



Virginia Pollution Prevention Case Study NASA Langley Research Center

Facility Information

NASA Langley Research Center (LaRC) employs approximately 3,900 individuals, including administrators, researchers, scientists, technicians, maintenance staff, and service contractors in Hampton, Virginia. LaRC pioneers the future in space exploration, scientific discovery, and aeronautics through research and development of technology, scientific instruments and investigations, and exploration systems. LaRC is focused on systems innovation for expanding air mobility, exploring space, and definitively characterizing the Earth's changing climate. NASA's sustainability policy is to execute the organization's mission without compromising the planet's resources so that future generations can meet their needs. NASA seeks to use public funds efficiently and effectively while promoting the health of the planet.

Located in the ecologically sensitive Chesapeake Bay Watershed, LaRC is committed to fulfilling their mission in a way that promotes environmental stewardship, sustainability, and continual improvement. Through pollution prevention methods, sustainability concepts and an established Environmental Management System (EMS), LaRC proactively manages the Center to meet or exceed a host of environmental compliance requirements pertaining to toxic and hazardous materials, resource conservation, water quality protection, and waste reduction. Today, LaRC's EMS serves as the management framework under which LaRC identifies, manages, and improves the sustainable practices identified in the Executive Order goals, Agency requirements, permits, and other regulatory drivers. LaRC's EMS provides a systematic approach for evaluating and addressing the Center's most significant environmental impacts as well as risks and potential benefits to LaRC's mission.

Environmental Challenges and Obstacles

LaRC's motivation to start an EMS and Sustainability program was rooted in presidential Executive Orders (EOs) and a subsequent NASA Policy Document that mandated LaRC's implementation of an EMS. The "NASA Environmental Management" Policy Directive required each NASA Center "to maintain an EMS at all appropriate organizational levels and incorporate sustainability practices to the extent practicable throughout its programs, projects, and activities." LaRC could also see the benefit in an EMS and understood that it was smart decision as well as a mandate. There were several industry and government examples of successful EMS programs, and LaRC evaluated these when considering an implementation strategy.

LaRC ran into many challenges and obstacles early on in the EMS process. Widespread participation and EMS visibility was a problem early on. Initially, it was difficult for some people outside of the Environmental Office to understand what the EMS really was and why they had to participate in an "environmental initiative." The EMS represented a cultural shift to environmental management becoming more than compliance and more than simply an environmental issue. The EMS attempted to bring new ways of thinking about operations and concepts such as sustainability to the forefront of decision making and planning in a continual

improvement process. There was a learning curve at the beginning and the EMS needed some time to grow into the way the Center does business.

A significant step in the path to a successful EMS was the increase in visibility and communication between the LaRC Environmental personnel and LaRC's Senior Management. Early in the process, the Environmental Manager worked diligently to implement several formal communication mechanisms with higher level staff who formerly knew little about the EMS requirements. The Environmental Manager started presenting a quarterly environmental status report to the LaRC Center Director and all Senior Management, the LaRC Associate Director was assigned as the EMS management sponsor, and the EMS Committee (referred to as the EMC) was incorporated as part of the official committee structure of the Center. The EMS requirements forced a more visible presence and formal communication with management. The increase in communication between the Environmental staff, Management, and other Center organizations has been a great aspect of the EMS.

After LaRC had successfully implemented most components of the EMS, the final challenge was establishing an effective internal auditing and corrective action process. The Environmental Office tapped into an existing internal auditing program that LaRC had established to meet ISO 9000 quality management standards. The LaRC Internal Assessment Program Manager agreed to conduct an annual audit of the LaRC EMS using established quality management standards and the EMS Internal Audit Checklist provided by NASA Headquarters. Each year a comprehensive EMS audit is conducted by LaRC's certified Internal Auditor, and the findings are entered into LaRC's corrective action database entitled the Corrective, Preventive and Improvement Action Tracking System. Each finding requires an analysis of the root cause and a plan of action for correcting the finding and preventing reoccurrence. Based on this annual review and the subsequent corrective actions, the LaRC EMS has been continually improving each year.

Implementation of the Sustainability Programs and Benefits from the EMS

The primary focus of the LaRC EMS is the annual re-evaluation and prioritization of LaRC's highest environmental aspects and impacts, and the commitment to make quantifiable improvements in these areas. Below are examples of LaRC's identified high priority aspects and some of the recent progress in these program areas.

Energy and Water Conservation Programs

Energy and water conservation has been a high EMS priority for several years. LaRC achieves energy and water conservation through implementation of efficiency projects as well as employee awareness. These efforts are overseen by the Energy Manager and involve personnel and facilities across the entire Center. The EMC and an Energy Efficiency Team (EET) help to improve energy conservation communication and project implementation. The committees provide direction and guidance regarding implementation of conservation activities at the Center, meeting three to four times a year to discuss energy and water conservation events and projects.

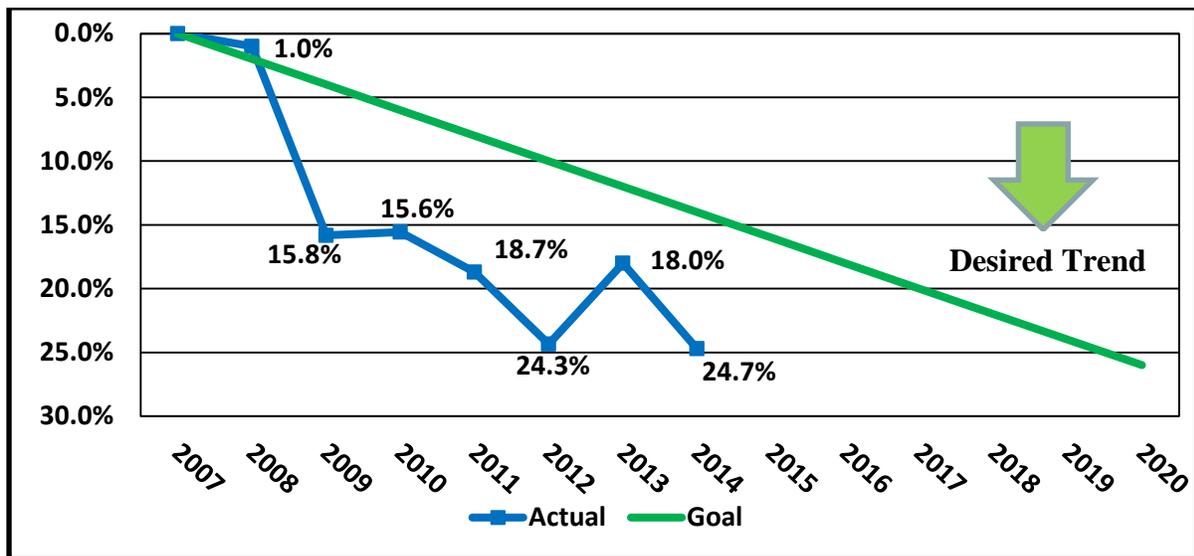
In FY 2014, LaRC purchased 12,000 Megawatt hours (MWh) of Renewable Energy Credits (RECs), equivalent to 9.2% of the Center's total FY 2014 electricity consumption. LaRC has also developed onsite generation of renewable energy. In FY 2010, the Center installed a 39.5

kilowatt (kW) solar array that is tied directly into the LaRC grid. LaRC also installed a 22 kW solar roof array and a 1.5 kW thin film skylight in 2011. These three onsite installations produced approximately 83.5 MWh of energy in FY 2014, about 4.3% better than design estimates. Because of the onsite energy production, LaRC received an additional 167 RECs, bringing the Center’s total RECs to 12,167 MWh, equivalent to 9.3% of the total FY 2014 electricity consumption of 130,374 MWh.

In FY 2014 LaRC implemented various additional projects born out of the EMC and EET committees. A new high-efficiency boiler was installed in the LaRC Steam Plant to reduce on-site fossil fuel consumption. In addition to the new boiler, operational improvements made at the facility in 2011 and 2012 reduced the plant’s FY 2014 natural gas consumption by 59% from the 2008 baseline levels. Occupancy sensors were installed in break rooms and restrooms throughout the Center as well as high bay lighting controls. Several buildings have undergone retrocommissioning to optimize heating and cooling operations. The Center is also adding steam metering to better monitor steam usage at the building level.

The EMC worked diligently to help implement a computer power management pilot program in November 2014. Computers on Center are not designed to enter a “sleep” state during the evenings due to the need for IT security access and software updates. However, alternative security methods are being tested that will allow the sleep state to initiate. If successful, this effort is projected to reduce the Center’s electricity consumption 1 to 3%. The benefit of having IT personnel involved on the EMC was evident during this project.

In FY 2014 and 2015, water conservation was identified as a high EMS priority, with the goal to reduce LaRC’s water consumption by 2% annually. The data in the table below shows LaRC’s progress towards achieving the goal. In FY 2014, LaRC’s water consumption intensity had been reduced by 24.7% relative to the FY 2007 baseline, up from an 18% reduction as of the end of FY 2013. This positive trend is a result of less water usage for demolition and construction activities on Center, fewer water system leaks, and fewer operational issues on cooling towers.



Sustainable Buildings

As LaRC began implementing a comprehensive 20-year revitalization program called ViTAL (Vibrant Transformation to Advance LaRC), sustainable buildings were identified as an EMS high priority. ViTAL includes six new state-of-the-art facilities, renovation and upgrade of critical infrastructure, and demolition of non-essential assets. This effort is intended to modernize the core of LaRC, better align the facilities with future mission requirements, and significantly reduce the Center's infrastructure and operations and maintenance costs.

The first new building was completed in 2011 and achieved LEED Platinum certification. Building 2101 has earned the U.S. Environmental Protection Agency's (EPA) ENERGY STAR certification, which means that the building performs in the top 25 percent of similar facilities nationwide for energy efficiency and meets strict energy efficiency performance levels set by the EPA. This is the first LaRC building to earn the certification. Commercial buildings that earn EPA's ENERGY STAR certification use an average of 35 percent less energy than typical buildings and also release 35 percent less carbon dioxide into the atmosphere. B2101 is an all-electric office building with a ground source heat pump heating and cooling system and two small photovoltaic electricity systems. By reducing lighting loads and optimizing heating and cooling schedules, the team significantly improved the already exceptional energy performance.

The second new building was completed in late 2014 and achieved a LEED Gold certification. Among other sustainable features, B2102 has a cafeteria that has been optimized for "green" operations, including high efficiency equipment, as well as room for future initiatives such as food composting. The facility also utilizes pervious pavers, bio-swales, and two large bioretention areas to improve stormwater quality and reduce stormwater runoff from the site.

Greening the Fleet

LaRC has reduced their petroleum use in fleet vehicles. The Logistics Management Branch (LMB), which is part of the EMC, continues to assess the fleet for opportunities to reduce unnecessary vehicles while maintaining a fleet size appropriate to meet mission needs. The current fleet size is 97 vehicles including thirteen E-85 vehicles and seven compressed natural gas vehicles. LaRC will continue to eliminate underutilized vehicles, right-size the fleet, and increase the acquisition of low and zero GHG emitting vehicles. As of FY 2014, LaRC exceeded the mandated reduction goal and had achieved a 59% reduction in fleet vehicle fuel use compared to their FY 2005 baseline. In FY 2015, plans were initiated to acquire four low speed electric vehicles (LSEVs) from another NASA Center. The LSEVs will be used in a pilot program to evaluate feasibility of use at LaRC. In support of their fleet management goals, LaRC has also developed a bicycle riding program. The Center has purchased more than fifty bicycles since 2011 to reduce motor vehicle usage on Center, which reduces fuel consumption, emissions, and traffic. This bicycle initiative is not only environmentally friendly, but also cost-effective.

Recycling

Over the years, LaRC has implemented many pollution prevention and waste reduction projects as part of their environmental programs. A wide variety of materials are collected for recycling including aluminum, copper, ferrous metals, white and mixed paper, toner cartridges, cardboard, plastic bottles, fluorescent light tubes, batteries, and oil. Construction and demolition (C&D)

debris is also recycled by LaRC contractors. This debris often contains bulky, heavy materials such as concrete, wood, metals, glass, and salvaged building components.

The chart below details the amounts of various recycled items since 2010:

| Type of Material | FY 2010 (lbs.) | FY 2011 (lbs.) | FY 2012 (lbs.) | FY 2013 (lbs.) | FY 2014 (lbs.) |
|----------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Aluminum | 7,000 | 7,580 | 8,230 | 7,540 | 6,780 |
| Batteries | 7,997 | 11,494 | 7,673 | 6,790 | 5,740 |
| Cardboard | 56,380 | 54,060 | 63,860 | 59,980 | 57,040 |
| Copper (incl. copper wire) | 0 | 0 | 14,420 | 0 | 0 |
| Ferrous Metals | 758,940 | 475,556 | 466,208 | 466,052 | 482,837 |
| Fluorescent Lighting Tubes | 11,471 | 14,689 | 2,756 | 2,775 | 2,244 |
| Mixed Paper | 56,700 | 70,520 | 58,300 | 42,140 | 44,120 |
| Toner Cartridges | 3,998 | 2,719 | 2,268 | 1,481 | 1,068 |
| Used Oil | 24,938 | 33,300 | 34,040 | 29,340 | 33,536 |
| White Paper | 69,160 | 109,060 | 82,840 | 59,200 | 57,800 |
| Plastic Bottles | 8,116 | 5,070 | 4,687 | 4,807 | 4,997 |
| Total | 1,004,700 | 784,048 | 745,282 | 680,105 | 696,162 |

A large percentage of solid waste collected is sent to the Waste-to-Energy (WTE) Steam Plant for energy recovery. This facility burns trash to generate steam, which is sent throughout NASA LaRC to be used as an energy source for heating and other uses. In FY 2014, LaRC landfilled 295,000 pounds, and diverted 2,207,000 pounds (including diverted yard waste, recyclables, and WTE steam plant) of non-hazardous waste which equates to an 88% diversion rate.

In FY 2014, a total of 24,477,246 pounds of C&D debris was generated. Of that, 2,721,492 pounds were sent to local landfills, and 21,755,754 pounds was recycled or reused. The diversion rate for C&D debris for FY 2014 was 89%. LaRC routinely diverts at least 50% of C&D debris.

Paper and cardboard are baled in order to obtain the highest possible rebate from the sale of these recyclables. The proceeds collected from the sale of recyclables at LaRC are used to fund additional recycling and pollution prevention projects. In 2012, LaRC recycling funds were used to purchase reusable glassware and washable soup bowls in the cafeteria in order to replace disposable cups and dishes that had been used in the past. In 2013 and 2014, recycling funds were utilized for a variety of pollution prevention activities including tree plantings, riparian buffer expansion, recycling equipment, and spill response materials.

Green Purchasing

Since LaRC and its contractors purchase significant amounts of materials and equipment to complete the Center's mission, Green Purchasing has been identified as an EMS high priority. LaRC requires the purchase of sustainable products and services. 95% of new contract actions must contain sustainable acquisition requirements, including task and delivery orders under new and existing contracts, where such products and services meet performance requirements. To

measure progress toward this goal, LaRC's Office of Procurement evaluated a total of 55 contract actions in FY 2014. 100% of the contract actions reviewed were compliant.

LaRC's Office of Procurement launched a "Paperless Contracting" pilot program for Simplified Acquisitions up to \$150,000 which decreased paper costs by 77% from FY 2012 to FY 2013. The initiative won a NASA IT Labs award to further investigate paperless contracting with the goal of possible implementation across the Agency.

Training and Communication

LaRC has implemented outreach and training programs to raise awareness and inform staff of their responsibilities in order to ensure EMS implementation, environmental compliance, and to improve environmental stewardship. As part of this effort, mandatory Facility Environmental Coordinator (FEC) classes are conducted annually to ensure they are aware of environmental issues and how they pertain to their facilities. LaRC Environmental personnel provide a variety of other training classes including EMS high priorities.

In FY 2014, LaRC created numerous environmental webpages available to the public, including the LaRC Environmental Policy. These pages allow LaRC to share environmental evaluations with the public as well as highlighting outreach and environmental stewardship efforts and best practices. Numerous articles were also posted on the website, with topics ranging from Chesapeake Bay water quality issues to local community recycling events.

LaRC implements a variety of environmental outreach efforts to continue raising awareness among employees and the community. At these events information on LaRC's EMS and sustainability programs are always presented. The annual Earth Day event is the largest outreach activity. The 2014 Earth Day event highlighted the EMS priorities of water quality and alternative energy. The event included a rain barrel workshop, a living shoreline planting effort, a training class on green purchasing, and visits from environmental exhibitors.

Evaluation of the Process

The information provided above is evidence that a strong EMS and sustainability program can add improvements and efficiencies to all areas of environmental consideration. Beyond improved environmental compliance, LaRC has seen real costs savings from these programs especially in the area of water conservation. LaRC feels this process was well worth the effort.

LaRC has learned many important lessons along the way that may benefit others. The EMS is not a stand-alone program at LaRC, instead it is incorporated into all organizational business practices. The EMS is everyone's responsibility *as a way of business*. At the federal level, having Headquarters support and driving sustainability as a core concept makes it easier for an individual Center to implement a program. Agency support is critical to a successful program. Likewise, Center management support is critical as well. When Center management gets involved in the process and advocates for the EMS, Center personnel take it more seriously.

Implementation of the EMS and associated environmental programs is an ongoing process that needs to be reevaluated regularly in order to continually improve. It is also important to make sure that all elements of the programs are being implemented as planned. The "Plan – Do –

Check – Act” cycle is extremely important for an EMS. To ensure compliance, an internal auditor performs an evaluation of LaRC’s EMS on an annual basis. These auditing actions are powerful tools for program development. Understanding the program strengths and weaknesses is important. Also, getting feedback from people not close to the program has proven very helpful. A fresh set of eyes can often see improvements much easier than day-to-day operators.

Recognition

Since 2004, LaRC has participated in the Virginia Environmental Excellence Program (VEEP) at the Exemplary Environmental Enterprise (E3) Level. VEEP is a voluntary program run by the Virginia Department of Environmental Quality to promote environmental achievement through the development and implementation of an EMS. In addition to being an E3 facility, LaRC participated in the VEEP Sustainability Partners program, which requires that organizations commit to continual, measureable, and verifiable conservation efforts.

LaRC registered for the Federal Green Challenge in August 2012. This program is a national effort run by the EPA that challenges Federal Agencies to lead by example in reducing the Federal Government’s environmental impact. Federal facilities select a minimum of two of the following target areas to address – waste, electronics, purchasing, energy, water, or transportation. Members commit to an improvement goal of at least 5% per year in their selected target areas. LaRC’s goals are to increase the tons of material composted or recycled by 5% and to reduce the amount of water consumed by 5%. LaRC won a FY 2012 Federal Energy and Water Management Award for their work with the WTE Steam Plant as well as their efforts to optimize biomass energy. These awards honor organizations that are making significant contributions to energy and water efficiency within the federal government.

LaRC has also received the 2012 Excellence in Energy and Water Management group award for the Langley New Town Phase One Design-Build Team as well as the NASA Environmental Quality group award for the Sustainable Demolition Team. These awards are from the NASA Environment & Energy Award program, which is an internal agency-wide program to recognize outstanding leadership in environmental and energy initiatives. LaRC received two NASA Blue Marble Awards in 2014. These awards are presented biennially by NASA Headquarters to recognize exceptional environmental leadership in support of NASA’s mission and goals. The 2014 Individual and Team NASA Environmental Quality Awards were granted for achievements in the subcategories of Conservation and Environmental Communication.

Since 2010 LaRC has been certified as a Tree City USA facility, requiring LaRC to develop a tree board and a tree ordinance, budget a forestry program, and hold an Arbor Day observance and proclamation. In April 2015, the Hampton Roads Sanitation District awarded LaRC with the Diamond Award for pretreatment excellence and outstanding environmental compliance, representing ten plus years of perfect compliance. LaRC also won Virginia Governor’s Environmental Excellence Awards in 2011 for their UESC Project and New Town Phase One and in 2012 for their WTE Steam Plant partnership. Lastly, LaRC was honored with the 2014 Commonwealth of Virginia Innovation Technology Finalist recognition for cooperative deployment of a GIS-based Flood Analysis Tool with the City of Poquoson.

Continual Improvement of the Program

In line with the core principle of an EMS, LaRC is always seeking to improve. In FY 2015, Energy Conservation was once again identified as a high EMS priority, with the goal to reduce energy in goal-subject facilities by 3%. To contribute toward this goal, LaRC plans to implement energy conservation projects such as developing “shutdown” settings for Center-wide HVAC control, initiating a program to incorporate energy management data into LaRC GIS, and continuing the small energy project funding process for FCs and FECs across the Center. The Center will also complete an additional 36 walk-thru facility energy and water audit and implement the new Center-wide energy competition model.

Water conservation has also been identified as high EMS priority, with the goal to improve water quality and reduce the quantity of water used by, and discharged from, the Center. To meet these goals LaRC will be developing a process to more quickly identify water consumption anomalies and implement a project to install “zone” water meters. These meters will allow more precise understanding of water usage on the Center and aid in faster identification of leaks. Several water quality discharge projects are being planned to address stringent Chesapeake Bay regulations.

LaRC has also begun evaluating climate change risks and effects on operations, mission, and infrastructure. LaRC’s 2011 *Resilience and Adaptation to Climate Risks Workshop* launched the Center’s efforts toward meeting the EO climate change objectives. Nearly 100 individuals from government and the private sector were in attendance. The workshop focused on three areas of adaptation: Built Systems, Natural Resource Systems, and People/Community Systems. The workshop provided a forum for discussing projected long-term climate change impacts on LaRC and surrounding communities to include sea level rise, increased temperature, air quality alerts, extreme rain and drought, increased summer energy demand, changing ecosystems, and intense hurricanes. LaRC’s Master Plan has been amended to include consideration of climate change impacts on the mission, operations, and infrastructure of the Center. LaRC NEPA personnel have also started including climate change effects and adaptations in the NEPA planning process.

Some other areas of improvement that LaRC is considering include:

- Evaluating the feasibility of installing a Compressed Natural Gas (CNG) fueling station at LaRC to increase use of the CNG vehicles. Currently, CNG vehicles must be fueled offsite. An onsite fueling station would make fueling more convenient.
- Evaluating the feasibility of converting the building heating systems that are currently heated with #2 Fuel Oil to steam-heated systems. This would reduce the quantity of #2 fuel oil combusted at the Center with a corresponding reduction in GHG emissions.
- Pursuing LEED for Existing Buildings certification for buildings that meet or that could be readily upgraded to meet the minimum qualifications. LEED for New Construction certified buildings can also be certified as LEED for Existing Buildings following one continuous year of operation, signifying that the building meets all design parameters.
- Installing advanced meters on cooling towers, which are major water users, with leaks, valve malfunctions and other issues causing a significant amount of unnecessary water loss each year. The meters are currently read manually once a month, but the installation of smart meters with connection to the EMCS would allow real-time monitoring of cooling tower water usage and faster identification of leaks and other problems.