, while more natural areas decrease the amount of runoff. There is the potential to become water self-sufficient by harvesting rainwater and reducing the use of domestic water.

For reporting water conservation, the domestic water use is captured and compared to the installation population and building square footages for comparison year to year.

Storm water conservation is based on comparing the 2-year post development calculation to a 2-year pre-development (greenfield) calculation using the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS), Soil Conservation Service Method as outlined in Urban Hydrology for Small Watersheds Technical Release 55. Any increase in runoff has the potential for contaminated or polluted waters from parking lots, streets, and the airfield to reach water systems off site, resulting in a need for improved containment and/or treatment.

Waste Reduction:

Every economic activity produces waste. The average human uses 45 to 85 tons of materials each year. Due to diminishing resources and recent legislation, bases need to reduce the amount of waste produced and increase the amount of waste recovered. Composting has the potential to significantly alter the amount of waste thrown into local landfills.

For reporting waste reduction, data is captured regarding total waste, landfill, recycling, compost, hazardous, and the costs associate with each. The data is compared to installation population, USEPA recommended guidelines, and tracked year to year.

Land Utilization:

Community sustainability requires a transition from poorly managed sprawl to land use planning practices that create and maintain efficient infrastructure, ensure a sense of community, and preserve natural systems. Many current land use practices have converged to generate haphazard, inefficient, and unsustainable sprawl. Stratified land use policies and inadequate funding for demolition of obsolete facilities isolates employment locations, shopping and services, and housing locations from each other, thereby creating excessive transportation and creating excessive hard surfaced areas.

For reporting land use, source data was gathered on the installation that provides a baseline site area along with area breakdowns for buildable, non-buildable, and habitat areas. Combining this information with building footprints and building areas by category/use codes allows the breakdown of land use and utilization of the installation. Some of the starting basic calculations include total building area relative to the buildable land along with the total non-built or green area relative to the entire site. An attempt was made to provide a reference of built area relative to the site occupancy. Currently, the square footage per FTE being used to provide a comparison of building area against the installation's population and to depict the utilization of the building space is twice the code-recommended square footage. The code requirement is taken from the Contractor's Guide to the Building Code, IBC Table 1004.1.1: Maximum Floor Area Allowances per Occupant.

6. Recommendations

The recommendations described in this report are derived from the specific information obtained at the installation and are intended for further definition and development of projects that would have a direct and viable impact for the sustainability of the installation. The recommendations are categorized within the pre-established sustainability indicators. Ultimately, this list will be used to develop a prioritized group of projects.

II. INSTALLATION INFORMATION

A. Background

Seymour Johnson AFB is located in east-central North Carolina in central Wayne County, in the city of Goldsboro (see the figure on the following page). The host unit at Seymour Johnson AFB is the 4th Fighter Wing (FW) of the ACC.

The landscape on Seymour Johnson AFB is flat to gently rolling with elevations ranging from 45 to 110 feet MSL. Agricultural, commercial, industrial, and residential development surrounds the installation. The U.S. Highway 70 corridor, with major commercial and retail businesses, together with some residential development, defines the installation's northeast boundary. The Neuse River floodplain surrounds the western end of the runway. Base wetlands are all adjacent to the river or Stoney Creek, which defines the base’s northern boundary. The river floods periodically, though floods are now regulated by Falls Dam located near Raleigh, and flooding has been significantly reduced. The southern and eastern boundaries are loosely defined by residential and agricultural uses.

B. History

Seymour Johnson AFB was established in 1942 during the Second World War as Headquarters, Technical School, Army Air Forces Technical Training Command. It subsequently evolved into a training site for several types of aircraft. In 1943, the Provisional Overseas Replacement Training Center was added as a secondary mission to prepare officers and enlisted men for overseas duty. In addition, the Base became the home of the 75th Training Wing and the 326th Fighter Group, providing Army Air Corps and replacement pilots for the P-47 Thunderbolt aircraft. In 1944, basic training of P-47 pilots became the primary mission at Seymour Johnson AFB. At the end of WWII, Seymour Johnson AFB was designated as a Central Assembly Station for processing and training military personnel being reassigned throughout the continental United States and the Pacific. This function was discontinued in September 1945, and the Base became an Army Air Force Separation Center. The Base was deactivated in 1946 after the war, and in 1949 the property was deeded to the city of Goldsboro.

Between 1950 and the end of 1952, Piedmont Airlines conducted commercial flights to the Seymour Johnson Air Field. During this time, the Base facilities were leased to private interests for warehouse storage, temporary residence, light manufacturing, family housing, and special presentations.

In December 1952, the city of Goldsboro transferred the Base to the federal government, and the U.S. Army Corps of Engineers renovated and repaired the Base. Seymour Johnson AFB was reactivated in April 1956 as a Tactical Air Command base. Three months later, the 83rd Fighter-Day Wing was assigned to the Base as a primary, or host, unit. The 4th Fighter-Day Wing replaced the 83rd Wing in December 1957.

In 1958, the 4241st Strategic Wing was formed on the Base. The Wing was redesignated as the 68th Bombardment Wing, operating B-52 and KC-135 aircraft until 1982. Redesignated in 1985 as the 68th Air Refueling Wing, the unit accepted its first KC-10. In 1991, the 68th was deactivated, and the personnel and aircraft were assigned to the 4th Wing.

On June 1, 1992, the Air Force was reorganized, and Seymour Johnson AFB became an ACC installation. Under ACC, the host unit at Seymour Johnson AFB is the 4th FW, which operates F-15Es. This wing consists of the 335th and 336th Fighter Squadrons and the 333rd and 334th Fighter Training Squadron.


SEYMOUR JOHNSON AIR FORCE BASE
Vicinity Map
Lynchburg
Roanoke
Greensboro
Durham
Raleigh
Charlotte
Columbia
Charleston
Seymour Johnson AFB
Goldsboro
Seymour Johnson AFB
Elroy
N Harding Dr
Maryland
Cincinnati
Louisville
Richmond
Kentucky
Virginia
Norfolk
Dover
Baltimore
Washington
Knoxville
North Carolina
Charlotte
Spartanburg
Raleigh
Goldsboro
Seymour Johnson AFB
Atlanta
South Carolina
Georgia
Charleston
Savannah
Atlantic Ocean

Fighter groups and other personnel from Seymour Johnson AFB have participated successfully in numerous engagements in WWII, the Korean conflict, Vietnam, and the Persian Gulf War.

The Base was annexed to the city of Goldsboro on 7 February 1977.

C. Mission

The 4th FW's mission is to put airpower on-target, on-time for America.

The 4th FW is home to the multi-role, all-weather F-15E Strike Eagle and provides worldwide deployable aircraft and personnel capable of executing combat missions in support of the Aerospace Expeditionary Force. The 4th FW accomplishes its training and operational missions with F-15E Strike Eagles. Two of the wing's four fighter squadrons are operational units, capable of deploying worldwide on short notice and immediately generating combat power. The other two squadrons are responsible for training all F-15E aircrews for the Air Force.

The 4th FW is composed of four groups at Seymour Johnson AFB. The 4th Operations Group is responsible for flight operations, while Maintenance Group has responsibility for the maintenance support used to maintain, mobilize, and deploy F-15E Strike Eagle aircraft. The group also oversees all on- and off-aircraft equipment maintenance, while providing standardized weapons loading and academics training. The 4th Mission Support Group is charged with operating and maintaining the base's infrastructure and, like the other 4th FW groups, has a deployment responsibility. The 4th Mission Support Group is responsible for the leadership and management of civil engineering, communications-computer systems support, security and law enforcement, personnel, information management, education, food services, housing, and recreation. The healthcare professionals of the 4th Medical Group are dedicated to providing the best health care possible to the 4th FW and its associate units.

The wing also provides logistical support to the 916th Air Refueling Wing, which operates KC-135R Stratotanker aircraft in air-to-air refueling missions.

The 4th FW is a unit of the Ninth Air Force (9 AF, United States Air Forces Central [USAFCENT]). The 9 AF-USAFCENT is a numbered Air Force of the United States Air Force ACC. It is headquartered at Shaw Air Force Base, South Carolina. The primary mission of 9 AF is to project decisive air and space power for United States Central Command and America.

D. Geography

The Base has a total area of 5.1 square miles; of which, 5 square miles is land and less than 0.1 square miles is water.

Coordinates:	35° 20' 22" N, 77° 57' 38" W
State:	North Carolina
County:	Wayne
Elevation:	109 feet above mean sea level; field elevation
Terrain:	Flat to gently rolling
Soils:	Naturally deposited alluvial silts, clays, and sands

E. Climate

Temperature: Average July maximum and minimum temperatures are 91°F (33°C) and 71°F (22°C), respectively

Average January maximum and minimum temperatures are 54°F (12°C) and 33°F (0.5°C), respectively

Precipitation: Average yearly rainfall is 49.4 inches (125.5 cm), average yearly snowfall is 4.5 inches (11.4 cm)

Humidity: Average Annual Relative Humidity 85 percent (morning) and 54 percent (afternoon; reported for Raleigh; NOAA, 2008)

Wind: Seymour Johnson AFB Wind Power Classification is 1 or poor

WIND POWER CLASSIFICATION	WIND POWER DENSITY	WIND SPEED
1	0-200 w/m^2 @ 50m aboveground level	0-12.5 mph aboveground level
Source: National Renewable Energy Laboratory, http://www.nrel.gov/gis/wind.html w/m^2 = watt per square meter; m = meter; mph = miles per hour		

F. Demographics

As of September 2009, there were 1,743 people (including 519 military and 1,224 dependents) residing on the base. The off-installation residing population was 9,109 people, including 4,024 dependents. The residing population density was 348 people per square mile. There were 531 military family housing units at an average density of 106 units/square mile. There are also 722 dormitory rooms.

III. FINDINGS

A. Description

A set of five sustainability indicators has been established to summarize the installation's level of sustainability: 1) Carbon Footprint, 2) Energy Usage, 3) Water Conservation, 4) Waste Reduction, and 5) Land Utilization. These indicators have been established to consolidate the large amount of data analyzed into a few comprehensive outputs. The findings associated with the indicators presented below are based on the population and consumption numbers presented in the following table.

POPULATION AND CONSUMPTION NUMBERS, SEYMOUR JOHNSON AFB	
Base Area (acres)	3,232
Usable Building Area (SF)	
Without Family Housing	4,578,522
With Family Housing	6,711,670
Base Population	
Military	5,604
Civilian	974
Dependent Population	5,248
2009 Energy Use[1] Annual	
Electric Use (kWh)	75,803,000
Natural Gas (cf)	116,010,000
Potable Water (Mgal)	166.450
2009 Aviation Fuel Usage (gal)	46,304,637
2009 Other Fuel Usage (gal)	558,045
Diesel (Non-Mission)	286,433
Gas Fuel (Non-Mission)	216,862
Bio Diesel (Non-Mission)	54,717
Ethanol/E85 Fuel (Non-Mission)	33
Other Fuels (Mission)	202,104
Solid Waste (tons)—Total Municipal Waste Stream 2009	3,718
Solid Waste Recycled (tons)—Recycled from Total Municipal Waste Stream 2009	765

Sources: Usable Building Area compiled from the Real Property Records 6-2-10; Base Population data is from Economic Impact Statement, 2009; Energy Use, Mission Fuels, Non-mission Fuels source data is from HQ ACC/A7PS; and Solid Waste data is from Seymour Johnson AFB July 2010 comments.
[1]Includes the base and military family housing
SF = square feet, kWh = kilowatts hour,
cf = thousand cubic feet, Mgal = million gallons, and gal = gallons

B. Current Sustainability Indicators

Refer to the following pages for a summary of findings for the five sustainability indicators for Seymour Johnson AFB.

1. Seymour Johnson Carbon Footprint

In the context of the ISA, carbon footprint is a measure of the Carbon Dioxide (CO_2) and other Greenhouse Gas (GHG) generated to produce energy that is used by the installation. Each energy source has an associated CO_2/GHG value based on the source (e.g., gas, coal, solar, etc.) and the process used to convert fuels (e.g. gasoline engine, jet engine, oil furnace, etc.) to a usable form.

Total Carbon Footprint Seymour Johnson AFB is 460,152 mTons (includes Flying and Support Missions)

ACC and Seymour Johnson AFB jointly need to establish a goal for the installation's carbon footprint. Currently, based on industry benchmarks, Seymour Johnson AFB produces a smaller carbon footprint for mission support transportation and facilities and a larger one for flying mission shown on the following page.

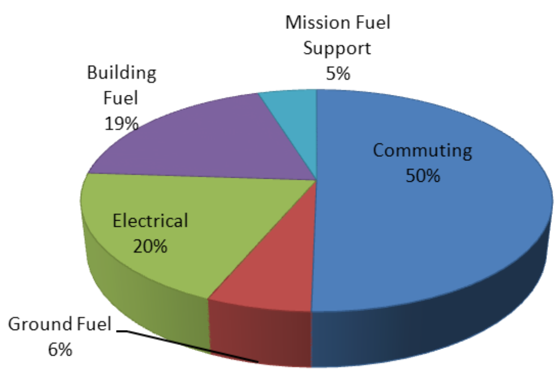
Annual Total Mission Support Carbon Footprint for Seymour Johnson AFB is 17,161 mTons

MISSION SUPPORT—Transportation[5] (No Commuting[3])

Annual Total Carbon Footprint:	3,765	mTons
Per FTE		
Baseline (2005):	(A)	mTons/FTE/year
Previous Year (2008):	(A)	mTons/FTE/year
Current Year (2009):	0.57	mTons/FTE/year
Benchmark[1]:	7.54	mTons/FTE/year
% Reduction from Baseline:	-	
% Reduction from Previous Year:	-	
Per Built SF		
Baseline (2005):	(A)	mTons/1,000 SF/year
Previous Year (2008):	(A)	mTons/1,000 SF/year
Current Year (2009):	1.16	mTons/1,000 SF/year
Benchmark[2]:	20.44	mTons/1,000 SF/year
% Reduction from Baseline:	-	
% Reduction from Previous Year:	-	

MISSION SUPPORT—Facilities[6]

Annual Total Carbon Footprint:	13,396	mTons
Per FTE		
Baseline (2003):	3.40	mTons/FTE/year
Previous Year (2008):	5.56	mTons/FTE/year
Current Year (2009):	2.04	mTons/FTE/year
Benchmark[1]:	7.54	mTons/FTE/year
% Reduction from Baseline:	40%	
% Reduction from Previous Year:	63%	
Per Built SF		
Baseline (2003):	7.77	mTons/1,000 SF/year
Previous Year (2008):	11.28	mTons/1,000 SF/year
Current Year (2009):	4.14	mTons/1,000 SF/year
Benchmark[2]:	20.44	mTons/1,000 SF/year
% Reduction from Baseline:	47%	
% Reduction from Previous Year:	63%	



MISSION SUPPORT CARBON FOOTPRINT[4] (INCLUDES COMMUTING[3])

[1]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 7.54 mTons/FTE.
[2]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 20.44 mTons/1,000 SF.
[3]Greenhouse gases from personal commuting (i.e., back and forth to work) is not included in the Mission Support Transportation calculation table because personal commuting is not part of the SSPP goals. However, in order to gain an understanding of the base's energy/carbon footprint from commuting it is included in the pie chart as a percentage of the Mission Support footprint.
[4]Definitions for pie chart categories can be found in IV. Glossary of Terms and Abbreviations.
[5]Mission Support—Transportation includes ground fuel and mission support fuel quantities shown in the pie chart.
[6]Mission Support—Facilities includes electrical and building fuels shown in the pie chart.
(A) = Data is incomplete.

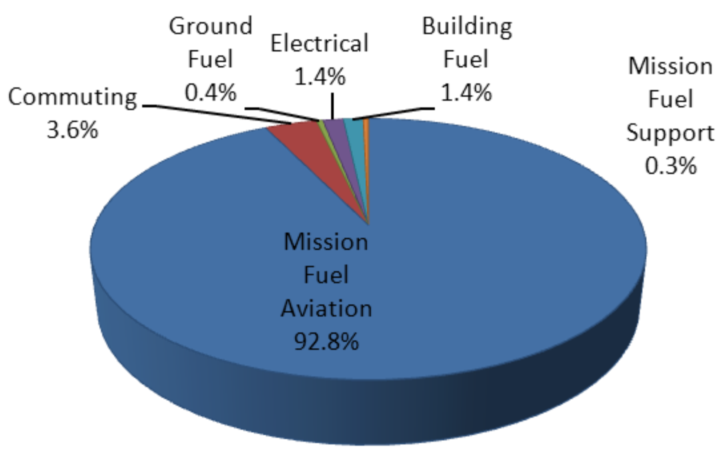
1a. Seymour Johnson Carbon Footprint—Flying Mission

Annual Total Flying Mission Carbon Footprint for Seymour Johnson AFB is 442,992 mTons

FLYING MISSION[1]

Annual Total Carbon Footprint:	442,992	mTons	
Baseline (2003):	(A)	mTons/FTE/year	**Per FTE**
Previous Year (2008):	59.31	mTons/FTE/year	
Current Year (2009):	67.34	mTons/FTE/year	
Benchmark[1]:	7.54	mTons/FTE/year	
% Reduction from Baseline:	-		
% Reduction from Previous Year:	-14%		
Baseline (2005):	(A)	mTons/1,000 SF/year	**Per Built SF**
Previous Year (2008):	120.19	mTons/1,000 SF/year	
Current Year (2009):	136.83	mTons/1,000 SF/year	
Benchmark[2]:	20.44	mTons/1,000 SF/year	
% Reduction from Baseline:	-		
% Reduction from Previous Year:	-14%-		

Flying Mission, Support, and Commuting Carbon Footprint Percentages



TOTAL CARBON FOOTPRINT[4]
FLYING, SUPPORT, AND COMMUTING

- The total grassland needed to offset the total carbon footprint
  for Mission Support is 46,033 acres = 14.2 times the installation area
  for Flying Mission is 636,688 acres = 196.9 times the installation area
- The Flying Mission carbon footprint is equivalent to 122 Pentagons
  1 Pentagon = 77,015,000 cu. ft.

[1]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 7.54 mTons/FTE.
[2]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 20.44 mTons/1,000 SF.
[3]Definitions for pie chart categories can be found in IV. Glossary of Terms and Abbreviations.
(A) = Data is incomplete.

2. Seymour Johnson Energy Usage

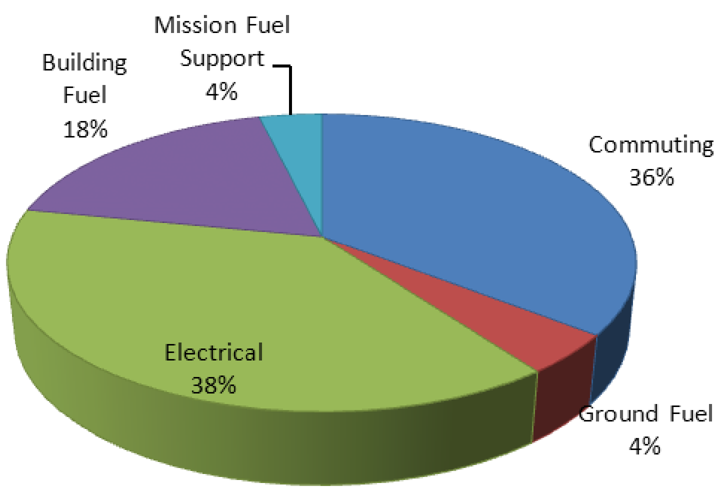
Total Energy Usage Seymour Johnson AFB is 6,677,383 MMBTU (includes Flying and Support Missions)

ACC and Seymour Johnson AFB jointly need to establish a goal for the installation's energy intensity. Currently, based on industry benchmarks, Seymour Johnson AFB has relatively low Mission Support energy usage and high Flying Mission energy usage which is shown on the following page.

Annual Total Mission Support Energy Usage for Seymour Johnson AFB is 436,463 MMBTU

MISSION SUPPORT—Transportation[5] (No Commuting[3])				MISSION SUPPORT—Facilities[6]		
Annual Total Energy Usage:	55,094	MMBTU		**Annual Total Energy Usage:**	381,369	MMBTU
Baseline (2005):	(A)	MMBTU/FTE/year	**Per FTE**	Baseline (2003):	86.57	MMBTU/FTE/year
Previous Year (2008):	(A)	MMBTU/FTE/year		Previous Year (2008):	105.64	MMBTU/FTE/year
Current Year (2009):	8.38	MMBTU/FTE/year		Current Year (2009):	57.98	MMBTU/FTE/year
Benchmark[1]:	327.00	MMBTU/FTE/year		Benchmark[1]:	327.00	MMBTU/FTE/year
% Reduction from Baseline:	-			% Reduction from Baseline:	33%	
% Reduction from Previous Year:	-			% Reduction from Previous Year:	45%	

Baseline (2005):	(A)	MMBTU/SF/year	**Per Built SF**	Baseline (2003):	0.20	MMBTU/SF/year
Previous Year (2008):	(A)	MMBTU/SF/year		Previous Year (2008):	0.21	MMBTU/SF/year
Current Year (2009):	0.02	MMBTU/SF/year		Current Year (2009):	0.12	MMBTU/SF/year
Benchmark[2]:	0.13	MMBTU/SF/year		Benchmark[2]:	0.13	MMBTU/SF/year
% of Energy from Renewable Source:	6.1%			% of Energy from Renewable Source:	0%	
% Reduction from Baseline:	-			% Reduction from Baseline:	40%	
% Reduction from Previous Year:	-			% Reduction from Previous Year:	45%	



MISSION SUPPORT ENERGY USAGE[4]
(INCLUDES COMMUTING[3])

[1]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 7.54 mTons/FTE.
[2]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 20.44 mTons/1,000 SF.
[3]Greenhouse gases from personal commuting (i.e., back and forth to work) is not included in the Mission Support Transportation calculation table because personal commuting is not part of the SSPP goals. However, in order to gain an understanding of the base's energy/carbon footprint from commuting it is included in the pie chart as a percentage of the Mission Support footprint.
[4]Definitions for pie chart categories can be found in IV. Glossary of Terms and Abbreviations.
[5]Mission Support—Transportation includes ground fuel and mission support fuel quantities shown in the pie chart.
[6]Mission Support—Facilities includes electrical and building fuels shown in the pie chart.
(A) = Data is incomplete.

2a. Seymour Johnson Energy Usage - Flying Mission

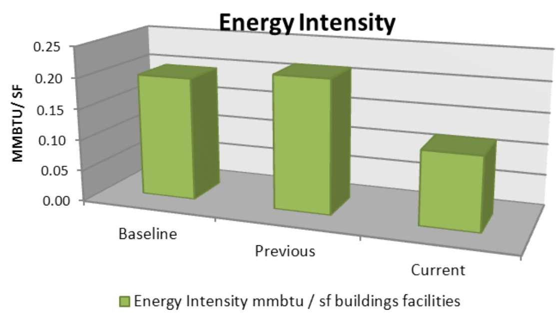
Annual Total Flying Mission Energy Usage for Seymour Johnson AFB is 6,240,920 MMBTU

FLYING MISSION

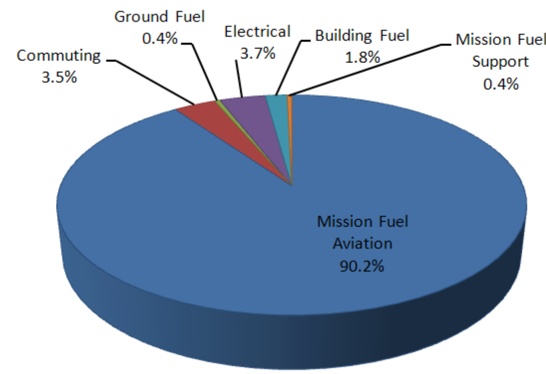
Annual Total Energy Usage:	6,240,920	MMBTU	
Baseline (2003):	(A)	MMBTU/FTE/year	**Per FTE**
Previous Year (2008):	835.55	MMBTU/FTE/year	
Current Year (2009):	948.76	MMBTU/FTE/year	
Benchmark[1]:	327.00	MMBTU/FTE/year	
% Reduction from Baseline:	-		
% Reduction from Previous Year:	-14%		

Baseline (2003):	(A)	MMBTU/SF/year	**Per Built SF**
Previous Year (2009):	1.69	MMBTU/SF/year	
Current Year (2010):	1.93	MMBTU/SF/year	
Benchmark[2]:	0.40	MMBTU/SF/year	
% Reduction from Baseline:	-		
% Reduction from Previous Year:	-14%		

Energy Intensity per Square Foot of Total Building Space



Flying Mission, Support, and Commuting Energy Usage Percentages



TOTAL ENERGY USAGE[3]
FLYING, SUPPORT, AND COMMUTING

- % of total energy from a renewable source
  for Mission Support is 4%
  for Flying Mission is 0%

[1]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 7.54 mTons/FTE.
[2]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 20.44 mTons/1,000 SF.
[3]Definitions for pie chart categories can be found in IV. Glossary of Terms and Abbreviations.
(A) = Data is incomplete.

3. Seymour Johnson Water Conservation

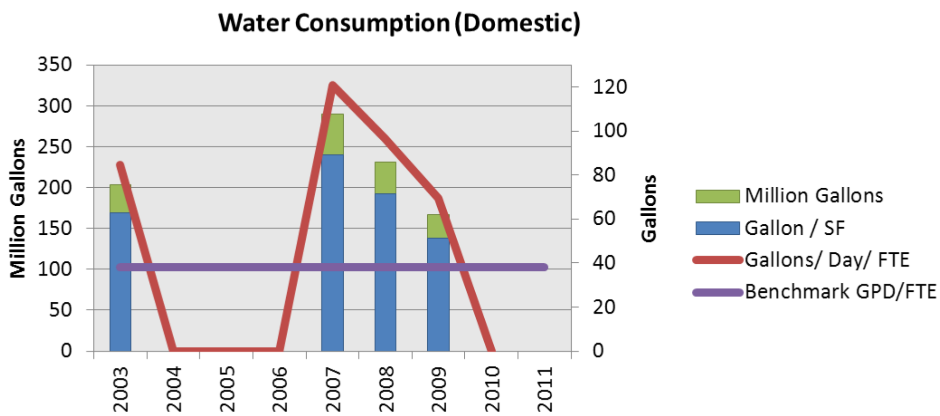
ACC and Seymour Johnson AFB jointly need to establish a goal for the installation's water conservation. Currently, based on industry benchmarks, Seymour Johnson AFB has average water consumption per FTE.

MISSION SUPPORT

Annual Total Water Consumption: 166.45 Million Gallons

Baseline (2007):	120.72	Gallon/FTE/day	Per FTE
Previous Year (2008):	96.44	Gallon/FTE/day	
Current Year (2009):	69.32	Gallon/FTE/day	
Benchmark[1]:	28-38	Gallon/FTE/day	
% Reduction from Baseline:	74%		
% Reduction from Previous Year:	28%		

Baseline (2007):	89.29	Gallon/FTE/day	Per Built SF
Previous Year (2008):	71.33	Gallon/FTE/day	
Current Year (2009):	51.28	Gallon/FTE/day	
Benchmark[2]:	-	Gallon/FTE/day	
% Reduction from Baseline:	74%		
% Reduction from Previous Year:	28%		



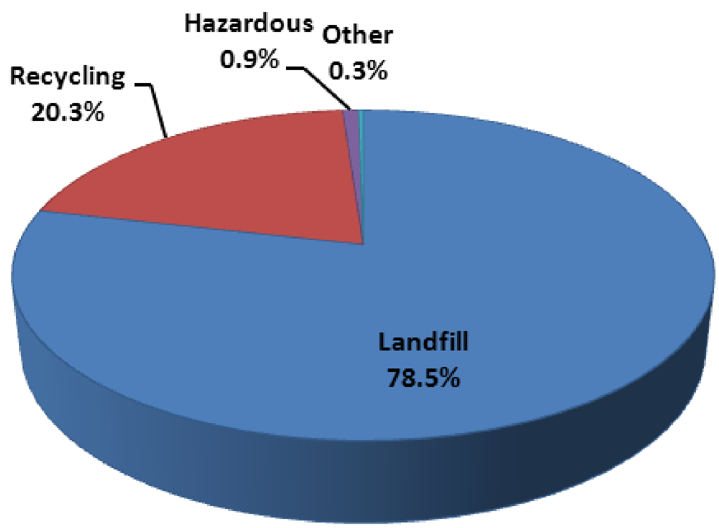
[1]Per Yudelson Associates, Benchmarking Campus Sustainability, 2010.
[2]Benchmark has yet to be established relative to an AFB. This could be established either through the initial ISA investigation or through an additional research project.
(A) = Data is incomplete.

4. Seymour Johnson Waste Reduction

ACC and Seymour Johnson AFB jointly need to establish a goal for the installation's solid waste reduction. Currently, based on industry benchmarks, Seymour Johnson AFB produces 3.13 lbs./FTE under the benchmark of 4.62 lbs./FTE.

MISSION SUPPORT

Annual Total Waste Production:	3,760	Tons	
Current Year (2009):	3.13	LBS/FTE/day	Per FTE
Benchmark[1]:	4.62	LBS/FTE/day	
Current Year (2009):	2.32	LBS/SF/day	Per Built SF
Benchmark[2]:	-	LBS/SF/day	
% Non-Hazardous Waste Diverted from Landfill	21%		



- Total % of composted waste material
  Currently is 0%

[1]Per the USEPA Municipal Solid Waste in The United States: 2007 Facts and Figures, the annual municipal solid waste (MSW) generation rate in 1960 was just 2.68 pounds (lbs.) per person per day; it grew to 3.66 lbs. per person per day in 1980, reached 4.50 lbs. per person per day in 1990, and increased to 4.65 lbs. per person per day in 2000. Since 2000, MSW generation has remained fairly steady. The generation rate was 4.62 lbs. per person per day in 2007.

[2]Benchmark has yet to be established relative to an AFB. This could be established either through the initial ISA investigation or through an additional research project.

5. Seymour Johnson Land Utilization

ACC and Seymour Johnson AFB jointly need to establish a goal for the installation's land utilization. Currently, based on industry benchmarks, Seymour Johnson AFB building density is significantly under the benchmark of 60,000 SF/acre while the amount of square footage per FTE is significantly higher than the benchmark. Additional studies and comparisons among ACC installations need to be completed to provide a weighted opinion on land utilization.

MISSION SUPPORT

Total Building Density[1]:

Current Year (2009):	6,348	SF/Acre
Benchmark[2]:	60,000	SF/Acre
Previous Year (2008):	6,365	SF/Acre
% Change from Previous Year:	0%	

Total Building Utilization[5]:

Current Year (2009):	492	SF/FTE
Benchmark[3]:	160	SF/FTE
Previous Year (2008):	493	SF/FTE
% Change from Previous Year:	0%	

MISSION SUPPORT

Total % Green Space[6]:

Current Year (2009):	74%	
Benchmark[4]:	-	
Previous Year (2008):	74%	

Total % Building/Impervious[7]:

Current Year (2009):	7%	
Benchmark[4]:	-	
Previous Year (2008):	7%	

Total % Building/Footprint[8]:

Current Year (2009):	54%	
Benchmark[4]:	-	
Previous Year (2008):	54%	

- 6,030 average daily traffic at the gates = 0.92 trips per FTE
- 13.21 people per acre of Mission Support developable area

[1]Building density = ACSES real property records, building square footage/property acreage.
[2]Per the U.S. Green Building Council (USGBC) LEED-NC guidelines, development density must be equal to or greater than 60,000 SF/acre.
[3]Per building code guidelines, the average gross square foot per FTE figured at 2 times code standard is 160.
[4]Benchmark has yet to be established relative to an AFB. This could be established either through the initial ISA investigation or through an additional research project.
[5]Building Utilization = ACSES real property records, building square footage/population
[6]% Green Space = Non-Built Green area/Total Installation area.
[7]% Building-to-Impervious = ACSES real property records and Geobase, usable building square footage/impervious area.
[8]% Building-to-Footprint = ACSES real property records and Geobase, usable building square footage/building footprint area.

C. Year-to-year Sustainability Indicators

This is the initial report for Seymour Johnson AFB; therefore, year-to-year comparisons do not exist at this time. For reports in future years, comparisons will be provided for the established sustainability indicators:

1. **Carbon Footprint**
2. **Energy Usage**
3. **Water Conservation**
4. **Waste Reduction**
5. **Land Utilization**

D. Current Sustainability Initiatives

Over the years, Seymour Johnson AFB has undertaken a number of substantial initiatives that can be characterized as sustainable. To help understand future actions that should be taken by the base, past actions need to be documented. The following are past actions that have been identified and undertaken by the base:

Energy Studies

- A renewable energy study was completed in 2006 to identify the most cost-effective sources for the base. The findings in the study determined thermal solar projects to be the most cost effective; wind and photovoltaic (PV) were determined to be the least cost-effective. The energy study is going to be updated in the near future; as a result, renewable recommendations should be updated as appropriate.
- No renewable energy sources are currently being used on base except for a few small solar panels for restoration sites to run pumps.
- The base energy manager has begun a program of Levels 1 and 2 energy audits. Level 3 audits for all facilities will be performed (FY11) under contract managed by the Air Force Civil Engineering Support Agency. Audits are used to determine the best candidates for additional metering and energy efficiency projects.

Reduction in Energy Consumption

- The base is currently at 27 percent reduction in energy consumption with respect to a 2003 baseline. The reduction in energy is the result of two main projects:
    - Heat plant decommissioning (2003-2004), which consisted of removing the old coal fired steam plant and steam heating systems and replacing the central system with a decentralized system of individual boilers (over 100 boilers) at buildings for heating. Steam lines were abandoned in place.
    - Light ballast replacement project (2005), which was an Energy Savings Performance Contract executed to replace fluorescent T-12 lighting with T-8 lighting in many locations on the base.

  - Lighting project to replace high-intensity discharge lighting with T5 High Output fixtures with sensors is ongoing on several buildings on base

- The base has been operating an Energy Monitoring Control Systems using Barber-Coleman Direct Digital Control (DDC) to control HVAC equipment throughout the base as well as hot water heaters in the housing area of the base. The controls have been used to reduce anticipated peaks by cycling the equipment during periods of high load. Efforts are ongoing to meter and automate systems for facilities throughout the base.

  - The base is planning to install occupancy sensors to help achieve a 30 percent energy consumption reduction goal.

  - Occupancy sensors are being coordinated with appropriate program start ballasts. The base has determined that occupancy sensors with instant start ballasts wear down lamps too quickly.

  - Variable Frequency Drives are being installed on HVAC fans to minimize the fan power used depending on the type of HVAC system the fan is serving and, based on the controls, how much the drives can actually decrease the fans speed.

Submetering

- Standard analog meters exist on approximately 100 facilities on base. Efforts have been made towards metering and automated systems for facilities throughout the base.

- The advanced metering program includes 38 facilities.

  - It includes all occupied buildings greater than 21,000 SF. Originally, advanced electrical metering was going to be for facilities of 35,000 SF or greater per ACC programming. However, the base was able to demonstrate the required payback for buildings as small as 21,000 SF based on the Air Force Civilian Engineering Support Agency's 2 percent payback rule.

  - The base plans to add advanced metering to more buildings after completion of the current program. Reimbursing facilities will be a priority.

  - The advanced electrical metering program finishes the energy management loop started with DDC controls on facilities. The base is now able to control and monitor energy use and develop building-by-building energy management strategies based on use trends and 15 minute energy rates received 24 hours in advance. The base is looking into its ability to pre-cool or adjust building use schedules for energy savings and cost.

  - Advanced metering natural gas program implemented with the installation of 18 gas meters on high gas consuming facilities. The system is operating and linked to the existing electric metering

  - Reporting to the central data collector is through wireless radio mesh.

Water Conservation Initiatives

- The base has undertaken a significant leak detection and pipe replacement program. All but about 12 miles of the base's 60 miles of piping has been replaced in the last 10-15 years. These efforts have led to a significant reduction in water consumption. Potable water reduction strategies have been limited to education, low-flow fixtures in new construction and maintenance activities, leak repairs and replacement of leaky water mains. However, there has not yet been a base-wide program of retrofitting fixtures with low-flow fixtures.

- All sewer main pipes were relined about five years ago in an attempt to eliminate inflow and infiltration problems identified in a Sewer System Evaluation Survey. The reduction of I/I reduces the amount of sanitary water pumped by on-base pump stations and treated off base by the local utility.

- All of the pumps at the sewage lift stations have been replaced with new pumps that reduce maintenance requirements and operate more efficiently than the old pumps. Future projects that add flow to the pump stations should review the selected pumps to verify the station is operating efficiently after the added flow.

Waste Reduction Initiatives

- The base operates a recycling program that meets the minimum requirements of state laws requiring recycling of cardboard, plastic bottles and wooden pallets. The base used to operate a more comprehensive recycling program when the prison camp was on base and could provide inmate support. Yard waste from the housing area is separated and hauled off base. According to base staff, the separated yard waste is composted.

- The base recycling program includes a lot of education of base staff and family housing area.

- The base recovers or recycles as much hazardous material as possible. The hazardous material recycling program includes antifreeze, waste oil, jet fuel and continued use solvent; lead acid batteries, oil and fuel absorbents, and dental amalgam; mixed scrap metal from the range; and returning empty 55 gallon drums.

E. Guidance Compliance Summary and Matrix

Refer to Appendix C to review required compliance with current Federal guidance.

IV. RECOMMENDATIONS

The Seymour Johnson AFB team has already implemented many forward-thinking programs to reduce energy and potable water use and enhance the environment on base. By implementing many programs since 2003, they have nearly met their 30 percent energy savings goals. The first recommendation is to "keep doing what you're doing," because the team has already achieved substantial progress on the front of energy conservation and has more great ideas programmed in the funding pipeline. However, even more will be expected in the future. To name just a few of the demanding goals[2] ahead for members of the federal government, by 2030, all new buildings will need to reduce their fossil fuel-generated energy consumption by 100 percent and, by 2020, greenhouse gas emissions must drop by 28 percent and potable water usage must drop by 26 percent. This is not the first round of tough energy and water reduction goals faced by the Air Force and by the SJ team, and over the last 20 years much of the "low-hanging fruit" has been successfully picked. Our recommendations fit into the following categories:

- Encourage implementation and/or extension of existing successful programs.
- Enhance sustainability on base for "free" by making the most of natural solutions that mimic ecosystem services and by capitalizing on existing natural assets such as the sun.
- Implement some "high-hanging fruit" ideas for long-term, significant improvement, possibly requiring programming and investment. Small, incremental gains alone, in many cases, will not be enough to meet the extremely ambitious requirements mandated for the federal government.

Ultimately, the following recommendations should be used to develop a prioritized group of projects.

A. Carbon Footprint

Seymour Johnson AFB is presently receiving all of their purchased electricity from a local utility company, Progress Energy. At present, all of the electricity available to the base from the local utility is from coal-fired power plants. The utility has plans to decommission the existing coal-fired power plant and change to natural-gas power plants in the near future.

A.1 Issue/Condition—The facility peak load has been measured at 13,712 Kilowatt (kW) (with diversity included). Forty-four diesel-fired generators are present at critical facilities, but these are only used for emergency use and are not involved in any demand-related energy cost savings procedures.

Recommendation—A large-capacity generator with a biodiesel burner could be installed to provide additional ability to reduce peak demands. Biodiesel is a renewable non-fossil energy resource that would provide a reduction of fossil-fuel energy consumption as required by EISA 2007 § 433 that would not be achieved through continued use of coal and natural gas power from the local energy utility. On-base use of biodiesel could also incorporate co-generation for use as both a power and heating source and would be double counted towards renewable energy use and generation goals as defined by EPAct 2005 § 203. A study should be performed to determine the capacity and location most appropriate for a biodiesel generation or co-generation facility. The study should consider the value of non-fossil fuel energy generation, impact on carbon footprint, the value of reduced dependence on the public utility and the potential to save on energy costs.

[2] See Appendix C for a cross-walk of federal requirements.

Recommendation—Convert/acquire more biodiesel fleet vehicles, with a preference for B100 over B20. If both the backup generator and fleet vehicles use B100 biodiesel, a bulk-purchase of biodiesel will be more cost effective.

A.2 Issue/Condition—A few electrical solar panels are in use to power small, remote facilities, but these do not feed back to the grid.

Recommendation—Continue the selective use of small grid arrays of PV panels for remote facilities rather than large array systems to support large areas of the base. PV panels are typically considered the least cost-effective renewable energy source.

Recommendation—EISA §523 calls for 30 percent of hot water demand to be solar thermal, if it is cost effective during the life cycle and the base has already identified a potential for the use of solar thermal heating at Seymour Johnson AFB. If used, thermal panels using evacuated tube technology should be considered for this purpose, since damaged tubes can be easily replaced without water leaks from the panels. In any event, with any new construction the base should consider the potential for adding solar systems and should design the buildings and the mechanical systems in a manner that makes the facility as "solar ready" as possible.

A.3 Issue/Condition—While the tendency to maintain the facility's dependence on the local utility for electricity is understandable, the more developed the facility's own ability to generate power is, especially through the use of renewables, the more centralized the heating and cooling systems may become. Use of municipal solid waste or biomass fueled combustion facilities has been considered for use at the base in the past. However, Title V permitting implications, and the associated costs and new requirements, have been considered hurdles that must be overcome. At present, there are no efforts to decrease the dependence on outside energy producers. Developments such as a municipal solid waste or biomass boiler facility, or the biodiesel generator mentioned above, would help to decrease dependence on energy produced outside the base and would also be a source of renewable energy. A co-generation facility that would generate power through biomass or biosolids gasification or combustion to develop steam to turn turbines to power the electrical grid and provide heating and cooling with steam-powered chillers would be a forward-thinking project. Plasma arc technology is another option for an on-base generation facility; however, the technology is not as widely available commercially for waste-to-energy facilities as fluidized bed combustion technology that could be used in a combustion type facility.

With regards to maintenance, the use of fewer, larger pieces of equipment in central plants can result in energy savings and decrease maintenance costs. For example, the larger a chiller is the smaller the cost per ton is for maintenance, and the fewer number of lbs. of refrigerant per ton is required to generate air conditioning. A central location for servicing the equipment and storing parts and tools and refrigerants and chemicals can minimize maintenance and enhances safety for the maintenance staff and building occupants.

Regarding distribution lines, the lines (pipes) require very little maintenance once they are installed in the ground and have a life expectancy of 50 plus years in most cases. Central systems with underground distribution pipes could include the following:

- Steam and steam condensate at anywhere from 15 to 150 lbs. per square inch
- Heating hot water at anywhere from 120F to 350F (medium temperature, pressurized hot water system)
- Ground source Geothermal with temps from 35 to 95F

- Solar Thermal with temps from 120 to 210F for heating systems or domestic hot water systems
- Compressed air
- Chilled water for air conditioning with temps from 38F to 50F
- Ice storage water with temps from 35 to 45F
- Condenser water from cooling towers to chillers or heat pumps at temps from 35 to 95F
- River water (another geothermal resource) for condenser water on chillers or heat pumps at temps from 35 to 85F.

Recommendation—These projects can provide long-term dividends for energy cost reductions and meeting federal requirements. Executive Orders 13423 and 13514 mandate renewable energy goals for the federal government as a whole, and MSW incineration and biomass combustion is considered "renewable" for purposes of compliance. EPAct 2005 §203 dictates that the facility receives double credit towards the renewable energy mandate for generating that energy on a federal facility. In considering this type of project, the base must also account for its impact on other environmental and sustainability considerations, such as potentially negative impacts on air quality and positive impacts on solid waste management and the local economy.

A.4 Issue/Condition—The average commuting distance for Seymour Johnson AFB personnel is estimated at 12.59 miles for appropriated funds employees, and traffic congestion is relatively minor. As a result, alternative modes and methods of transportation to/from the base, including ride-sharing, have never been fully embraced.

Recommendation—Create a base-wide ride-share program. Provide preferred parking (the closest spots to the building aside from handicap parking) for car/vanpools. Preferred parking spots not only encourage ride sharing but also contribute to Leadership in Energy and Environmental Design (LEED) certification of buildings.[3]

Recommendation—At an average of 15 mph (a reasonable speed for an inexperienced cyclist), a bicyclist can do a four-mile commute in 16 minutes. At 12.59 miles for the average commuter, this means a 50-minute commute, which may not be very appealing to most individuals. However, once on the base, the relatively small size of Seymour Johnson AFB's area makes it easy to traverse on a bike for small errands. Therefore, the purchase of unit-owned bikes (with helmets and a lock) for use on and around the base should be considered. These bikes can be used for free by unit personnel for short-distance errands within the administrative, unaccompanied housing, and flightline areas of the base without the inconvenience of moving a car and finding a parking spot for a short trip. Installation of bike racks at main facilities on the base would complement the purchase of unit-owned bikes.

In conjunction with unit-owned bikes, the base should accommodate bike travel on main thoroughfares by programming key roads with a wide shoulder or bike lane. Bikeways targeting commuters would connect the primary mission areas with the services/administrative areas and the on-base housing. Langley Street has already been identified as a potential candidate for a "complete-street" project that would be a thoroughfare between the fighter group and housing.

[3]To earn LEED credit 4.4 "Alternative Transportation: Parking Capacity" under Option 1, a building project must fulfill two requirements: the size of parking capacity must not exceed minimum requirements and the facility must provide preferred parking for carpools and vanpools for 5 percent of the total provided parking spaces.

B. Energy Usage

Base personnel have demonstrated a no-holds-barred approach to managing energy use, resulting in many progressive programs and practices. Additional projects should be considered to build upon past success, continue existing programs, and consider new options for energy savings.

B.1 Issue/Condition—Seymour Johnson AFB's operations staff is actively involved in energy-minimizing programs as a means to address the base carbon footprint and energy costs. The base has previously installed a radio frequency based load shed system produced by Comverge Technologies in 144 buildings on base that disengages HVAC equipment for 15 minutes out of every hour when the electrical demand for the base reaches 7.5 megawatts. The base has also installed a Barber-Coleman Network 8000 DDC system in 104 buildings on base to remotely control building HVAC equipment. Over 100 buildings have analog electric meters installed with 38 of the buildings on base included in a partially completed program to install advanced metering systems.

Recommendation—Continue the existing building DDC and Advanced Metering System programs and expand them where practical. Advanced Metering Systems enable the base energy managers to monitor and document in real time the largest energy users and their energy profiles in order to establish programs that will potentially minimize energy usage and costs related to the local tariff, which bills on 15-minute rate intervals published 24 hours in advance. Installing more of the advanced meters coupled in buildings with the DDC systems will allow the energy managers to identify energy wasters and implement demand controlled operations programs to reduce energy costs and make them more energy efficient.

Recommendation—Phase out the use of load shed devices in buildings with DDC systems, particularly those with advanced metering for which a demand based operation schedule can be developed. Load shed devices reduce electric load, but often at the cost of additional wear and tear on the HVAC equipment because they typically do not consider what stage of operation the equipment is in when the equipment is shut down and also increase the number of start and stop cycles the equipment runs through. Shutting off air conditioners regardless of the load also affects the ability of the equipment to maintain desired levels of relative humidity, increasing the opportunity for mold growth. Efficiency can be achieved through the development of a demand controlled operation plan and the use of a centralized DDC system that provides more significant control of equipment and space conditions that has less impact on the equipment.

Recommendation—Retro-commissioning programs for major energy users on base are planned to fine tune the mechanical systems already in place to ensure the buildings are operating as efficiently as they were designed. During this process, existing problems with HVAC, plumbing and electrical systems that may be affecting energy will be discovered and funds will subsequently be justified for necessary repairs. This program should be continued until all major facilities have been placed into as-new conditions.

Recommendation—The base is beginning to install economizers to use free-cooling when outside air temperatures are low and cooling is required. Some buildings with energy management systems (EMSs) are also using CO_2 monitors to perform demand-controlled ventilation when spaces are lightly staffed. Continue this practice on new construction and major renovations for energy savings. This practice also contributes to LEED credits for indoor environmental quality and energy savings.[4]

Recommendation—The addition of a "no-heat-and-no-cool" mandate for non-critical facilities from 15 March to 15 May and 15 October to 1 December could also present an opportunity to save costs as well as energy.

Recommendation—Interior lighting systems are continuously being modified to use more energy-efficient lamps and are being equipped with photocells and timers to minimize actual use. The base has been evaluating options for the replacement of fixtures based on suitability for the task area. The base should continue to replace lighting systems with more energy-efficient lamps.

Recommendation—The base may consider a study of the nighttime uses of lit parking areas to determine if all parking areas require the lighting that is currently used. If carried over to the daytime use of parking areas, the study may also show that a reduction of parking area is appropriate—refer to recommendations for Land Utilization for additional recommendations of parking area analysis.

Recommendation—Additional buildings are scheduled to have occupancy sensors installed in assembly areas, conference rooms, and restrooms to control lights. Continue and enhance this program.

B.2 Issue/Condition—Reducing the installation's energy intensity (on a BTU/SF basis) and increasing the use of non-fossil-fuel-generated energy is a complex problem that will only be solved by looking at the base energy situation in a holistic way. The base's infrastructure and facilities systems need to be evaluated and a resulting energy master plan and program needs to be developed as the result of analyzing a tremendous amount of facility, equipment, and energy usage data. An integrated energy master plan can discover base-wide energy savings on the order of 50 percent or better and identify geographically appropriate sources of renewable energy. The function of the master plan is to identify the projects that not only provide the best potential for meeting the goal of 30 percent energy savings by 2015 (EISA §431) and renewable energy goals, but also show economic benefit through a lifecycle cost analysis. An energy master plan goes beyond quick payback periods and individual building projects to illuminate the high-hanging fruit that can provide an order of magnitude improvement in energy savings across the entire installation.

Recommendation—Develop an energy master plan to discover the best alternatives to achieve EO, EISA and EPAct mandates. An energy master plan will identify a base-wide strategy that not only decreases Seymour Johnson AFB's carbon footprint but also saves energy use and cost. Alternatives that would be studied and vetted by an energy master plan team would include the following:

A. Use combined heat and power plants (co-gen) that burn biomass, if possible, and natural gas, if not. The current mix of fuel used for heating on base is natural gas and electricity (which is developed by 100 percent coal-fired plants).[5] Any modification to the type of heating used

[4]LEED Indoor Environmental Quality (EQ) credit 1–Outdoor Air Delivery Monitoring and Energy and Atmosphere (EA) credit 1–Optimize Energy Performance.
[5]Heating systems on the base consist mostly of gas-fired boilers (80 percent) and resistance electric and/or electric heat pumps (20 percent), so more natural gas is used than electric energy.

should favor non-electrical power sources to reduce the Source 2 GHG emissions caused by the local energy provider's use of coal to generate electricity.[6]

B. Construct district heating and cooling plants.

- District heating enables the use of co-generation plants to heat and power multiple buildings independent of local utilities. In lieu of steam distribution, a high-temperature hot water system that distributes hot water under pressure could be used to minimize construction and maintenance costs of the distribution network.

- District cooling plants provide the most energy-efficient means to produce air conditioning and also allow more use of thermal energy storage (TES) (such as ice storage) to perform electrical peak savings. Developing chilled water overnight results in approximately seven percent savings due to the generation occurring during cooler hours of the day.

C. Change over facilities that use electric heat-to-heat pumps or district heating. A master plan would likely recommend, at a minimum, converting electric-only systems to heat pumps in places that are both heated and air-conditioned, which would also allow retrofitting to district heating in the future.

D. Replace existing heating boilers (and hot water heaters) to 94 percent or higher condensing-type boilers in the event that district heating cannot be used.

E. Use ground source geothermal heat pump systems for future heating and cooling projects if the projects are at remote locations and cannot feasibly be placed on a district system.

F. Use variable refrigerant flow systems that can use internal space heat gains to minimize heating required for the exterior envelope of buildings as an alternative to water-source heat pump systems.

G. Recommend locations for installation of additional advanced meters for electricity and gas to enable individual users to monitor their energy use. Real-time energy use displayed in each facility can result in a significant savings since users take charge of their own habits.

H. Expand the installation of the comprehensive facility-based EMS that allows trained operations staff to continuously monitor and modify energy use.

B.3 Issue/Condition—Most of the existing chilled-water air conditioning systems and all of the direct expansion air conditioning systems are air-cooled machines. In general, these machines require 1.25 to 1.5 kW per ton of air conditioning to develop the required cooling. Water-cooled systems with screw machines or centrifugal compressors can develop chilled water for air conditioning at less than 1 kW per ton. Not only is the low efficiency of these units creating a greater carbon footprint than water-cooled equipment, but also the loss of refrigerant is increasing greenhouse gas emissions.

Recommendation—Water-cooled systems for larger facilities will save considerable electrical energy and decrease the amount of refrigerant lost from air conditioning equipment. A large central chiller facility providing chilled water to districts of the base can provide even more significant savings in energy and greenhouse gas emissions. The large distribution system acts as a thermal reservoir (the "flywheel" effect) that a diverse group of buildings use, and a central plant is more efficient in aggregate and easier to maintain than many smaller air conditioning units. Central chilled water plants

[6]SJAFB is presently receiving all of their purchased electricity from a local utility company, Progress Energy. The mix of fuels providing that power is currently 100 percent coal, but will be changed to 100 percent natural gas in the near future.

provide significant opportunities to not only save on energy use (and therefore decrease the carbon footprint) but also provide the following benefits:

- Lower maintenance costs and staffing requirements
- Less lost refrigerant per year
- Increased occupant safety, no refrigerants inside occupied buildings
- Improved controllability of air conditioning energy use
- Opportunity for use of TES tanks to decrease peak demands
- Opportunity for ice storage to decrease peak demands and improve dehumidification capability
- Ability to design chilled water systems for higher temperature gradients, saving energy and installed costs
- Potential for combined heating and cooling with a chiller/heat pump arrangement
- Increased useful space in existing buildings by removing mechanical equipment from buildings
- Elimination of eyesores and the potential for Legionnaires Disease by removing cooling towers where existing water-cooled units are installed. This change would also eliminate the need to store chemicals in occupied facilities.

Note—There is 4,661 tons of air conditioning equipment installed on the base according to an inventory provided in June 2010. The equipment generating that air conditioning, when running at peak conditions, requires approximately 5,365 kW of electricity, not including the air handler fans or circulating pumps (the peak load has hit 13,700 kW). If district cooling systems were able to be installed to serve the entire base with the required air conditioning, 930 tons less equipment would be required, and 2,000 kW less power would be required, substantially decreasing the base carbon footprint. See summary output of calculations below (nominal kW/ton numbers were used for each type of equipment).

Seymour Johnson | HVAC Systems | Woolpert 69953

Data source- Listing of all SJAFB HVAC air conditioners- received 6/17/10

Equipment Number	Type	MFG	Tons	Model	Serial #		1 kw/ton Air cooled Chillers KW	.2 kw/ton Gas-pack A/C KW	1.6 kw/ton Heat Pumps KW	1.5 kw/ton Air cooled splits/rtu's KW
		Totals=	4661			Total KW 5365.65	3138	18.8	1045.6	1163.25

Assumed diversity- District Cooling=	0.8	Tons saved with District Cooling=	932
Required tons- District system=	**3728.8**		
KW/ton for a District System=	0.90	KW saved with District Cooling=	2010
Kw required for District Cooling=	**3356**		

Recommendation—Since most buildings are provided with gas boilers, consider building Thermal Storage Batteries, similar to ice storage banks, and tie the buildings together with distribution piping to enable the use of either thermal solar systems or ground-source heat pump systems or chiller heat pumps to store low-temperature hot water for heating buildings.

B.4 Issue/Condition—A small central plant for multiple buildings can use water-cooled chillers and an ice storage system. A surface water pond can be used for additional heat rejection in support of the cooling towers.

Recommendation—Ice storage and a central plant should be considered for some locations on the base, with the potential for creating a district cooling system for as many clustered buildings as possible. The more buildings attached to a chilled water loop, the more benefits from the thermal storage system, and the lower the electrical usage of the base during peak loads as well as all season long.

Recommendation—Existing fire suppression deluge tanks contain a considerable amount of water that could potentially be used for a central chilled water system as a TES tank. By adding pumping capability, internal piping and controls and tank insulation, these tanks could store 38° F chilled water overnight that could be used during the day to offset the electrical energy required to create air conditioning during summer peak conditions. Temporary drawdown of the tanks during firefighting activities would be acceptable for the operation of the chilled water system.

B.5 Issue/Condition—Domestic hot water heating is provided almost exclusively by gas-fired equipment. Some of this equipment may be operating at efficiencies as low as 50 percent, depending on condition and age. Most equipment was initially rated for 80-percent efficiency when new.

Recommendation—If solar is not used due to life cycle costs and a distributed heating system is not available, a program to replace old, standard hot water heaters with newer, condensing-type gas-fired heaters rated for 94 percent or better efficiencies should be considered. Hot water heat pumps are also a potential efficiency improvement.

B.6 Issue/Condition—The local electric utility is charging the base on a 15-minute interval time-of-day rate. The electrical monitoring system is providing power factor kW and kWh data at 15-minute intervals to enable operators to coordinate energy demand with varying rates.

- Advanced metering and a control management system are being installed in buildings larger than 21,000 SF; some analog sub-metering is in place at the clinic, a section of family housing (as a whole) and at other on-base facilities to allow for reimbursements.
- The advanced metering installed to date has already verified previous estimations of which buildings are the highest energy users. The flight simulator building is confirmed to be the highest energy user on the base, and the advanced metering system has shown that the highest energy use for that building is during peak demand for the entire base.
- Barber-Coleman 8000 Series DDC is installed for approximately 130 buildings on base and in the family housing (excluding more recently constructed family housing) to reduce peak electric load by cycling HVAC equipment off during peak load times. However, insufficient real-time metering does not allow for the operation of a true consolidated EMS.
- The standard thermostat setpoints directed for all spaces is 68° F heating and 78° F cooling; however, these setpoints cannot always be controlled by operations since many of the systems are not part of a base-wide EMS.

It is imperative that base Energy Managers have the ability to assess the instantaneous level of power that is being consumed, as well as the major users of that power at any given time to coordinate the operations of the physical plant in the most advantageous manner to minimize energy use and energy costs.

Recommendation—Additional buildings that should be monitored are the ones that are suspected of being the most energy intensive. The base energy manager has begun a program of Levels 1 and 2 energy audits along with plans for Level 3 audits to be completed in FY12. Audits should be continued to determine the best candidates for additional metering and energy efficiency projects, which could be a part of an energy master planning effort.

Recommendation—Utilize data collected by the advanced metering systems to coordinate the use of buildings with periods of low demand. Adjustments to the scheduling of flight simulator use could have a significant impact on energy consumption during periods of peak demand.

B.7 Issue/Condition—Seymour Johnson AFB uses the ACC Sustainable Design and High Performance Green Building Design Scorecard as its green building self-assessment metric. The scorecard assembles and consolidates Executive Orders, Public Laws and Federal Agency rulemaking on Sustainable Development and High Performance Green Building Design requirements with the LEED Rating System. Using the scorecard is a way to achieve the desired LEED rating and meet critical statutory minimum requirements.

When applied in context, the scorecard rating system can illuminate opportunities for sustainable design, often with low- or no-cost choices. Some choices carry an upfront cost but provide long-term operational cost savings and are value-added building features. Starting with programming, the base can direct the design and construction of the building to achieve certain LEED and other federal requirements that base-level engineers deem to add the most value and advance the base towards their specific sustainability goals. Without direction otherwise, contractors often choose to satisfy requirements based on up-front cost alone.

Recommendation—Use the ACC scorecard requirements to guide and inform building projects towards lower lifecycle costs and enhanced sustainability.

Recommendation—Train the programming staff and design/engineering staff in the LEED Rating System and scorecard application.[7] A scorecard checklist must be completed for military construction projects, and can also be completed for Sustainment, Restoration, and Modernization building projects to inform their design. The checklist outlines a strategy that will inform all other stages of building design, so it is critical that base-level programmers understand LEED and the application of the scorecard; how it supports broader energy, water, and sustainability goals; and how to choose appropriate points for building projects. The single LEED AP® at Seymour Johnson AFB was relocating to Ft. Monroe at the end of April 2010. The base would do well to have at least one staff member become a LEED AP® to be a go-to person for assistance with LEED requirements.

Recommendation—Enhanced commissioning is a scorecard credit that carries an upfront cost to implement, but provides value to the installation in reducing long-term energy and maintenance costs.[8] As building energy systems become more advanced to meet higher levels of energy efficiency, commissioning becomes even more critical to assure those energy systems function as intended. We recommend enhanced commissioning because of the rapid payback period and long-term operational cost savings.

Recommendation—Choose roofing material and color to earn scorecard credits. For low-slope roofs (≤2:12), the roof surface must have a Solar Reflectivity Index (SRI) of 79 or greater, and for steep-slope roofs (>2:12) an SRI of 29 or greater is required. One, bronze-colored, standing-seam metal roof product is now available that meets these requirements; however, lightening the color of the roof would bring greater reflectivity and a reduction of heat gain into facilities.

[7] AFIT's Civil Engineer School offers a one-week course in LEED, for example.
[8] "The Cost-Effectiveness of Commercial Building Commissioning," by Lawrence Berkeley National Laboratory (LBNL), 15 Dec 2004

Recommendation—When siting a building and developing early schematic design, maximize the shape and orientation of the building with respect to the sun for passive solar heating, cooling and daylighting. This siting will maximize the energy performance the building achieves "for free" as a result of the sun and will help earn points in several categories.

Recommendation—Site buildings in places where occupants can walk or bike to adjacent services and amenities instead of driving, ideally embodying the LEED concept of "Community Connectivity" [9] Include safe pedestrian and bikeways in base development plans.

Recommendation—Set aside 5 percent of parking for car/vanpools and 5 percent for low-emitting vehicles in preferred locations near building entrances. This embodies the LEED concept[10] and encourages alternative transportation.

Recommendation—Maximize water use reduction in all new buildings. By choosing plumbing fixtures that use less water than the fixture requirements passed in the Energy Policy Act of 1992, projects can earn scorecard points[11] and will also assist the base in achieving the potable water reduction goal of 26 percent reduction by 2020 compared to a 2007 baseline.[12]

B.7 Issue/Condition—The base has installed 57 shelters for the aircraft on the FW apron area. The shelters block the light from the existing apron lighting system, dropping levels below minimum standards and requiring the use of portable light masts for task lighting. The base plans to install four 1,000 W lamps in each shelter to provide task lighting once funds are appropriated. The additional lights will increase the energy consumption on the base.

Recommendation—Other bases installing individual aircraft shelters have installed PV panels on the top of the shelters for generating electricity to offset the added energy load of the lights installed for the shelters. The shelters purchased for Seymour Johnson AFB may not allow for installation of a PV array, but the base should review possibilities for the installation of panels with the shelter manufacturer.

Recommendation—Once installed, lighting in the shelters will likely spill out into and cover a significant portion of the apron area. After the lighting is installed, a study of apron lighting with the existing light masts turned off should be conducted to determine the need for the continued use of the existing lighting system, especially since the shelters block most of the lighting from the high-mast lights. The study may show that none of the lights are necessary or that the amount of fixtures on the high-masts can be reduced with some re-aiming of the fixtures. Reduction or elimination of the use of the existing high-mast poles will help to compensate for the increased energy use and maintenance requirements associated with the new shelter lights.

[9] Sustainable Site credit 2.

[10] Sustainable Site credit 4.3 and 4.4.

[11] Water Efficiency credit 3.1, 3.2 and Innovation and Design credit 1 are all achievable by achieving gradually higher water efficiency. Under LEED NC v2.2, a maximum of three points can be earned by reducing water use by 40 percent. Under LEED NC v3, a maximum of five points can be earned with 45 percent water use reduction.

[12] Executive Order 13514 §2(d)(i).

C. Water Conservation

The Seymour Johnson AFB team has made their most significant achievements in water reduction through a program of eliminating leaking water systems on the base. Seymour Johnson AFB has only begun a program of retrofitting existing fixtures with low-flow fixtures on an as-needed replacement basis and installing fixtures in new projects, but no base-wide replacement program has yet been implemented. The golf course on base does use non-potable surface water from the lakes on the golf course for irrigation, but the irrigation system is also connected to the potable water system to avoid excessive draw down of the lakes. The base energy manager noted that the base has taken extensive effort to reduce energy use, but has only recently been able to show improvement on lifecycle cost for water conservation projects.

C.1 Issue/Condition—Potable water reduction strategies have been limited to education, low-flow fixtures in new construction and maintenance activities (leak repairs and low-flow replacement fixtures) prior to FY07, which is the EO 13514 benchmark for a 26 percent reduction of potable water use. There has not yet been a base-wide program of retrofitting fixtures with low-flow fixtures.

Recommendation—Initiate a program of installing low-flow water fixtures and automated faucets in base facilities to the maximum extent feasible throughout the base. The program can be further expanded by implementing the use of effluent water for toilet flushing and other non-potable water uses in new construction on the base, as acceptable to local plumbing code.

Recommendation—Seymour Johnson AFB is located in a climate where rain water harvesting can provide a regular source of water for both potable and non-potable uses. Although the low cost of potable water from the City of Goldsboro currently prohibits rain water harvesting from being effective on a lifecycle cost basis for facilities adjacent to the existing distribution system, rain water harvesting may be more feasible and should be considered for remote facilities on the base. Rain water harvesting systems should be considered as an alternative to the replacement of water lines for remote portions of the base.

Recommendation—As suggested by the base energy manager, the golf course should consider gradual replacement of golf course grasses with native Bermuda grass that is more tolerant of local conditions and would require less water consumption. Bermuda grass should be the top consideration whenever grass is going to be used on base.

C.2 Issue/Condition—Potable water use on base is not sufficiently metered across the base to be able to identify and target high-use activities and areas. The base has installed 25 meters for sub-invoicing customers on base. Additional meters have been installed to separate the water use of the family housing area from the main base. Meters have not been installed on the main portion of the base to measure use by individual buildings or even groups of buildings.

Recommendation—Expand metering of water systems on base to more closely identify high-intensity water users on base. The metering program could begin by establishing districts and then individually metering buildings and water use points (e.g., wash racks) in the district with the highest intensity of water use. The metering installed should provide real-time data to the base energy manager for assessing periods of high use. Data collected from the expanded metering program should be used to make staff and residents more aware and more accountable for water use.

Recommendation—Seymour Johnson AFB is located in a relatively humid climate that produces a significant amount of air conditioning condensate from air-handling units. The condensate is generally good quality water and could be used without treatment for non-potable water uses. Combining multi-unit drains into storage tanks and pumping the water to cooling towers for makeup water or for flushing toilets in facilities can result in a significant amount of water. This use especially applies to medical clinic units due to the high percentage of outside air used in these facilities.

C.3 Issue/Condition—Low chlorine levels in potable water coming onto the base require daily flushing to keep levels within regulated limits. Use of the existing water tower on base has been discontinued partly due to the increased retention time of the water, further reducing the residual chlorine levels.

Recommendation—Model the existing water distribution system. The model should consider existing water use and future water use meeting the 26 percent reduction requirement with current chlorine levels. The water model should determine looping and size reductions to minimize stagnation of water in the water distribution system so that as the existing water main is replaced, the system performance can be maximized. The model should also quantify the amount of water disposed through the automated flushers to support lifecycle cost analysis for future projects.

Recommendation—Consider non-potable uses for the flush water. If a central cooling plant is installed on the base, flush water could be redirected to the plant as use for makeup water. Flush water could also be used to supplement the ponds on the golf course that are used for irrigation. If appropriate storage and piping is provided, flush water might also be appropriate for use at vehicle wash racks and aircraft wash racks. For example, a landscaping contractor was recently redirected to pull water for landscape irrigation from a flush point instead of from a non-flush point.

Recommendation—Along with the review of potential uses for flush water, consider the feasibility of modifying and repurposing the existing water tower on the base for storage of flush water. The existing tower is near a regular flushing point. Should the tower be used to store flush water, a potential use for the water could be for the POV wash rack on base, which is approximately 1,200 feet away.

C.4 Issue/Condition—There are multiple oil and water separators throughout the base. According to a URS 2007 Survey, many of the separators are needed, but most are not performing adequately or are not designed properly for the sources of flow they receive.

Recommendation—Implement the recommendations of the URS Survey that include replacing or improving the operation of the oil and water separators, as well as eliminating unnecessary units.

D. Waste Reduction

D.1 Issue/Condition—At its peak, the Seymour Johnson AFB recycling program had four or five full-time staff and utilized local inmate labor in the recycling center to sort and manage materials. They utilized on-base storage capacity to time commodity markets. The availability of inmate labor decreased and the base hired a contractor to operate the recycling center. Upon expiration of the combined MSW and recycling service contract, new Air Force policy mandated that qualified recycling programs be financially self-supporting, and the contractor support of the recycling center was eliminated. Currently, the base recycles cardboard, plastic, bottles and wooden pallets. They also have yard-waste pick-up in the housing area. Recyclables (except cardboard) are comingled in outdoor containers that are hauled and sorted by the service contractor.

D.2 Issue/Condition—Construction teams executing new construction or major renovation projects must divert at least 60 percent of construction and demolition debris away from the landfill via recycling or reuse, regardless of contracting vehicle (USACE, AFCEE, etc.).[13] Some, but not all, contractors are complying with this requirement and/or providing reporting of diversion.

Recommendation—Require all projects teams, regardless of funding source or execution agency, to divert 60 percent of construction and demolition debris away from the landfill. This will meet the requirement found in the newly published DoD Strategic Sustainability Performance Plan, 2010, and will earn LEED Materials and Resources credit 2.1 "Construction Waste Management-Divert 50 percent from Disposal." ACC command level guidance will also identify 60 percent diversion as a requirement. Another possibility is to write performance-based contracts that encourage teams to achieve 75 percent or higher levels of waste diversion in support of LEED MR credit 2.2.

E. Land Utilization

E.1 Issue/Condition—There are approximately 160 acres of vehicle parking area on the base. Anecdotal evidence suggests there are a number of parking areas that are underutilized. Parking areas are a source of power usage for lighting, storm water runoff and heat, and they contribute to maintenance costs. An excess of parking encourages single-occupancy vehicle use over ride-sharing and alternative means of transportation. Additionally, some streets in the community center of the base carry little traffic, as they are redundant with parallel thoroughfares.

Recommendation—Undertake a parking area analysis to determine the need for the current amount of parking area within an overall goal to reduce the parking area that will, in turn, reduce resource demand. Parking could be centralized among the various existing and planned campuses of the base instead of dispersed between the campuses. For example, the fighter campus plan eliminates parking and consolidates it to make the area compliant with AT/FP requirements. This consolidation provides an opportunity to reduce the total amount of pavement and encourage alternative means of transportation on base such as pedestrian and bike traffic. Reducing parking areas also reduces the land area of the base set aside adjacent to parking for AT/FP.

Recommendation—Seek opportunities to redevelop and thereby eliminate redundant streets and alleys, reducing pavement area. Eliminating under-used streets also frees up land for redevelopment formerly set aside for AT/FP adjacent to roadways.

Recommendation—Seek opportunities to redevelop existing streets as "complete streets" that encourage safe and comfortable transportation for all modes, including pedestrians, cyclists, motorists and future mass-transit shuttle stops, while incorporating low sustainable design techniques to minimize the impact of the built infrastructure on the environment.

E.2 Issue/Condition—By 2030, all new buildings will need to reduce their fossil-fuel-generated energy consumption by 100 percent, with intermediate goals in the intervening years (i.e., 50 percent by 2010). The Air Force is also required to reduce its energy intensity (BTUs/SF) by 30 percent by 2015, and to reduce greenhouse gas emissions by 28 percent by 2020. Enacting such dramatic improvements in energy efficiency without dramatic construction cost increases will require taking maximum advantage of "free" energy savings. Passive solar design of buildings can reduce a

[13]Required by Guiding Principles for Federal Leadership in High Performance and Sustainable Building Memorandum of Understanding (MOU) and Executive Order 13514.

building's energy demand by as much as 30 percent, at essentially no cost. Seymour Johnson AFB cannot afford to develop new buildings without maximizing solar orientation for energy savings.

Recommendation—Maximize solar orientation through land development planning. All future area development plans (ADPs) in areas without an established road system must be laid out and new buildings must be oriented such that solar heat gains/losses are optimized. This is generally with the long axis of buildings east-west and solar exposures to the north and south. The layout of new streets in an ADP often dictates the future orientation of buildings toward the street and as such, aligning the street grid according to the sun is critical. Aligning streets and buildings on an east-west axis will serve the dual purpose of also optimizing those buildings to host rooftop solar panels, should such an opportunity arise. To ensure compliance, any ADP or building not designed to optimize passive solar gains should require permission/review from a higher level of authority.

E.3 Issue/Condition—Seymour Johnson AFB uses the ACC Sustainable Design and High Performance Green Building Design Scorecard as its green building self-assessment metric. Use of the scorecard can illuminate opportunities for sustainable development, often with low- or no-cost choices. One opportunity is called "Community Connectivity," which rewards development within a half-mile radius[14] of at least 10 community amenities (restaurants, library, shopping, churches, etc.) and high-density housing, such as dormitories or apartments. There must also be pedestrian access between the amenities, housing and the building to earn scorecard credit. Seymour Johnson AFB can apply this metric to future developments and ADPs to see if a plan encourages mixed-use development and connectivity and will enhance the walkability and bikeability of Seymour Johnson AFB. Developing towards improved connectivity will have many "free" benefits such as reduced vehicle miles traveled on base, reduced associated greenhouse gas emissions, improved fitness for those who choose to walk/bike.

Recommendation—Develop, track, and improve over time a community connectivity metric for the installation. Measure the diversity of services/uses within an area with a half-mile radius around future development and use the metric to highlight and encourage mixed-use development. This practice will help achieve "free" but meaningful scorecard points.

E.4 Issue/Condition—Seymour Johnson AFB has an attractive community of native, mature pine trees growing in the administrative and community center areas of base. The tall, attractive trees help to reduce the heat island effect on the base, provide energy savings through shading, provide habitat and maintain water quality.

Recommendation—Plant more trees in the administrative, unaccompanied housing and industrial areas of Seymour Johnson AFB. A suggested goal is to become a Tree City USA through the Arbor Day Foundation.[15] Tree planting should be part of the Complete Streets program for the administrative and community center of the installation. Plant trees strategically to shade buildings, thereby reducing heat load and energy costs; reducing the heat island effect of dark pavements and hardscapes; shading walk/bikeways connecting key services and buildings; and enhancing the habitat by choosing native/indigenous tree species. The native Pine trees of Seymour Johnson AFB grow tall and straight and keep their needles year-round, making them ideal shade trees.

[14]A half-mile radius was chosen because it is the distance a typical person is willing to walk instead of drive. It equates to roughly a five-minute walk.
[15]The neighboring community of Goldsboro, North Carolina, is already a Tree City USA.

V. GLOSSARY OF TERMS AND ABBREVIATIONS

Term	**Definition**
Alternative work schedule	Work schedules that do not follow the traditional format of an 8-hour day Monday through Friday; alternatively compress the 40 hour work week into fewer days or allow staff to work remotely.
Aviation fuel	All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range, which will be used for blending or compounding into aviation gasoline.
Baseline	A standard reference case or condition used as a basis for comparison. Establishing a clearly defined baseline is important and defining a repeatable baseline is essential if the work is to be compared to results of other work.
Baseline year	The year in which the baseline was established.
Benchmark	A standardized problem or test case that serves as a basis for evaluation or comparison. The terms benchmark and baseline are often used interchangeably. Consistent and repeatable benchmarking requires clearly defined performance metrics and protocols for developing the reference case to serve as the baseline.
Buildable area	Land use classification areas including administration, aircraft operations and maintenance, community commercial, community service, manufacturing and production, and medical/dental.
Building Fuel	Includes gas, oil, and liquid propane gas used for buildings.
CO_2 equivalent	A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). CO_2 equivalents are commonly expressed as "million metric tons of CO_2 equivalents (MMTCDE)." The CO_2 equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. (MMTCDE = (million metric tons of a gas) * (GWP of the gas))
CO_2 equivalent (CO_2e)	A measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of CO_2 as the reference. For a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same GWP, when measured over a specified timescale (generally, 100 years).
Carbon equivalent	A metric measure used to compare the emissions of different greenhouse gases based upon their GWP. Greenhouse gas emissions in the U.S. are most commonly expressed as "million metric tons of carbon equivalents" (MMTCE). GWPs are used to convert greenhouse gases to CO_2e–they can be converted to carbon equivalents by multiplying by 12/44 (the ratio of the molecular weight of carbon to CO_2). The formula for carbon equivalents is: MMTCE = (million metric tons of a gas) * (GWP of the gas) * (12/44)
Carbon footprint	The total set of GHG emissions caused directly and indirectly by an individual, organization, event or product.
Climate Registry	A nonprofit collaboration between North American states, provinces, territories, and Native Sovereign Nations to record and track the greenhouse gas emissions of businesses, municipalities and other organizations. Data submitted to the Climate Registry is inputted into the Climate Registry Information System (CRIS), which was developed on EPA's CRAVe-EATS platform.
Commuting	Calculated based on average commuting distance of base FTE using a mix of passenger car and light trucks used for commuting. A typical fuel MPG is calculated for each and summed to calculate the total gallons of fuel used for commuting.
Current year	The FY in progress.

Term	Definition
Design guideline	A set of rules and strategies to help building designers meet certain performance criteria such as energy efficiency or sustainability.
Electrical	Electricity usage entered is for the KWH used by the base annually. Note that the relationship between energy intensity and carbon footprint varies based on the mix of coal, natural gas, diesel, fuel oil, nuclear, wind, solar, and hydro electric energy production within the eGRID region.
Energy	The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy). Energy has several forms, some of which are easily convertible and can be changed to another form useful for work. Most of the world's convertible energy comes from fossil fuels that are burned to produce heat that is then used as a transfer medium to mechanical or other means in order to accomplish tasks. In the United States, electrical energy is often measured in kWh, while heat energy is often measured in BTUs.
Energy efficiency	Using less energy to provide the same level of energy service. Also referred to as efficient energy use and is achieved primarily by means of a more efficient technology or process rather than by changes in individual behavior.
Energy intensity	Ratio between the consumption of energy to a given quantity of output; usually refers to the amount of primary or final energy consumed per unit of gross domestic product.
Energy recovery	Includes any technique or method of minimizing the input of energy to an overall system by the exchange of energy from one sub-system of the overall system with another. The energy can be in any form in either subsystem, but most energy recovery systems exchange thermal energy in either sensible or latent form.
Energy Star	An international standard for energy efficient consumer products. Devices carrying the Energy Star logo, such as computer products and peripherals, kitchen appliances, buildings and other products, save 20%-30% on average.
Fiscal Year (FY)	The period used for calculating the annual ("yearly") sustainability indicators. The U.S. government's FY begins on October 1 of the previous calendar year and ends on September 30 of the year with which it is numbered. For example, FY for 2008 is written as "FY08" or as "FY07–08."
Fleet	Two or more vehicles.
Flying Mission	Includes anything that directly effects or has direct participation in flight or deployment operations.
Footprint	The outline of the total area of a lot or site that is surrounded by the exterior walls of a building or portion of a building, exclusive of courtyards. In the absence of surrounding exterior walls, the building footprint shall be the area under the horizontal projection of the roof.
Full-time Equivalent (FTE)	In the U.S. Federal government, FTE is defined by the Government Accountability Office (GAO) as the number of total hours worked divided by the maximum number of compensable hours in a work year as defined by law. For example, if the work year is defined as 2,080 hours, then one worker occupying a paid full time job all year would consume one FTE. Two employees working for 1,040 hours each would consume one FTE between the two of them.
General aviation	That portion of civil aviation, which encompasses all facets of aviation except air carriers. It includes any air taxis, commuter air carriers, and air travel clubs, which do not hold Certificates of Public Convenience and Necessity.
Geographical Information System	An information system that integrates, stores, edits, analyzes, manages, shares, and displays geographic information that is linked to a specific location.
Grassland	Terrestrial ecosystem (biome) found in regions where moderate annual average precipitation (25 to 76 centimeters or 10 to 30 inches) is enough to support the growth of grass and small plants but not enough to support large stands of trees.

Term	Definition
Green space	A land use planning and conservation term used to describe protected areas of undeveloped landscape. Also known as open space.
Greenhouse effect	The effect produced as greenhouse gases allow incoming solar radiation to pass through the Earth's atmosphere, but prevent part of the outgoing infrared radiation from the Earth's surface and lower atmosphere from escaping into outer space. This process occurs naturally and has kept the Earth's temperature about 59˚F warmer than it would otherwise be. Current life on Earth could not be sustained without the natural greenhouse effect.
Ground Fuel	Ground Fuel is considered the total of all government vehicle fuel used outside flightline fuel use.
Incentive program	A formal scheme used to promote or encourage specific actions or behavior by a specific group of people during a defined period of time.
Indicator	A parameter, or a value derived from a set of parameters, that points to, provides information about, or describes the state of a phenomenon. It has significance beyond that directly associated with the parameter value. Indicators are one of many tools for simplifying, quantifying, and communicating vast amounts of information in ways that are more easily understood. They are also useful for alerting us to what areas that need more attention, as well as areas that see improvement.
Industrial sector	Construction, manufacturing, agricultural and mining establishments.
Installation	A facility directly owned and operated by or one of its branches that shelters military equipment and personnel and facilitates training and operations.
Land classification	The analysis of land according to its use. Land classifications include agricultural, industrial, recreational, and residential.
Land use	The human modification of natural environment or wilderness into built environment such as fields, pastures, and settlements.
Land use planning	The term used for a branch of public policy which encompasses various disciplines which seek to order and regulate the use of land in an efficient and ethical way.
Leadership in Energy and Environmental Design (LEED)	Green Building Rating System, developed by the USGBC, provides a suite of standards for environmentally sustainable construction.
Lumen	A measure of the perceived power of light.
Meter	Metering devices used on utility mains for electricity, water and gas.
Metric	Any measurable quantity. A performance metric is a metric of some performance characteristic; however, not all metrics are performance metrics. For example, area is a metric, but it is not a performance metric.
Metric ton	Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs. or 1.1 short tons. See short ton.
Military	Any property or aspect of a military.
Mission Fuel	This includes aviation fuel only. That is, the fuel needed for the aircraft to fly.
Mission Support	Includes all other activities on the installation that do not directly affect flight and deployment operations.
Mission Support Fuel	This fuel is used for vehicles working on the flightline. It does not include fuel used for aircraft.
Offset	An agent, element, or thing that balances, counteracts, or compensates for something else.
Performance goal	A specific statement of a desired level of achievement. Performance goals must be measurable and definite such that progress can be evaluated. Performance metrics should be carefully chosen to measure progress toward performance goals.

Term	Definition
Performance indicator	A high-level performance metric that is used to simplify complex information and point to the general state or trends of a phenomenon. Performance indicators are used to communicate general trends and are often used on a program planning level to show progress toward goals. See the definition of indicator for more discussion.
Performance metric	A measurable quantity that indicates some aspect of performance. Performance metrics should measure and communicate progress toward achieving performance goals. There are different levels of performance metrics.
Performance objective	A general statement of a desired achievement.
Population density	A measurement of population per unit area or unit volume.
Potential energy	Energy stored within a physical system that has the potential to be converted into other forms of energy, such as kinetic energy, and to do work in the process. The standard unit of measure for potential energy is the joule, the same as for work or energy in general.
Power generation	The process of creating electricity from other forms of energy. Also known as electricity generation.
Previous year	12-month period prior to the current year.
Procedure	A standard method or set of methods for determining one or more performance metrics.
Procurement	The acquisition of goods and/or services at the best possible total cost of ownership, in the right quality and quantity, at the right time, in the right place and from the right source for the direct benefit or use of corporations, individuals, or even governments, generally via a contract. Simple procurement may involve nothing more than repeat purchasing. Complex procurement could involve finding long term partners or even 'co-destiny' suppliers that might fundamentally commit one organization to another.
Renewable energy	Energy obtained from sources that are essentially inexhaustible, unlike, for example, the fossil fuels, of which there is a finite supply. Renewable sources of energy include wood, waste, geothermal, wind, PV, and solar thermal energy. See hydropower, PV.
Residential sector	An area or portion consisting only of housing units.
Transportation sector	Consists of private and public passenger and freight transportation, as well as government transportation, including military operations.
Abbreviations	
ACC	Air Combat Command
Acre	A unit of area equal to 43,560 square feet.
ACUPCC	American College and University Presidents' Climate Commitment
ADP	area development plan
AFB	Air Force Base
BMP	Best Management Practice
BTU	British thermal unit: The quantity of heat required to raise the temperature of 1 pound of water 1°F at or near 39.2°F.
cfs	cubic feet per second
CH_4	Methane
CO_2	carbon dioxide
Cf	cubic foot: A unit of volume of a cube with sides of one foot in length.
DDC	Direct Digital Control
DoD	Department of Defense
EMS	Energy Management System
FTE	full-time equivalent
FW	fighter wing
FY	fiscal year

Term	Definition
gal	gallon
GIS	Geographical Information System
GWP	global warming potential
ISA	Installation Sustainability Assessment
kW	kilowatt
kWh	kilowatt hour
lb.	pound
LEED	Leadership in Energy and Environmental Design
m	meter
Mgal	million gallon
MMBTU	One Million Btus. A Btu is the quantity of heat required to raise the temperature of 1 pound of water 1°F at or near 39.2°F.
MMTCDE	million metric tons of CO_2 equivalents
MMTCE	million metric tons of carbon equivalents
Mph	miles per hour
MSW	municipal solid waste
mTons	metric tones
N_2O	nitrous oxide
PV	Photovoltaic
SCS	Soil Conservation Service
SF	square feet
SRI	solar reflectance index
SSPP	Strategic Sustainability Performance Plan
TES	thermal energy storage
TR-55	Technical Release 55
USEPA	U.S. Environmental Protection Agency
USGBC	U.S. Green Building Council
w/m2	watt per square meter

VI. APPENDICES (NOT INCLUDED)

A. Data Collection Forms and Supporting Documentation

1. Development

2. Energy

3. Water

4. Waste

5. Operations

A.1 Development: The following pages include the development data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Seymour Johnson AFB.

A.2 Energy: The following pages include the energy data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Seymour Johnson AFB.

A.3 Water: The following pages include the water data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Seymour Johnson AFB.

A.4 Waste: The following pages include the waste data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Seymour Johnson AFB.

A.5 Operations: The following pages include the operations data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Seymour Johnson AFB.

C. Data Sources

The following are data sources received from HQ ACC/A7PS and SJAFB:

1. Reports
    a. Architectural Compatibility Standards, SJAFB, 2002
    b. Air Installation compatible Use Zone, SJAFB, 1993
    c. Drinking Water Systems Management Plan, SJAFB, (no date)
    d. Natural Infrastructure Assessment, SJAFB, 2009
    e. Traffic Circulation Plan, SJAFB, 2005
    f. Economic Resource Impact Statement, SJAFB, 2009
    g. Cultural Resources Management Plan, SJAFB, 1998
    h. Hazardous Waste Management Plan, SJAFB, 2004
    i. Integrated Natural Resources Management Plan, SJAFB, 1998
    j. Integrated Solid Waste Management Plan, SJAFB 2001
    k. Storm Water Pollution Prevention Plan, SJAFB, 2009
    l. SJAFB eGP, as updated
2. Miscellaneous Data Provided by SJAFB
    a. Automatic and manual flushing points, water system
    b. DDC System status by building
    c. Load shedding information
    d. Occupancy Sensor data
    e. Mass transit information
    f. Alternative work schedule policy
    g. Commuting distance
    h. ERP site information and status
3. Data Provided by HQ/ACC/A7PS for SJAFB
    a. Mission Fuel Data Use for 2009
    b. Non-Mission Fuel Data Use for 2009
    c. Fleet Data Numbers for 2009
    d. Potable water, Electric, and Natural Gas for the Main Base and Military Family Housing (2003, and 2006-2009)
4. Geobase Data
    a. Data provided by both HQ ACC/A7PS and SJAFB
5. Meeting Minutes

B. Expanding Requirements

There are expanding requirements for military facilities constantly being developed and issued. The expanding requirements include new Executive Orders, Statutes, Directives, Rulemaking, and Guidance.

1. Executive Order 13514
2. Executive Order 13423
3. Energy Policy Act 2005
4. Energy Independence and Security Act of 2007
5. Higher Level DoD and HAF directives
6. MAJCOM directives
7. Key Air Force Environmental Goals
8. Other Federal Agency rulemaking and guidance
9. See Separate Attachment Appendix C for a Crosswalk of Regulations

C. References

National Renewable Energy Laboratory, http://www.nrel.gov/gis/wind.html

NOAA, 2008, http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgrh.html

Other publications and websites used as resources:

1. http://epa.gov/
2. http://www.eere.energy.gov/
3. www.un.org/esa/dsd/susdevtopics/sdt_land.html
4. http://www.nps.gov/sustain/spop/jtree.htm
5. http://www.eia.doe.gov
6. ISAUK Research Report 07-01, A Definition of Carbon Footprint, June 2007.
7. http://acupcc.aashe.org/ghg-scope-statistics.php
8. http://www1.eere.energy.gov/femp/program/printable_versions/waterefficiency.html