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December 5, 2014

MEMORANDUM FOR JOHN YATES
OFFICE OF OPERATIONS PROGRAM MANAGEMENT
SC-33

FROM: M. G. Branton for JOHNNY O. MOORE
ORNL SITE OFFICE

SUBJECT: SITE SUSTAINABILITY PLAN (SSP) FOR THE OAK RIDGE NATIONAL LABORATORY (ORNL)

ORNL's SSP is attached. The plan describes our comprehensive approaches to fulfilling Executive Order 13514, summarizing the fiscal year (FY) 2014 performance status and including projected performance goals for FY 2015. In accordance with Office of Science (SC) guidance, we submit this as the final SSP for FY 2014. Included in this year's SSP, Appendix A, is ORNL's Self-Certification Form for Energy Intensity Goal of EISA 2007. The Consolidated Energy Data Report is being submitted electronically to the Department of Energy's Sustainability Performance Office with a copy to SC.

If there are any questions or additional information is required, please contact Mary Rawlins at (865) 576-4501, Teresa Nichols at (865) 576-0541, or Bryce Hudey at (865) 576-6426.

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ORNL/TM 2014/641

OAK RIDGE National Laboratory

# Site Sustainability Plan

## with FY 2014 Performance Data

December 2014

U.S. DEPARTMENT OF ENERGY

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Energy and Transportation Science Division

# Site Sustainability Plan with FY 2014 Performance Data

December 2014

Prepared by

OAK RIDGE NATIONAL LABORATORY

Oak Ridge, Tennessee 37831-6283

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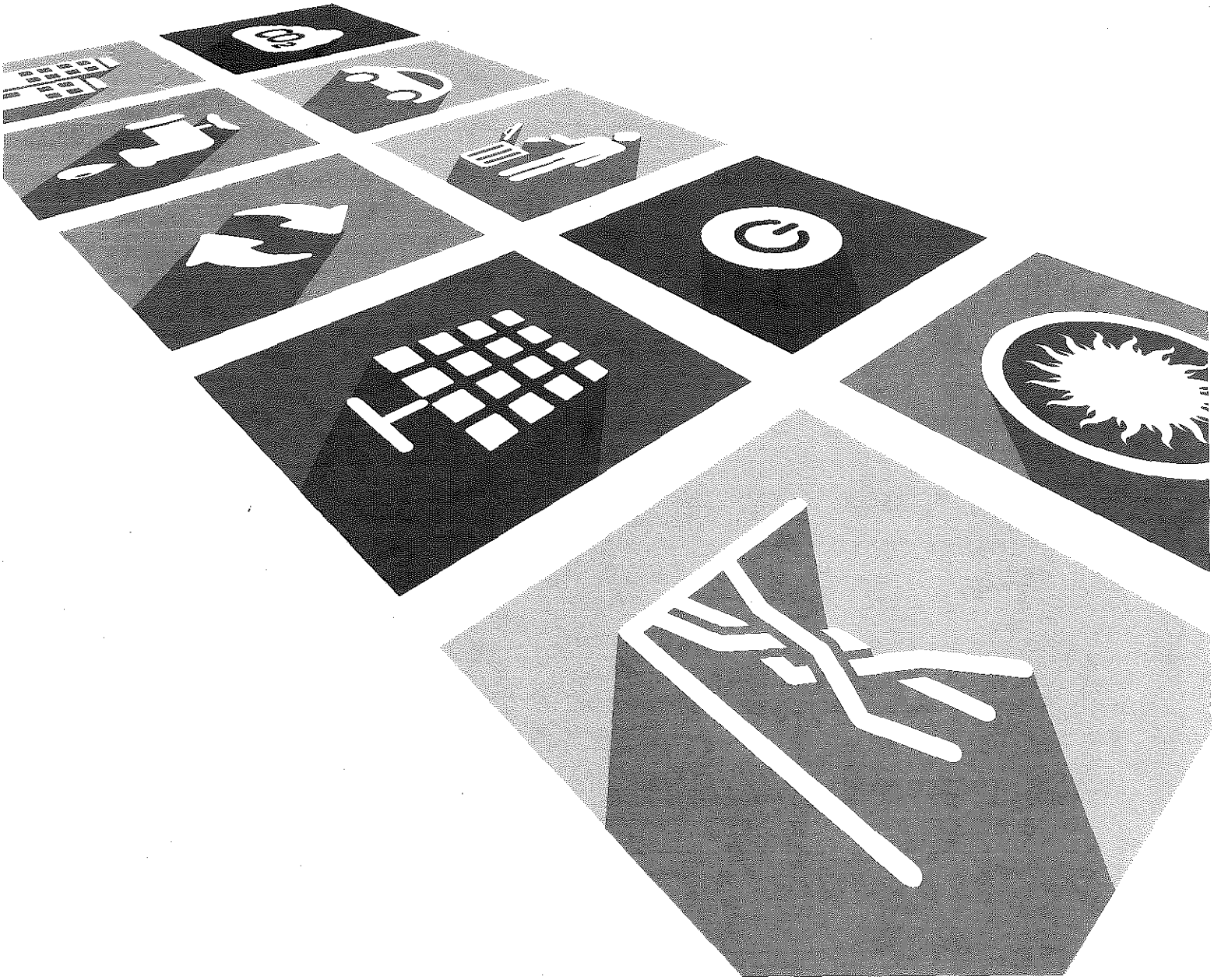


# Contents


**Figures and Tables List** . . . . . ii

**List of Acronyms** . . . . . iii

**I. Executive Summary** . . . . . iv

Table 1. Summary of ORNL attainment of DOE SSPP sustainability goals . . . . . v

**II. Performance Review and Plan Narrative** . . . . . 1

Goal 1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory . . . . . 1

1.1 GHG Reduction – Scope 1 & 2 . . . . . 1

1.2 GHG Reduction – Scope 3 . . . . . 4

Goal 2: Sustainable Buildings . . . . . 6

2.1 Energy Intensity Reductions . . . . . 6

2.2 EISA Section 432 Energy and Water Evaluations . . . . . 7

2.3 Metering for Individual Buildings . . . . . 8

2.4 Cool Roofs . . . . . 9

2.5 Existing Buildings - High-Performance Sustainable Buildings Guiding Principles . . 10

2.6 New Construction – Comply with High-Performance Guiding Principles . . . . . 11

2.7 Regional and Local Planning . . . . . 12

Goal 3: Fleet Management . . . . . 13

3.1 Fleet Alternative Fuel Consumption . . . . . 13

3.2 Reductions in Fleet Petroleum Consumption . . . . . 14

3.3 Light Duty Vehicle Purchases must be Alternative Fuel Vehicles (AFV) . . . . . 15

Goal 4: Water Use Efficiency and Management . . . . . 15

4.1 Potable Water Use Intensity . . . . . 15

4.2 ILA Water Consumption . . . . . 16

Goal 5: Pollution Prevention and Waste Reduction . . . . . 17

5.1 Solid Waste Reductions (nonhazardous, other than construction waste) . . . . . 17

5.2 Construction and Demolition Materials and Debris . . . . . 18

Goal 6: Sustainable Acquisition . . . . . 20

6.1 Sustainable Acquisitions and Procurements . . . . . 20

Goal 7: Electronic Stewardship and Data Centers . . . . . 20

7.1 Core Data Centers Performance Indicators . . . . . 20

7.2 Annual Weighted Power Utilization Effectiveness Goals . . . . . 22

7.3 Power Management of Electronic Equipment . . . . . 22

7.4 Electronic Stewardship . . . . . 23

Goal 8: Renewable Energy . . . . . 24

8.1 Renewable Energy Performance . . . . . 24

Goal 9: Climate Change Resilience . . . . . 25

9.1 Climate Change Resilience . . . . . 25

Goal 10: Energy Performance Contracts . . . . . 27

10.1 Energy Performance Contracts . . . . . 27

**III. Fleet Management Plan** . . . . . 28

**IV. Funding** . . . . . 29

**V. Electrical Energy & Utility Cost Projections, and HEMSFs** . . . . . 30

**Appendix A: Self-Certification form for the Energy Intensity Goal** . . . . . 34

**Appendix B: Policy and Program Statement** . . . . . 38

**Appendix C: Climate Change Resilience** . . . . . 39

# Figure and Table List

## Figures

Figure 1. ORNL Scope 1 and 2 GHG performance status for FY 2014 compared with the FY 2008 baseline. . . . . 2
Figure 2. ORNL Scope 1 & 2 GHG reduction plan by source (2020 goal = 277,986 $MTCO_2e$). . . . . 4
Figure 3. ORNL Scope 3 GHG snapshot with FY 2014 data and projections. . . . . 6
Figure 4. Summary of EUI reduction results and progress toward goal. . . . . 6
Figure 5. ORNL building energy performance – FY 2001–FY 2014 . . . . . 7
Figure 6. Energy use intensity improvement 2003 to 2015. . . . . 7
Figure 7. ORNL plan for high performance sustainable buildings (2015 goal: 22 HPSBs). . . . . 10
Figure 8. Alternative fuel consumption and cumulative percent increase from FY 2005 to the present. . . . . 13
Figure 9. Comparison of petroleum vs. alternative fuel consumption from FY 2005 to the present. . . . . 13
Figure 10. Percentage of ORNL vehicles using E85 on a monthly basis from FY 2000 to the present. . . . . 13
Figure 11. Petroleum consumption and cumulative percent decrease from FY 2005. . . . . 14
Figure 12. ORNL performance status to FY 2014. WUI reduction of 22% is ahead of the DOE goal. . . . . 16
Figure 13. Profile of ORNL water use from FY 2007 to the DOE target year of FY 2020. . . . . 16
Figure 14. ORNL municipal waste diversion . . . . . 18
Figure 15. ORNL construction and demolition waste diversion. . . . . 18
Figure 16. ORNL electricity and cost savings from power management. . . . . 23
Figure 17. ORNL vehicle mileage utilization FY 2005 through FY 2014. . . . . 28
Figure 18. ORNL vehicle inventory from FY 2000 through FY 2014. . . . . 28
Figure 19. FY 2014 utility energy consumption and percentages. . . . . 30
Figure 20. ORNL utility costs for FY 2014. . . . . 30
Figure 21. ORNL projected electrical energy cost. . . . . 31
Figure 22. ORNL HEMSF utility consumption compared with base site usage. . . . . 31

## Tables

Table 1. Executive Summary Table of ORNL's Attainment of DOE Sustainability Goals . . . . . v
Table 2. Scope 1 and Scope 2 GHG emission inventory (FY 2014 compared to the FY 2008 baseline). . . . . 2
Table 3. ORNL Scope 1 GHG emission projections to FY 2020 (DOE goal year) . . . . . 3
Table 4. ORNL electricity projections & Scope 2 GHG emission projections without REC purchases. . . . . 3
Table 5. ORNL Scope 3 GHG emissions performance status . . . . . 4
Table 6. ORNL energy audit results in annual square footage and percentage of campus . . . . . 8
Table 7. Potential savings identified by project . . . . . 22
Table 8. ORNL Climate Change Risks and Actions . . . . . 25
Table 9. ORNL local use objectives for FY 2014 . . . . . 28
Table 10. Funding for actual and planned sustainability projects. . . . . 29

# Acronym List

| | |
|---|---|
| AFV | alternative fuel vehicle |
| AMS | Acquisition Management Services |
| B20 | fuel blend consisting of 20% biodiesel and 80% petrodiesel |
| BAS | Building Automation System |
| Btu | British thermal unit |
| C&D | construction and demolition |
| CACS | cold aisle containment system |
| CEDR | Consolidated Energy Data Report |
| CEDS | Central Energy Data System |
| CRU | computer room unit |
| CSB | Computational Science Buildin |
| DOE | US Department of Energy |
| E85 | fuel blend consisting of up to 85% ethanol with up to 15% gasoline (also E-85) |
| ECM | energy conservation measure |
| EISA | Energy Independence and Security Act |
| EO | Executive Order |
| EPA | US Environmental Protection Agency |
| EPACT | Energy Policy Act |
| EPEAT | Electronic Product Environmental Assessment Tool |
| ESPC | energy savings performance contract |
| EUI | energy use intensity |
| EV | electric vehicle |
| FAR | Federal Acquisition Regulation |
| FAST | Federal Automotive Statistical Tool |
| FFV | flexible fuel vehicle |
| FIMS | Facilities Information Management System |
| FMD | Facilities Management Division |
| G/GSF | gallons per gross square foot |
| GHG | greenhouse gas |
| GPs | Guiding Principle |
| GPY | gallons per year |
| GSA | General Services Administration |
| GSF | gross square feet |
| HEMSF | high energy mission specific facility |
| HFIR | High Flux Isotope Reactor |
| HPC | high performance computing |
| HPSB | high performance sustainable building |
| HRIBF | Holifield Radioactive Ion Beam Facility |
| HVAC | heating, ventilating, and air conditioning |
| ILA | industrial, landscaping, and agricultural |
| IT | information technology |
| ITSD | Information Technology Services Division |
| JCI | Johnson Controls, Inc. |
| KAT | Knoxville Area Transit |
| kW | kilowatt |
| kWh | kilowatt-hour |
| LEED | Leadership in Energy and Environmental Design (US Green Building Council) |
| LSV | low speed vehicle |
| MGY | million gallons per year |
| MHP | Managed Hardware Program |
| MSW | municipal solid waste |
| $MTCO_2e$ | metric tons of carbon dioxide equivalent |
| MW | megawatt |
| MWh | megawatt-hour |
| NEPA | National Environmental Policy Act |
| NREL | National Renewable Energy Laboratory |
| O&M | operations and maintenance |
| OLCF | Oak Ridge Leadership Computing Facility |
| ORNL | Oak Ridge National Laboratory |
| ORO | Oak Ridge Office |
| OTC | once-through cooling |
| P-Card | purchasing card |
| P2 | pollution prevention |
| PUE | power utilization effectiveness |
| PV | photovoltaic |
| RE | renewable energy |
| REC | Renewable Energy Credit |
| SCI | Sustainable Campus Initiative |
| SCTR | Sustainable Campus Transportation Roadmap |
| $SF_6$ | sulfur hexafluoride |
| SMR | small modular reactor |
| SNS | Spallation Neutron Source |
| SSG | Southeast Sustainability Group |
| SSP | Site Sustainability Plan |
| T&D | transmission and distribution |
| TVA | Tennessee Valley Authority |
| UPS | uninterruptible power source |
| VAC | volts, alternating current |
| VFD | variable frequency drive |
| WPT | Wireless Power Transfer |
| WUI | water use intensity |

# I. Executive Summary

Oak Ridge National Laboratory (ORNL) is both the largest science and energy laboratory in the US Department of Energy (DOE) complex and one of the oldest national laboratories still operating at its original site. These characteristics provide a unique and challenging opportunity to integrate sustainability into legacy assets while providing modern, energy-efficient facilities that help to support the growth of important national missions. ORNL is committed to leveraging the outcomes of DOE-sponsored research programs to maximize the efficient use of energy and natural resources across a diverse campus. As a result of budget constraints, the Sustainable Campus Initiative (SCI) operated differently in FY 2014: aggressively working on deliverables in the first 4 months of the fiscal year and operated in compliance mode the remainder of the year. SCI maintained a commitment to the integration of technical innovations into new and existing facilities, systems, and processes with a comprehensive approach to achieving Executive Order 13514 and supporting federal initiatives on climate change resiliency. ORNL continues to pursue and deploy innovative solutions and initiatives to advance regional, national, and worldwide sustainability and continues to transform its culture and engage employees in supporting sustainability at work, at home, and in the community. Table 1 summarizes ORNL's FY 2014 performance and planned actions to attain future goals. ORNL continued to achieve numerous successes during FY 2014, which are described in detail throughout this document. The following are some key highlights.

**High Performance Sustainable Buildings (HPSBs).** In FY 2014, ORNL added two buildings to the HPSBs inventory, advancing the total count to 25 buildings and setting an internal goal of achieving an inventory of 28 buildings by the 2015 target year. In FY 2013, ORNL exceeded the DOE HPSBs program target of 22 buildings and did so 2 years ahead of schedule.

**Fleet Management.** In FY 2014, ORNL continued to exceed DOE goals in all three site sustainability plan fleet management categories. ORNL alternative fuel use in FY 2014 has increased from the 2005 baseline by 220%, exceeding the cumulative target of 136% set by DOE. Fleet petroleum consumption has experienced a 55% decrease, exceeding the DOE target of an 18% decrease. Additionally, 100% of light duty vehicles purchased in FY 2014 were alternative fuel vehicles.

**Water Management.** Water use intensity measured 138 G/GSF in FY 2014 (a reduction of 22% to date, exceeding the DOE FY 2014 target of 14%). ORNL has developed an aggressive plan to reduce water consumption that includes repairing leaks, replacing old distribution lines, and eliminating once-through cooling where possible.

**Annual Sustainability Reporting.** The Second Annual ORNL Sustainability Report was published in February 2014 and distributed electronically to all ORNL staff, as well as to nine surrounding communities (city/county governments and educational institutions).

**ORNL Federal Awards Associated with Sustainability Efforts.** ORNL received two 2014 Federal Green Challenge (FGC) National Awards in the Electronics Target area: (1) for having the greatest improvement over the previous period and (2) for implementation of desktop, application, and server virtualization technologies, setting a 2014 FGC goal to increase the use of "zero clients" by 5%.

## FY 2014 SUCCESS STORIES

### SCI Wireless Power Transfer Project: Science at Its Best

The ORNL mailroom has a new set of high-tech wheels for delivering mail; however, it's not your average Prius. This Prius is capable of traveling on and off campus while using wireless power transfer (WPT). This collaborative project, sponsored by SCI, ORNL Facilities and Operations (F&O), and DOE's Vehicle Technologies Program, allows ORNL to be one of the first DOE laboratories using this leading-edge technology on site. Research staff built the WPT station and oversaw the retrofitting of the Prius for WPT, while staff from F&O assisted with the installation of the WPT station. Mail delivery using the new vehicle technology began on September 29, 2014. The National Transportation Research Center is continuing research on WPT for next-generation vehicles.

*SCI project team leads (Madhu Chinthavali and Steven Campbell) demonstrate WPT technology to Martin Keller (kneeling)*

### ORNL Takes the Old and Makes it New, Modern, and Energy Efficient

ORNL's F&O Directorate renovated Wing 3 of building 4500N. A total of 20,000 ft² of vacant and deteriorating laboratories, offices, and building infrastructure was completely remodeled and is now home to ORNL's Climate Change Science Institute. The modern-

ization project rebuilt the entire wing (originally commissioned in the 1950s) to create 130 new offices with modern amenities including daylighting, sky lights; energy-efficient windows; high-efficiency HVAC; and LED lighting. F&O design experts expect energy savings of approximately 64% compared to the original lab/office use.

**Business Travel Avoidance through Cloud Technology**

After a pilot period, the new ORNL videoconference service, called Blue Jeans, was formally offered to all ORNL users on a 24/7 basis beginning in January 2014. Use of the new cloud-based video service has grown tremendously and is returning great value in the form of expanded collaboration opportunities, avoided travel expense, and reduced Scope 3 greenhouse gas emissions through avoided travel. In the first 9 months of operation, a total of 3,977 meetings were held involving more than a half million participant minutes, 504 cities, and 28 countries, all while avoiding the financial and environmental costs of traditional business travel.

**Table 1. Executive Summary Table of ORNL's Attainment of DOE Sustainability Goals**

| SSPP Goal # | DOE Goal | Performance Status through FY 2014 | Planned Actions and Contributions | Risk of Nonattainment |
|---|---|---|---|---|
| Goal 1: Greenhouse Gas Reduction | | | | |
| 1.1 | 28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline (2014 target: 19%) | Scope 1 estimate is 63,163 $MTCO_2e$, a decrease of 30% from FY 2008. | Scope 1 reductions are on target due to ECM efforts, ESPC implementation, and $SF_6$ process reductions. | Scope 1: Low |
| | | Scope 2 estimate is 332,462 $MTCO_2e$, an increase of 33% from FY 2008 after allowances for purchased renewable energy credits (RECs). | Scope 2 reductions represent more of a challenge due to growth in electricity demands for mission critical facilities (HEMSF). | Scope 2: High |
| | | The combined estimate for Scopes 1 & 2 is 395,625 $MTCO_2e$, an increase of 17% from the baseline year of FY 2008 | | |
| 1.2 | 13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline (2014 target: 5%) | Scope 3 estimate is 43,509 $MTCO_2e$. Overall Scope 3 emissions have increased by 6%. All Scope 3 elements are on trend to meet targets with the exception of T&D. Increased electricity consumption and a 33% increase in T&D losses limits the overall performance. | Employee engagement focus areas such as responsible business travel and employee commute and telework programs will ensure progress toward Scope 3 reductions. T&D losses will grow along with purchased electricity; however, a new substation coming online in FY 2015 will increase efficiency and reduce the effect of T&D losses. | High |
| Goal 2: Sustainable Buildings | | | | |
| 2.1 | 30% energy intensity (Btu/GSF) reduction by FY 2015 from a FY 2003 baseline (2014 target: 27%) | ORNL achieved a reduction of 29.5%, exceeding the FY 2014 goal. | Ongoing energy audits in progress will identify additional energy conservation projects to achieve the 30% goal. | Low |
| 2.2 | EISA Section 432 energy and water evaluations | Over 25% evaluated during this second year of the current 4-year cycle. | Continue pace of 25% or more through current cycle (end of FY 2016). Leverage knowledge from previous cycles to conduct focused evaluations. | Low |

| SSPP Goal # | DOE Goal | Performance Status through FY 2014 | Planned Actions and Contributions | Risk of Nonattainment |
|---|---|---|---|---|
| 2.3 | Individual building metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015) (2014 target: 90% and 50%, respectively) | ORNL is in compliance with DOE mandates by achieving 91% for electrical use. The balance of the metering is anticipated to be completed by the end of FY 2015. The remaining systems are progressing toward full compliance. | Continued implementation of metering plan will allow progress toward metering of all commodities. Goals have been met with respect to electricity, natural gas, and chilled water. | Low |
| 2.4 | Cool roofs—all new roofs and roof replacements must meet cool roof standards and have thermal resistance of at least R-30 (unless uneconomical or excluded) | Reroofing projects on two facilities added 23,014 $ft^2$ to the ORNL cool roof inventory. | Continue to ensure compliance. | Low |
| 2.5 | 15% of existing buildings greater than 5,000 GSF are compliant with the Guiding Principles (GPs) of high performance sustainable buildings (HPSB) by FY 2015 (2014 target: 13%) | Two additional existing buildings achieved HPSB status in FY 2014 for a total of 25. The target goal of 15% (22 buildings) was exceeded in FY 2013, 2 years ahead of schedule. | Efforts will continue toward expanding the existing HPSB inventory—planning for three additional buildings in FY 2015. | Low |
| 2.6 | All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs | To date, 16 new facilities have been built to LEED and GP standards. One other building has been designed to meet LEED Gold standards and will be completed in 2015. | All new construction is designed for LEED Gold as a routine part of the facility development process. | Low |
| Goal 3: Fleet Management | | | | |
| 3.1 | 10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline (2014 target: 136% cumulative since 2005). | To date, alternative fuel use has increased from the 2005 baseline by 220%, exceeding the target. | Continue to use alternative fuels and continue to educate drivers about the importance of using alternative fuels in Flex Fuel vehicles. | Low |
| 3.2 | 2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline (2014 target: 18% cumulative since 2005). | ORNL has achieved a 55% reduction in fleet petroleum consumption compared to the 2005 baseline. | Continue to use alternative fuel. Continue to ensure biodiesel quality is maintained. | Low |
| 3.3 | 100% of light duty vehicle purchases must be alternative fuel vehicles (AFVs) by FY 2015 and thereafter. | 100% of light duty vehicle purchases in FY 2014 were AFVs. | Continue to purchase AFVs from GSA schedules as funds and approvals are available. | Low |

| SSPP Goal # | DOE Goal | Performance Status through FY 2014 | Planned Actions and Contributions | Risk of Nonattainment |
|---|---|---|---|---|
| **Goal 4: Water Use Efficiency and Management** | | | | |
| 4.1 | 26% potable water intensity (G/GSF) reduction by FY 2020 from a FY 2007 baseline. (FY 2014 target: 14%) | Water use intensity measured 138 G/GSF in FY 2014 (a reduction of 22% to date, exceeding the interim goal). | Additional savings are planned that include eliminating once-through cooling and repair of leaks in the water distribution system. However, new facilities to be commissioned in FY 2018 could reverse the trend. | Medium |
| 4.2 | 20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline. | No ILA water use at ORNL. | No ILA water use at ORNL. | N/A |
| **Goal 5: Pollution Prevention and Waste Reduction** | | | | |
| 5.1 | Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris, by FY 2015. | A 35% diversion rate was achieved in FY 2014. While less than the target, this represents a modest improvement in the past year. | Continue mitigation measures and process improvements to close the gap for this goal in FY 2015 and beyond. | High |
| 5.2 | Divert at least 50% of construction and demolition materials and debris by FY 2015. | ORNL's diversion rate for construction and demolition debris for FY 2014 is 70%. | Continue process improvements. Additional focus will be placed on segregation of waste. | Medium |
| **Goal 6: Sustainable Acquisition** | | | | |
| 6.1 | Procurements meet requirements by including necessary provisions and clauses in 95% of applicable contracts | 100% of all applicable contracts in FY 2014 contained terms and conditions that invoke requirements for sustainable acquisitions. | Procurement transactions will continue to include standard terms and conditions containing sustainable acquisition requirements. | Low |
| **Goal 7: Electronic Stewardship and Data Centers** | | | | |
| 7.1 | All core data centers are metered to measure monthly power utilization effectiveness (PUE) of 100% by FY 2015 (2014 target: 90%) | All data center equipment is metered. | Plans are being developed for adding meters in the 5800 chiller plant. | Low |
| 7.2 | Core data center maximum annual weighted average PUE of 1.4 by FY 2015 (2014 target: 1.5) | The calculated PUE value at the end of FY 2014 is 1.27 for the CSB data center, exceeding the goal. | More accurate monthly and annual PUE calculations will continue to progress toward even better performance. | Low |
| 7.3 | Power Management - 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012. | 100% of the eligible PC's, laptops, and monitors are being actively power managed. | Continue to actively ensure all eligible computing equipment is power managed. | Low |

| SSPP Goal # | DOE Goal | Performance Status through FY 2014 | Planned Actions and Contributions | Risk of Nonattainment |
|---|---|---|---|---|
| 7.4 | Electronic Stewardship—95% of eligible electronics acquisitions meet EPEAT standards. | 95% of eligible computers, monitors, and laptops meet EPEAT standards. | Continue to actively ensure all computers, monitors, and laptops are meeting EPEAT standards. | Low |
| Goal 8: Renewable Energy | | | | |
| 8.1 | 20% of annual electricity consumption from renewable sources by FY 2020 (2014 target: 7.5%) | ORNL produced on-site renewable electricity of 0.035% of consumption. Local (Tennessee Valley Authority) and marketplace REC purchases resulted in a total of 53,716 MWh of renewable attributes, exceeding the FY 2014 goal at 9%. | Annual REC purchases will permit ORNL to meet the goal until additional cost-effective on-site generation is implemented. | Medium |
| Goal 9: Climate Change Resilience | | | | |
| 9.1 | Address DOE Climate Adaptation Plan goals | Progress documented in Section 9. | | |
| Goal 10: Energy Performance Contracts | | | | |
| 10.1 | Utilization of Energy Performance Contracts | Progress documented in Section 10. | | |

# II. Performance Review and Plan Narrative

## Goal 1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory

### 1.1 GHG Reduction—Scope 1 & 2

**DOE Goal:** 28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline. (2014 target: 19%).

Oak Ridge National Laboratory's (ORNL's) Sustainable Campus Initiative (SCI) continues its drive to integrate the sustainability message into organizational processes and procedures. Through employee engagement efforts, personnel have become more aware of how daily actions and facility operations can be modified to reduce carbon emissions. All of the individual sections of this plan will discuss strategies and tactics that will lead to the reduction of carbon emissions. In addition, process improvement plans currently being developed in a number of divisions will work together to promote sustainability and reduce greenhouse gas (GHG) emissions by source (covering all scopes), resulting in improved performance toward the attainment of site sustainability plan (SSP) goals.

As is the case with most US Department of Energy (DOE) locations, ORNL's greatest source of GHG emissions is the result of purchased electricity—the primary contributor of Scope 2 emissions—something over which we have little control. One of our most proactive endeavors in this area is working with the Tennessee Valley Authority (TVA), our regional electrical power provider, to reduce carbon emissions whenever possible.

#### Performance Status

ORNL aggressively strives to have a positive influence on achieving the overall DOE goal of a 28% reduction target for total Scope 1 and Scope 2 GHG emissions. Table 2 shows the FY 2014 Scope 1 and 2 GHG emissions inventory, and Figure 1 shows the FY 2014 ORNL Scope 1 and 2 emissions performance compared to that of FY 2008. Major factors in the GHG inventory include the following.

- The FY 2014 Scope 1 GHG estimate is 63,163 metric tons of $CO_2$ equivalent ($MTCO_2e$), a decrease of 30% from the FY 2008 baseline. Scope 1 reductions are on target due to previously implemented energy conservation measures (ECMs), the results from the Johnson Controls, Inc. (JCI), energy savings performance contract (ESPC) implementation, and $SF_6$ process reductions.
- As shown in Table 2, Scope 2 GHG emissions totaled 373,262 $MTCO_2e$ before renewable energy credits (RECs). Purchased RECs resulted in avoidance of 40,800 $MTCO_2e$ in GHG emissions, reducing the FY 2014 Scope 2 GHG estimate to 332,462 $MTCO_2e$, an increase of 33% over FY 2008. This increase in Scope 2 emissions is the result of growth in purchased electricity.
- The FY 2014 combined total Scope 1 and 2 estimates is 395,625 $MTCO_2e$, an overall increase of 17% from FY 2008.
- Sulfur hexafluoride ($SF_6$) process losses decreased greatly from the baseline as plans for the decommissioning of the Holifield Radioactive Ion Beam Facility (HRIBF) continued to develop. (See $SF_6$ Progress below).
- Purchased electricity continued to grow as important mission facilities, such as world-class research in computational programs, continued to expand.

#### $SF_6$ Progress

$SF_6$ is a key contributor to ORNL's Scope 1 GHG emissions inventory. Active management of $SF_6$ emissions will be necessary to meet DOE's overall reduction goal of 28% for Scope 1 GHG emissions. An overall awareness of the global warming potential of $SF_6$ has resulted in a more cautious approach to the requisition and purchase of this potent GHG. ORNL is committed to evaluating processes and purchasing improvements with the potential to reduce $SF_6$ emissions.

The tandem accelerator $SF_6$ inventory at the end of FY 2014 was approximately 207,340 lb. Losses during the year were normal process losses totaling 1,480 lb, which was less than the facility baseline of 2,500 lb/year as established as part of the ORNL FY 2008 GHG baseline analysis. Normal process losses differ from year to year due to a variety of factors including the number of $SF_6$ transfer cycles to and from storage, operating temperatures, and pressures, and the amount of recirculation of the gas in the accelerator. The $SF_6$ process loss in FY 2014 is calculated at 15,306 $MTCO_2e$ (from estimated releases of 1,480 lb), a 44% reduction from the FY 2008 baseline of 27,102 $MTCO_2e$ (from releases of 2,500 lb).

As of the end of FY 2014, tandem accelerator operation is not currently funded by the DOE Office of Nuclear Physics. However, limited accelerator operation continues on a full-cost recovery basis, and the accelerator is being maintained in a safe and secure condition as future options for the accelerator and experimental systems are explored. All surveillance and maintenance activities associated with the tandem accelerator and the $SF_6$ gas handling system continue as normal. In addition, facility staff members continually

evaluate the potential for further loss reductions, including simplification of the gas handling system, refurbishment of compressors, and elimination of potential single-point failures.

Purchases of $SF_6$ for nonprocess uses remain small relative to the tandem accelerator process use, and the nonprocess purchases continue to decline as a result of overall cognizance regarding $SF_6$ impacts.

## Plans and Projected Performance

**Scope 1 GHG projections.** Scope 1 reduction estimates indicate that ORNL is on target to exceed the FY 2020 target reduction goal of 28%. By the target year we expect to see total Scope 1 GHG reductions of 43%. This projected success is based on a number of key projects and initiatives, summarized below. Table 3 shows the various categories of Scope 1 emissions by source, with FY 2008 and FY 2014 actual data, as well as projections for out-years to the FY 2020 target year.

**Table 2. Scope 1 and Scope 2 GHG emission inventory (FY 2014 compared to the FY 2008 baseline)**

| Scope 1 GHG Emissions ($MTCO_2e$) | FY 2008 | FY 2014 | Increase (Decrease) | Increase/Decrease (%) |
|---|---|---|---|---|
| Natural Gas, Facilities | 48,563 | 40,255 | (8,308) | -17 |
| $SF_6$ Process Losses | 27,102 | 15,306 | (11,796) | -44 |
| Fugitive Gases | 10,660 | 1,980 | (8,680) | -81 |
| Fuel Oil, Facilities | 1,968 | 4,289 | 2,321 | +118 |
| Fleet Fuels | 1,104 | 868 | (236) | -21 |
| Minor Sources | 203 | 465 | 262 | +129 |
| **Total Scope 1 GHG Emissions** | **89,600** | **63,163** | **(26,437)** | **-30** |
| **Scope 2 GHG Emissions** | **FY 2008** | **FY 2014** | **Increase (Decrease)** | **Increase/Decrease (%)** |
| Purchased Electricity | 249,407 | 373,262 | 123,855 | +50 |
| Purchased RECs—GHG Avoided | — | (40,800) | (40,800) | -- |
| Net Annual Scope 2 GHG Emissions | 249,407 | 332,462 | 83,055 | +33 |
| **Scope 1 and Scope 2 GHG Emissions** | **FY 2008** | **FY 2014** | **Increase (Decrease)** | **Increase/Decrease (%)** |
| Combined GHG Calculation | 339,007 | 395,625 | 56,618 | +17 |

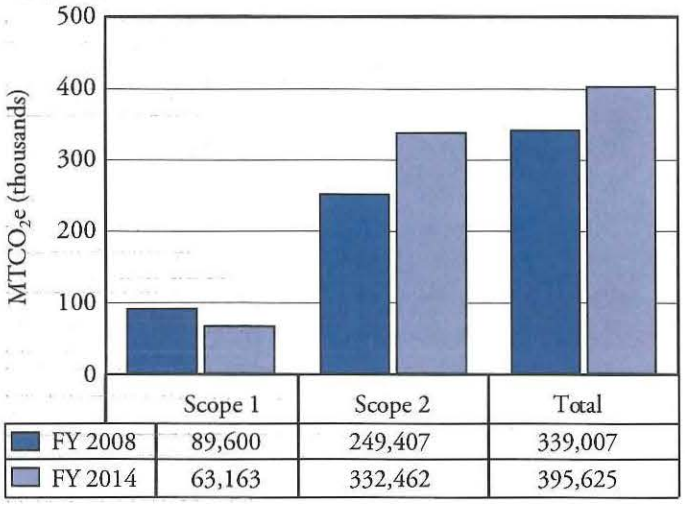



**Figure 1. ORNL Scope 1 and 2 GHG performance status for FY 2014 compared with the FY 2008 baseline.**

- Natural gas and fuel oil purchases for facilities are expected to decrease with the commissioning of a more efficient steam system, currently under development by JCI.
- $SF_6$ process losses at HRIBF are expected to decline as the tandem accelerator research operation is not currently funded.
- The results of ECMs and energy audits managed by the Facilities Management Division (FMD) will provide continuous incremental progression toward the FY 2020 goals.
- Nonprocess fugitive emissions should continue to decline as research scientists are made aware of less potent alternatives for tracer gases and laboratory research.

**Table 3. ORNL Scope 1 GHG emission projections to FY 2020 (DOE goal year)**

| FY 2014 Data Snapshot | ORNL Scope 1 GHG Projections FY 2008 to FY 2020, $MTCO_2e$ | | | | | | | | Projection at FY 2020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FY 2008 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | FY 2018 | FY 2019 | FY 2020 | Increase/ (Decrease) | Increase/ Decrease (%) |
| Natural Gas, Facilities | 48,563 | 40,255 | 42,000 | 37,800 | 36,000 | 35,280 | 34,574 | 33,883 | (14,680 | -30 |
| $SF_6$ Process Losses | 27,102 | 15,306 | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 | (15,102) | -56 |
| Other Fugitive Gases | 10,660 | 1,980 | 1,940 | 1,902 | 1,864 | 1,826 | 1,790 | 1,754 | (8,906) | -84 |
| Fuel Oil, Facilities | 1,968 | 4,289 | 2,100 | 2,058 | 2,017 | 1,977 | 1,937 | 1,898 | (70) | -4 |
| Fleet Fuels | 1,104 | 868 | 851 | 834 | 817 | 801 | 785 | 769 | (335) | -30 |
| Minor Sources | 203 | 465 | 456 | 447 | 438 | 429 | 420 | 412 | 209 | +103 |
| **Total Scope 1 GHG Emissions** | **89,600** | **63,163** | **59,347** | **55,040** | **53,135** | **52,312** | **51,506** | **50,716** | **(38,884)** | **-43** |

**Scope 2 GHG projections.** Scope 2 reductions represent a tremendous challenge due to continued growth in electricity demands for mission-critical facilities such as the Spallation Neutron Source (SNS). The importance of ORNL's high energy mission specific facilities (HEMSF) and the associated electricity the facilities are projected to consume are detailed in Section V of this report.

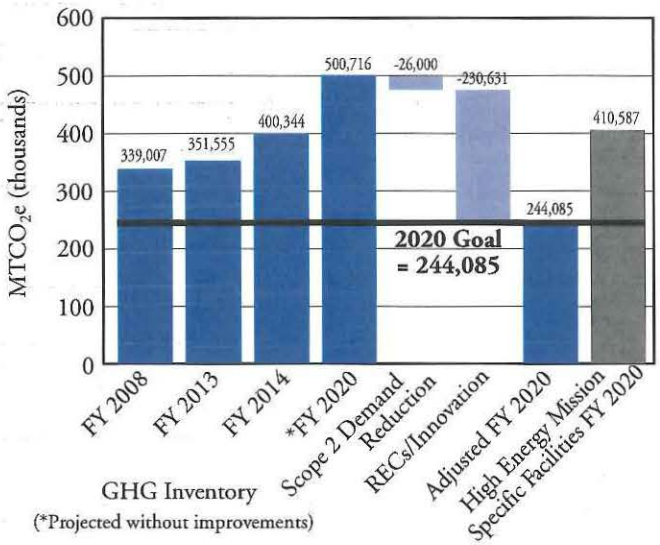
- Purchased electricity will grow as critical mission facilities expand to meet national research demands.
- ECMs and other energy improvement projects will provide Scope 2 demand reductions and combine for incremental relief during the performance period.
- The TVA small modular reactor (SMR) development will be a significant factor in the reduction of Scope 2 GHG emissions; however, this project will be commercialized after the FY 2020 target date for reductions in GHG emissions. (See Section 8 for additional information.)
- Viable clean energy projects are being explored at this time, and potential transformation technologies will continue to be studied as they are developed.
- Purchase of RECs will be needed to offset increases in Scope 2 GHG emissions until clean energy projects are identified and implemented.

Table 4 indicates that although electricity use is projected to more than double during the goal period, Scope 2 GHG emissions are projected to grow by only 80% due to expected reductions in grid emissions rates by our power supplier. TVA has committed to a number of initiatives that serve to reduce carbon emissions and to moderate the need for coal consumption during times of peak power demand. As a federal entity, TVA is also expected to play a role in federal leadership in EO 13514 goals. Recent annual reports show that decreases in carbon emissions are being realized, and TVA has further stated that their goal is to approach a 50% carbon intensity by 2015 [in FY 2008 the US Environmental Protection Agency (EPA) e-grid rate for the TVA region was 69%], so there is ample room for improvement. As the TVA GHG output emissions improve, improvements in ORNL's Scope 2 GHG emissions performance will follow.

**Table 4. ORNL electricity projections & Scope 2 GHG emission projections without REC purchases**

| FY 2014 Data Snapshot | Purchased Electricity (Site Base + HEMSF) Projections to FY 2020 | | | | | | | | Projection at FY 2020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FY 2008 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | FY 2018 | FY 2019 | FY 2020 | Increase/ (Decrease) | Increase/ Decrease (%) |
| Purchased Electricity (MWh) | 362,025 | 589,335 | 680,000 | 672,000 | 696,000 | 825,000 | 780,000 | 740,000 | 381,975 | +106 |
| **Purchased Electricity GHG Emission Projections ($MTCO_2e$)/ *Without* REC Purchases** | **Scope 2 GHG Projections to FY 2020 (80% Growth)** | | | | | | | | **Projection at FY 2020** | |
| | **FY 2008** | **FY 2014** | **FY 2015** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **FY 2020** | **Increase/ (Decrease)** | **Increase/ Decrease (%)** |
| | 249,407 | 373,262 | 424,350 | 403,200 | 416,000 | 475,000 | 458,000 | 450,000 | 200,593 | +80 |

ORNL's updated waterfall chart (Figure 2) is used to demonstrate the need for innovative and transformational technologies to help DOE realize the 28% reduction target for Scope 1 & 2 GHG emissions. The purchase of RECs will be used to temper the growth in Scope 2 emissions while clean energy projects continue to be evaluated.




Scope 1: Direct Emissions (natural gas, $SF_6$, fleet vehicles, stacks, hoods)
Scope 2: Purchased Electricity
Scopes 1 and 2 FY 2020 Target: 28% reduction from FY 2008 baseline

**Figure 2. ORNL Scope 1 & 2 GHG reduction plan by source (2020 goal = 244,085 $MTCO_2e$).**

# 1.2 GHG Reduction—Scope 3

**DOE Goal:** 13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline (FY 2014 target: 5%).

By definition, Scope 3 GHG emissions include those activities that organizations can influence, but not control, by business processes alone. As with most federal workplaces, the Scope 3 emissions are attributed to the following activities at the site:

- transmission and distribution (T&D) losses from purchased electricity,
- employee workplace commutes,
- employee business air travel, and
- employee business ground travel.

ORNL continues its overall commitment to communications on GHG reduction, aimed at employee engagement. Influencing the actions of employees and their awareness of how those actions affect the carbon footprint of the organization is one of the foundational methods to achieve a more sustainable future. Employee outreach interactions are designed to focus efforts on the reduction of direct and indirect emissions in all actions. Communication is designed to reach management, employees, and contractors to encourage sustainable practices in the workplace, at home, and in the community.

## Performance Status

The FY 2014 Scope 3 GHG emissions estimate is 43,509 $MTCO_2e$. Overall the Scope 3 inventory grew by 6% from the FY 2008 baseline, which is not on target for the DOE goal of a 13% reduction. Scope 3 performance indicators (Table 5) demonstrate that while the employee commutes, business air travel, and business ground travel categories have all improved, a 33% growth in T&D losses limits the overall performance.

At the end of FY 2014, the ORNL employee workforce had experienced a 1% increase since the FY 2008 baseline year. Even with more employees, reductions have been made in Scope 3 GHG emissions attributable to employee commuting and business travel. These achievements are due to strong engagement with employees, management, and regional resources aimed at encouraging carpooling, ride shares, alternative work arrangements, and responsible business travel. Table 5 demonstrates that while most Scope 3 categories have shown impressive improvements, a 33% increase in T&D losses (associated with the increase in purchased electricity) has negatively impacted overall performance toward the DOE goal of a 13% reduction in Scope 3 GHG emissions.

SCI members have continued to successfully work on issues such as incentives for carpooling and the establishment of anti-idling policies. Efforts were initiated to develop mechanisms to track the number of people who are teleworking, using alternative work week arrangements, and making use of teleconferencing to avoid business travel. Programs include the following.

**Table 5. ORNL Scope 3 GHG emissions performance status**

| Scope 3 GHG Emissions Categories | FY 2008 ($MTCO_2e$) | FY 2014 ($MTCO_2e$) | Change ($MTCO_2e$) | Change (%) |
|---|---|---|---|---|
| T&D Losses | 16,429 | 21,900 | +5,638 | +33 |
| Employee Commutes | 16,193 | 15,061 | -1,132 | -7 |
| Business Air Travel | 7,204 | 5,711 | -1,493 | -21 |
| Business Ground Travel | 1,169 | 837 | -332 | -28 |
| Other | 44 | — | -44 | — |
| **Total Scope 3** | **41,039** | **43,509** | **+2,637** | **+6** |

**Carpool Promotion and Participation.** ORNL continues its partnership with Smart Trips, a program of the Knoxville Transportation Planning Organization. As a result of the outreach and promotional efforts, 74 ORNL employees logged 10,788 commute alternative entries into the Smart Trips system in the first 3 quarters of 2014.

**Alternative Work Schedules.** ORNL Human Resources reported that 200 employees were on compressed work week schedules: 150 working 80 hours in 9 working days (9/80) as opposed to the typical 10 and another 50 working four 10-hour days each week (4/10) as opposed to the typical five 8-hour days. In the past 2 years, 110 employees have established formal telework agreements. To encourage telework, the organization developed official telework policies and a process for employee application and manager approval. SCI worked with the Human Resources Division to promote the new policy. In addition, ORNL is leading an effort on telework best practices, partnering with 5 other DOE labs.

**Business Travel.** The significant reduction in business air and ground travel is due to a better awareness of the benefits of conservative travel and improved teleconferencing tools. In December 2012 an organization-wide email concerning the need for all divisions to help with new goals on conference management and conference travel was distributed to all employees by the ORNL laboratory director. The memo emphasized the benefits of environmentally friendly practices such as carpooling or taking public transportation while on business travel and the added benefits of the use of teleconferencing tools whenever practical. The implementation of an improved teleconferencing system in January 2014 is already proving to be a great tool in the avoidance of business travel.

**T&D Losses:** While the employee commute and business travel indicators are showing steady progress toward the DOE goal, T&D losses represent the largest category of Scope 3 GHG emissions at ORNL. For the 2014 performance year, ORNL's T&D losses from purchased electricity grew by 33% from the baseline. This is directly related to the consumption of purchased electricity to support ORNL operations and mission critical facilities. During the current performance period electricity purchases totaled 589,335 MWh, a 60% increase from FY 2008, the baseline year.

## Plans and Projected Performance

Because of the nature of Scope 3 emissions and the fact that such emissions are beyond the direct control of organizations, reductions are dependent upon strong communications with employees and regional partners. At ORNL, SCI, using employee engagement, is the primary tool to ensure progress toward Scope 3 reductions related to employee commutes and business air and ground travel. The rural setting of ORNL is a barrier to the development of public transportation options; therefore, a key for SCI is to continue promoting alternative commuting options and alternative work schedules.

ORNL is committed to reducing Scope 3 GHG emissions. The following efforts are currently under way to help meet the Scope 3 GHG reduction goals.

## HIGHLIGHT: Business Travel Avoidance Through Cloud Technology

*A successful program, expected to prove even more valuable in the future*

In late 2013 ORNL embarked on a mission of modernizing the videoconference capabilities of the laboratory to expanded collaboration opportunities with external partners. The proof of concept was completed for the new cloud-based video as a service offering that would bring the usefulness of video conferencing to a new level at ORNL. Use of the new service, commonly referred to as Blue Jeans, has exploded and is returning benefits in the form of improved collaborations, avoided travel expenses, reduction of greenhouse gases, and improved work-life balance.

The Blue Jeans service was formally put into production on January 1, 2014. The service is offered at no additional cost to the end-user community and is available for user registration at any time. The user population has grown consistently at the rate of approximately 50 users per month since initiation of the service, resulting in the current community of 560 registered users.

As the user base has grown, so has the utilization of the service. ORNL is tracking and reporting usage based on the number of meetings. Since January, ORNL has observed consistent growth, with a current average rate of more than 35 meetings per day or more than 650 meetings during the month of September. In the first nine months of production, a total of 3,977 meetings have been held involving more than a half million participant minutes, 504 cities, and 28 countries.

### *T&D losses – related efforts*

Because the largest portion of Scope 3 GHG emissions is attributed to T&D losses from purchased electricity, Scope 3 emissions (in total) are expected to increase as we approach the target year, FY 2020. The reduction of GHG emissions resulting from T&D losses is dependent upon our engagement with TVA to work in tandem to establish clean power production goals and to upgrade the T&D infrastructure. ORNL has a strong working relationship with TVA, and both the DOE Oak Ridge Site Office and ORNL have taken steps to strengthen those bonds in recent years. To reduce T&D losses and improve the reliability of medium voltage distribution, ORNL has developed a strategy to install a new substation closer to the high energy computational load center. ORNL is involved in many planning and working committees with TVA. The laboratory has taken a proactive position and included TVA as a key member of its solutions team for cleaner electrical grid emissions, which will also reduce T&D losses. In summary, the risk of nonattainment of the Scope 3 GHG reduction goal of 13% is high, primarily due to T&D losses. By FY 2020 consumption of purchased electricity at ORNL is

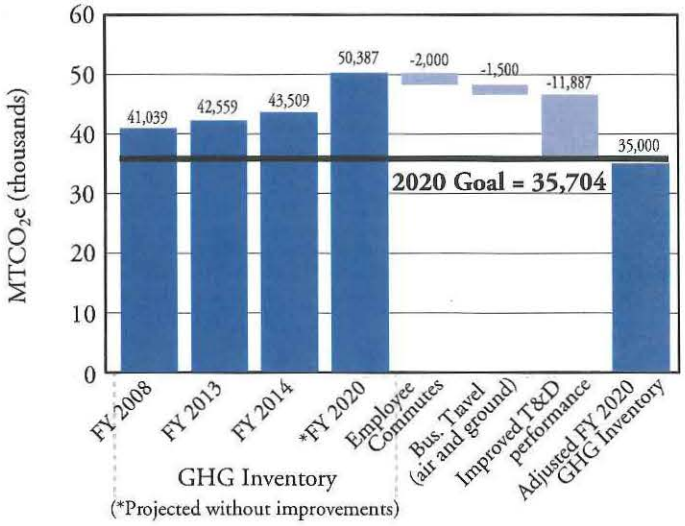
expected to more than double compared to the baseline established in FY 2008, thus impacting achievement of the Scope 3 GHG reduction goal.

***Transportation– and employee commuting–related efforts***

ORNL will continue to maximize transportation options and community outreach by coordinating with local, state, and federal telecommute and rideshare agencies, including further development of regional transportation planning partnerships such as Smart Trips. The laboratory will also continue its employee outreach and education programs to increase participation in commuting options and telework alternatives, including maintaining and updating promotional tools and websites to assist employees in making informed decisions.

***Business air travel– and business ground travel–related efforts***

Several federal, DOE, and ORNL travel initiatives emphasize the overall benefits of reduced business travel. Travel policies aimed at reducing cost also lead to more efficient use of time and lessen GHG emissions by curtailing the use of travel-related fuels. ORNL will continue to promote the initiatives that have resulted in the current successes in this Scope 3 performance area such as providing access to advanced technologies such as the Blue Jeans Videoconference tool.




Scope 3: Indirect Emissions (T&D losses, employee commutes, employee business travel).

**Figure 3. ORNL Scope 3 GHG snapshot with FY 2014 data and projections.**

# Goal 2: Sustainable Buildings

## 2.1 Energy Intensity Reductions

**DOE Goal:** 30% energy intensity reduction (in British thermal units per gross square foot) by FY 2015 from a FY 2003 baseline. (FY 2014 target: 27%).

### Performance Status

ORNL has continued to make steady progress toward meeting or exceeding the goal of reducing energy intensity by 30% by FY 2015 from a FY 2003 baseline (Figure 4). The FY 2014 energy use intensity (EUI) reduction is 29.5%, exceeding the current year target of 27%. This is the result of a combination of factors, including continued construction of new energy-efficient facilities, repurposing existing facilities to better align with mission and resources for effective operations, and demolition of inefficient legacy facilities. Aggressive energy reduction activities in current facilities will be combined with ongoing audits and the ECMs program, new efforts in building commissioning, benchmarking energy consumption, and best management practices. As demonstrated in Figure 5, over the past decade the footprint of ORNL's offices and laboratories has increased 54%, accompanied by an impressive decrease in energy consumption of 4.3%.

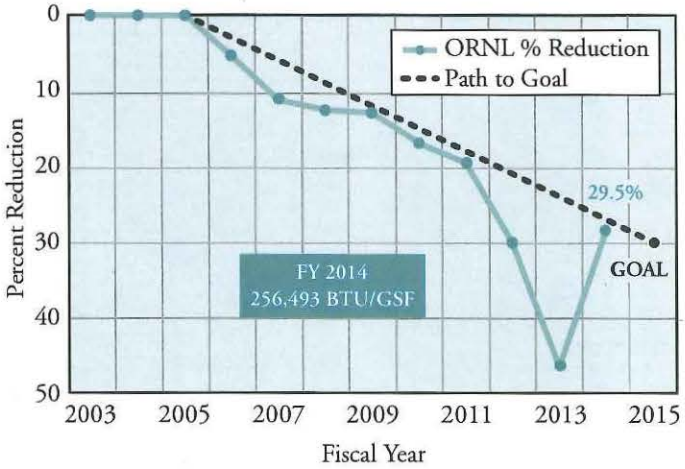



**Figure 4. Summary of EUI reduction results and progress toward goal.**

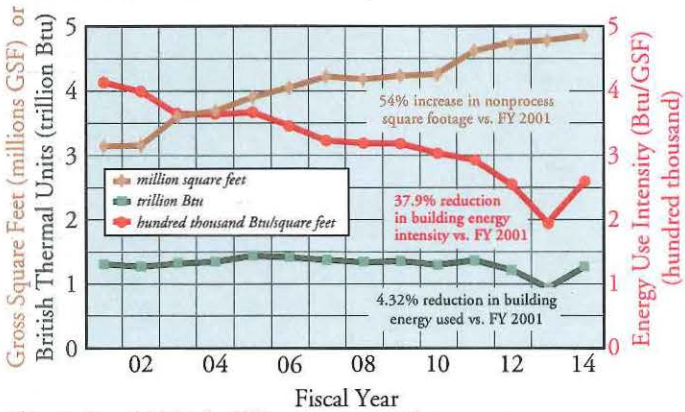



**Figure 5. ORNL building energy performance – FY 2001–FY 2014.**

Based on FY 2014 data, energy use in the buildings category at ORNL is 1,249 billion Btu, [not including ORNL's excluded facilities as defined by the Energy Policy Act (EPACT) of 1992]. Given an area of 4,869,690 gross square feet (GSF) of energy-consuming buildings, trailers, and other structures/facilities identified in the Facilities Information Management System (FIMS), the FY 2014 calculated EUI is 256,493 Btu/GSF.

## Plans and Projected Performance

ORNL has made significant progress in energy use intensity reduction by driving beyond the annual progression toward the FY 2015 goal. We are well positioned to achieve the EUI reduction goal, and the focus now is on maintaining this reduction while continuing to strive for improvement. This objective will be supported by the continued operation of the ESPC-implemented ECMs and the integrated, in-house energy management program.

An ESPC with JCI is a significant component of ORNL's strategy for achieving the goals established to meet the EPACT directives. A delivery order with JCI was awarded in July 2008 and formally accepted in July 2012. The ESPC ECMs included steam system decentralization, lighting upgrades, water conservation, building management system improvements, mechanical equipment upgrades, and steam production improvement. Among the improvements, the building management system ECM modernized heating, ventilating, and air-conditioning (HVAC) control systems and provided the means to significantly reduce or eliminate energy intensive simultaneous heating and cooling in several large air-handling units. Measurement and verification of ESPC ECM performance continued in FY 2014 with increased emphasis on observations, documentation of improvement suggestions, and feedback to operations and maintenance (O&M) personnel.

ORNL's in-house energy management strategy revolves around utility meter data with a "measure to manage" philosophy. These meter data provide the basis for benchmarking, which sets priorities for energy auditing. Energy audits identify ECMs that range from building envelope repairs, to high efficiency equipment upgrades, to HVAC control system optimization. Existing building commissioning efforts have proven beneficial for realizing energy savings potential by adjusting parameters of existing systems, consistent with current usage conditions. To sustain the resulting performance and savings achievements, ongoing commissioning leverages utility meter and building automation system (BAS) data for monitoring trends and identifying anomalies.

Based on persistent savings from ECMs and aggressive energy innovation in the construction, repurposing, and renovation of buildings, we anticipate the EUI goal of 30% reduction will be obtained in the FY 2015 goal year (Figure 6).

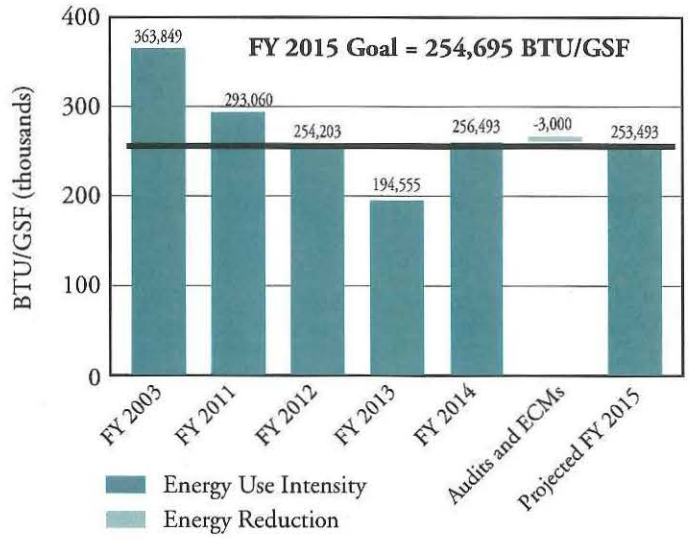



**Figure 6. Energy Use Intensity improvement 2003 to 2015.**

# 2.2 Energy Independence and Security Act Section 432 Energy and Water Evaluations

**DOE Goal:** EISA Section 432 energy and water evaluations, benchmarking, project implementation, and measures follow-up.

## Performance Status

ORNL has made good progress on the energy audit program, having completed the second year of another 4-year cycle in FY 2014. Section 432 of the 2007 Energy Independence and Security Act (EISA) requires that 25% of 75% of facility energy use be audited each year, with audits repeated on a 4-year cycle. Note: evaluation by an energy service company for a site-wide initial proposal in preparation for an ESPC is acceptable as fulfilling this 4-year requirement.

The JCI ESPC evaluation in FY 2008 provided the first 100% audit of the ORNL campus (Table 6). In FY 2009 ORNL chose to proceed with a second round of audits, although doing so was not required at that time because of the JCI initial proposal, to provide additional detail on potential ECMs that could be carried

**Table 6. ORNL energy audit results in annual square footage and percentage of campus**

| Year | Annual Square Footage | Annual Percentage of Campus | Cumulative Square Footage | Audit Company |
|---|---|---|---|---|
| 2008 | 3,195,365 | 100.00 | 3,195,365 | JCI (ESPC) |
| 2009 | 1,294,069 | 40.50 | 4,489,434 | V3 |
| 2010 | 627,382 | 19.63 | 5,116,816 | Keres/EMG |
| 2011 | 470,563 | 14.73 | 5,587,379 | Keres/EMG |
| 2012 | 775,596 | 24.27 | 6,632,975 | Keres/EMG |
| 2013 | 963,160 | 30.14 | 7,326,135 | WorkingBuildings |
| 2014 | 976,385 | 27.12 | 8,302,520 | WorkingBuildings |

out using in-house operating staff and funds. This also provided a ready list of ECMs in the event supplemental funds became available. This second round of audits (completed in FY 2012) evaluated 3.2 million ft$^2$ of building space.

In FY 2013 ORNL began a new audit cycle and elected to modify the associated statement of work to focus on specific energy and water use issues and avoid duplication of work conducted during the previous rounds. This approach has proved very successful in identifying HVAC optimization opportunities that require only minor capital modifications and use intelligent control sequences of operation to maximize the potential of existing systems. In many cases, these audits serve as the first phase of an existing building commissioning process and a foundation for follow-on efforts.

Recommended energy and water conservation measures from all audits are compiled on a composite list for prioritization, tracking, and periodic reevaluation to verify that they are still pertinent. Primary prioritization is ordered by life-cycle cost and benefit analyses, but secondary factors are also taken into consideration to facilitate alignment with current opportunities and identify measures that have the best potential for implementation.

### Plans and Projected Performance

In FY 2015 and foreseeably through the remainder of this cycle of audits, ORNL will continue with the approach of focusing American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) level 2 in-depth audits on energy and water issues. Specific emphasis will continue to be applied to ensuring the quality and feasibly of recommended energy and water conservation measures. It is for this reason that a hold-point has been introduced to the audit process that promotes preliminary feasibility evaluations. If projects pass objectives of the first hold-point, then additional evaluations will be developed. In addition to these audits, ORNL will engage in-house facility managers and facility engineers to identify lighting, building envelope, and other energy-impacting opportunities that become apparent through the course of their daily tasks. By quantifying the energy economics associated with these opportunities, ORNL's sustainability and energy efficiency personnel will aid facilities personnel in the organization and prioritization of these items to garner the attention that they deserve.

Continued focus will be placed on improving the breadth and depth of ORNL's benchmarked building portfolio. The EPA ENERGY STAR Portfolio Manager currently contains many meter datasets for ORNL buildings, but efforts to improve the continuity of data and consistency of building profiles are under way. Capabilities within ORNL's Central Energy Data System (CEDS) are expected to be integral to streamlining and automating data flow to the ENERGY STAR Portfolio Manager.

## 2.3 Metering for Individual Buildings

**DOE Goal:** Individual buildings metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015). (FY 2014 target: 90% and 50% respectively).

### Performance Status

FY 2014 metering percentages calculated as of October 2014 are as follows.

- 91% electricity
- 90% natural gas
- 70% chilled water
- 7% steam

ORNL's specific status with respect to each requirement and/or goal is as follows.

- Goal: Meter at a building level 90% of electricity by October 1, 2012

- The metering goal for electricity was achieved by the initial goal date of 2012. An updated analysis at the end of FY 2014 resulted in the current electricity metering rate of 91%.

- Goal: Meter at a building level 90% of natural gas, steam, and chilled water by October 1, 2015. FY 2014 target is 50% for each of the following.
  - Natural Gas: The FY 2014 metering rate for natural gas is calculated at 90%, meeting the final goal one year ahead of schedule.
  - Chilled Water: The FY 2014 metering rate for chilled water is calculated at 70%, exceeding the current year goal of 50% and progressing toward the final goal of 90%.
  - Steam: The building metering rate for steam is calculated at 7% for FY 2014, not currently on target. ORNL is metering all generated steam output, has implemented limited metering of steam use at the building level and is working to expand the building level steam metering to achieve the 90% goal by FY 2015.

To comply with metering goals and other DOE sustainable buildings guidance, ORNL design procedures are in place to ensure utility meters are installed at the building level for all new construction and major renovations of buildings greater than 5,000 ft².

### Plans and Projected Performance

Since the 2012 DOE metering goals were established, significant progress has been made in ORNL's advanced metering infrastructure, with new devices installed in the electrical, steam, and chilled water systems. The advancement of metering use will continue into FY 2015, with primary focus on the steam distribution system, which is currently not on tract because of its size and technical complexity. Lessons learned from steam meter installations in the last 2 years will provide a good foundation for improved deployment in FY 2015. Efforts will also continue on development of the chilled water energy metering infrastructure. Most high-priority chilled water loads are already metered, so now the focus will shift to closing gaps and enhancing the big picture for consumption. Several natural gas–consuming buildings have been targeted to receive advanced flow meters in FY 2015. Attention will also be given to district compressed air to identify the largest loads on the system and to plan for meter installations to more closely monitor the frequency and magnitude of end uses.

Data from advanced meters, the validity of utility bills, and the verification of cost and unit savings is accomplished through the deployment of the CEDS information system. CEDS will continue to be enhanced as more linked devices are brought online and the system's user group continues to grow. In the near term, plans are being made to develop interactive mechanical utility distribution system diagrams for an intuitive representation of meter locations and improved ease of system navigation. Interactive online diagrams for medium-voltage electrical distribution and computational facilities have already been developed, and plans are being made to expand this concept to additional buildings with advanced electrical meters. Improved in the initial system training programs and refresher training will continue to be an essential part of the CEDS support strategy continuous efforts.

Standardized building level energy reports are being developed for monthly distribution to facility operations and management personnel. These reports will be used as a catalyst for discussions regarding building energy performance and operational opportunities for improvement. To promote energy awareness and engagement of ORNL's general employee population, digital dashboards will be developed for building-installed kiosk monitors that will display real-time energy data to building occupants. Continuous efforts will be made to maintain updated documentation of site meter inventory details and operational status. Processes will be refined to manage calibration and other actions required to maintain the integrity of CEDS and its data.

## 2.4 Cool Roofs

**DOE Goal:** All new roofs must meet cool roof reflectivity standards and have thermal resistance of at least R-30.

ORNL continues to integrate cool roof strategies for all new building projects and reroofing projects (both current and planned) when it is feasible and cost effective. Highly reflective roofing with adequate insulation is the standard, but the planning process also includes other strategies such as green (planted) roof systems and photovoltaic (PV) systems. As part of FIMS reporting, cool roof information is updated biannually to ensure compliance with the DOE goals.

### Performance Status

In FY 2014 reroofing projects on two facilities, buildings 3525 and 7603, added 23,014 ft² to the ORNL cool roof inventory. No new construction projects were completed. In addition, roofs on two minor generator facilities, buildings 7921 and 7931, were replaced with highly reflective roofing membranes.

An ORNL FIMS analysis completed at the end of FY 2014 indicates that at total of 596,551 square feet (22% of SC facilities) have now been updated to Cool Roof standards.

### Plans and Projected Performance

Continue to ensure compliance is maintained.

# 2.5 High Performance Sustainable Buildings Guiding Principles—Existing Buildings

**DOE Goal:** 15% of existing buildings greater than 5,000 GSF are compliant with the GPs for federal leadership in HPSB by FY 2015 (FY 2014 target: 13%).

## Performance Status

In FY 2014, ORNL's high performance sustainable buildings (HPSB) inventory reached a total of 25 buildings, exceeding the DOE Goal of 15% (22 buildings). During FY 2014 two additional facilities (buildings 1005 and 3137) were evaluated and found to align with the Guiding Principles (GPs) for federal leadership in HPSB (Figure 7).

More than ever before, existing buildings must be driven to perform at a higher level with emphasis on sustainability. ORNL's systematic approach to identifying HPSB candidates and applying the GPs has proved effective in keeping us on track to meet the FY 2015 requirements. HPSB candidates have been identified based on building space use, existing metering infrastructure, and initially identified energy conservation opportunities. Action plans for achieving building specific GPs are developed and executed, while laboratorywide standards are used to fulfill HPSB policies and procedures. Engagement of facility managers, facility engineers, and other technical personnel has been essential to acquiring quality benchmarking data, performing commissioning activities, and implementing energy conservation measures.

ORNL HPSB efforts have begun to shift from office buildings to include laboratory and mixed use buildings as experience with the GPs has grown. Lessons learned in the FY 2012 and FY 2013 laboratory-focused HPSB efforts were applied to laboratory building 1005 in FY 2014. The prior efforts focused on evaluating the operation of existing systems and their suitability with respect to current facility use. Temperature and airflow setpoints and equipment operating sequences were examined with the intent to rightsize and achieve maximum efficiency potential from existing systems. Occupant comfort and known conditions were also taken into consideration for a holistic evaluation of building performance. Modifications were made to implement occupancy-based lighting control, and standardized furniture task lighting was found to support the GPs.

While all of the GPs contribute to the betterment of buildings, the existing building commissioning process has proved most beneficial in identifying opportunities to optimize existing equipment and systems to better align with current space use. With the evolution of research programs and projects, buildings are often used in a manner that is different from their original designs. Because of this, identifying, evaluating, and adjusting HVAC airflow volumes, setpoints, and control sequences and related actions have proved to provide the best return on investment. ORNL realizes that achieving HPSB status is not the end but rather just the beginning of an ongoing plan-do-check-act cycle to ensure the persistence of savings and potentially even increase them over time.

## Plans and Projected Performance

Current construction and planning documents indicate an additional three facilities will be added to the HPSB inventory in FY 2015. With a plan-do-check-act strategy, emphasis will be placed on ensuring that the level of performance of buildings in the existing HPSB inventory is sustained or even improved. Specifically, this will involve continuing current commissioning techniques; maintaining benchmarks; and verifying that policies and procedures remain current, visible, and in use. As it becomes increasingly more challenging to apply the GPs to more complex buildings, intensive effort and often capital investment is required to make significant changes toward energy consumption reduction. Additional time will also be required to measure performance and verify savings. Efforts will continue toward expanding the existing HPSB inventory at a pace that does not compromise the ability to effectively manage the buildings in the current inventory.

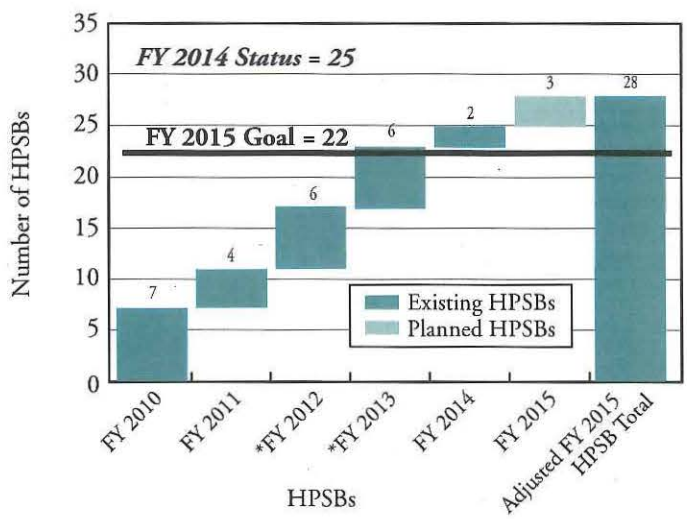



**Figure 7.** ORNL plan for high performance sustainable buildings (2015 goal: 22 HPSBs).

# 2.6 High Performance Sustainable Buildings Guiding Principles—New Construction

**DOE Goal:** All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs for federal leadership in HPSB.

## Performance Status

As of the end of FY 2014, 16 facilities had been constructed to US Green Building Council Leadership in Energy and Environmental Design (LEED) standards and met the DOE HPSBs GPs. LEED certification has either been received or is in progress for the following facilities.

1. Building 1521—ORNL West End Research Support Facility (LEED Certified)
2. Building 3625 (expansion)—Advanced Materials Characterization Laboratory (LEED Silver)
3. Building 4020—MAXLAB Building Research Laboratory (LEED Gold)
4. Building 4100—Chemical and Materials Science Laboratory (LEED Gold)
5. Building 4500N—Wing 3 Renovation (LEED Gold pending)
6. Building 5100—Joint Institute for Computational Sciences (LEED Silver)
7. Building 5200—ORNL Conference Center (LEED Certified)
8. Building 5300—Multi-Program Research Facility (LEED Gold)
9. Building 5600—Computational Sciences Building (LEED Certified)
10. Building 5700—Research Office Building (LEED Certified)
11. Building 5800—Engineering Technology Facility (LEED Certified)
12. Building 7990—Melton Valley Warehouse (LEED Certified)
13. Building 7995—Melton Valley Maintenance Facility (LEED Gold)
14. Building 8630—Joint Institute for Neutron Sciences (LEED Certified)
15. Building 8640—ORNL Guest House (LEED Gold)
16. Building 8930—Chestnut Ridge Maintenance Facility (LEED Gold pending)

## Plans and Projected Performance

Design procedures are in place to ensure that all new construction, major renovations, and alterations of buildings greater than 5,000 GSF will comply with the DOE goals for HPSBs.

Currently the following planned facility will be designed to achieve LEED Gold and qualify for meeting the GPs for federal leadership in HPSB.

- Building 7018, Logistical Services Center Building—under construction; scheduled for completion in the second quarter of 2015.

### SUCCESS STORY: Building 4500N, Wing 3, Office Renovation

The 4500N Wing 3 office renovation project updated and renovated more than 20,000 ft² of old laboratory and office space into a modern open office environment. As a result of using natural daylighting, skylights, and installing 100% Energy Star equipment, estimated energy savings of 30% compared to a standard open office environment were achieved.

Collaboration/meeting space was greatly enhanced in this modernization and reuse of existing space. The expected energy savings compared to the original laboratory/office use is approximately 64%. Water savings of 30% was achieved through the use of low flow fixtures for the new break room and retrofitting of existing rest rooms.

Natural daylight above cubicles.

New conference/meeting room space.

# 2.7 Regional and Local Planning

**DOE Goal:** Efforts to increase regional and local planning coordination and involvement.

## Performance Status

**Regional Outreach.** Last year ORNL and its regional partners announced a new nonprofit sustainability organization, the Southeast Sustainability Group (SSG). SSG comprises research, academic, and industry partners throughout the southeastern United States with a shared vision for advancing sustainability in the region—defined primarily as EPA's Region IV (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, and Native American groups in the region). During FY 2014 SSG worked to finalize its formation documents and select its initial projects. SSG has decided to pursue two early projects based on the four key areas of its charter (sustainable transportation, low-carbon power generation, energy efficiency, and water and waste management). These projects include the installation of solar capacity across the region to offset power being used by plug-in electric vehicles (EVs) and the adoption of highly efficient water heaters in residential and business applications. In addition to ORNL, other SSG members include Black Bear Solar Institute (Pigeon Forge, Tennessee), Clark-Atlanta University, Indian River State College (Florida), the Tennessee Valley Authority, and the University of Tennessee. For additional information on SSG: www.southeastsustainabilitygroup.org.

**Transportation Efforts.** ORNL and the leaders of the Sustainable Campus Transportation Roadmap (SCTR) actively engage in regional and local planning for sustainable transportation as well as outreach activities for the enhancement of sustainable transportation in the entire southeast region. In 2014, SCI coordinated with state and regional transportation programs to help create more effective, efficient, and affordable regional transportation and commuting options. Staff members from ORNL actively participated in local and regional organizations, including service on the board of directors of the East Tennessee Community Design Center. Related activities included participation in the Northwest Planning Study Update and the Knox to Oak Ridge Greenway Study. ORNL and SCTR leaders actively encourage the development of additional greenways and bicycle facilities in Hardin Valley as well as between the City of Oak Ridge and ORNL. Efforts that began in 2012 to gain approval for a traffic light at SR 95 and Bethel Valley Road is on track to be installed by the end of calendar year 2014, thus reducing idling time as well as improving safety. Finally, collaborations continue with the regional DOE Clean Cities program, Knoxville Area Transit (KAT), City of Knoxville, and Smart Trips.

ORNL also coordinates with local, state, and federal telecommute and rideshare programs. Specific efforts included the following.

- Encouragement of Smart Trips participation by ORNL employees. As employee commuting is a major contributor to Scope 3 GHG emissions, please see Section I/Goal 1.2 (GHG Reductions—Scope 3) for a detailed description of FY 2014 Smart Trips activities, plans and results.
- Participation in the Knoxville Regional Transit Development Plan process to expand transit opportunities across the region and in the Pellissippi Parkway corridor.
- Service as a board member on the local DOE Clean Cities coalition.
- Participation in 2014 Southeast Alternative Fuels Conference.
- ORNL employee participation in the Smart Trips program has declined, and in response ORNL has actively encouraged participation through targeted on-site advertisements on the digital video monitors on campus and by hosting Smart Trips at employee onsite events such as the wellness fair. ORNL continues to actively promote ride sharing, biking to work, and other non-single-occupancy employee commuting options.

## Plans and Projected Performance

Ongoing efforts will focus on the following:

- Continue developing regional transportation planning partnerships with organizations such as Smart Trips and KAT.
- Report on Southeast Alternative Fuels Conference, focusing on regional transportation planning.
- Continue to participate in the Knoxville Regional Transit Development Plan to coordinate ORNL's commute/ transit needs with the long-range transportation strategy for the region.
- Continue to participate in the PlanET regional consortium, sharing sustainability lessons learned with regional leadership.
- Continue actively participating in SSG.

# Goal 3: Fleet Management

## 3.1 Fleet Alternative Fuel Consumption

**DOE Goal:** 10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline. (FY 2014 target: 136% cumulative since 2005).

*Note: Fleet vehicle data are available in the Federal Automotive Statistical Tool (FAST) system. Fuel calculations are in natural units of gallons, not gasoline gallon equivalents.*

### Performance Status

Fuel data for FY 2014 reflect that ORNL alternative fuel use has increased from the 2005 baseline by 220%, exceeding the target. The graphs included in this section (Figures 8 and 9) demonstrate ORNL's commutative progression in alternative fuel use both in percentage increases per year and in comparison of alternative fuels to traditional petroleum products. Petroleum use continues to decline as alternative fuels prove to be available and are used.

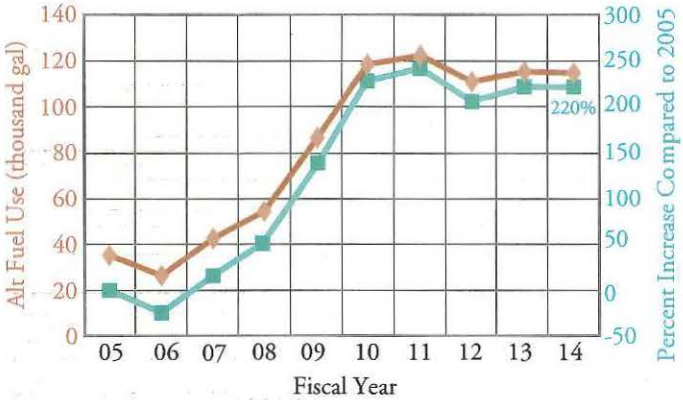



**Figure 8. Alternative fuel consumption and cumulative percent increase from FY 2005 to the present.**

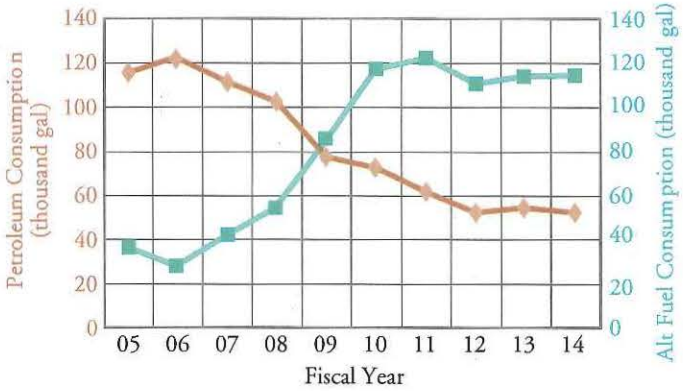



**Figure 9. Comparison of petroleum vs. alternative fuel consumption from FY 2005 to the present.**

The installation of the additional on-site E85 pump at ORNL has helped minimize missed fuel opportunities and keep E85 use high. E85 fuel quality is frequently tested to ensure ethanol content using an outside fuel test laboratory. Any interruptions in the availability or quality of alternative fuels could quickly lead to reduced alternative fuel use and increased petroleum use, which would set back our progression toward SSP goals. The percentage of fleet vehicles using E85 on a monthly basis has steadily improved since 2000, as shown in Figure 10, as laboratory management has continued to emphasize the importance of using E85 in flexible fuel vehicles (FFVs).

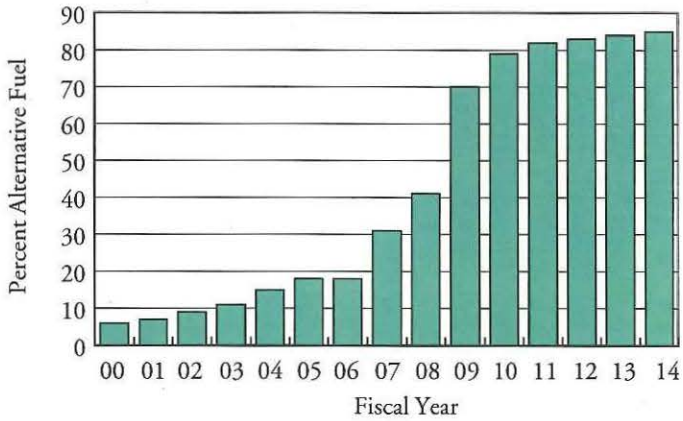



**Figure 10. Percentage of ORNL vehicles using E85 on a monthly basis from FY 2000 to the present.**

ORNL continues to be a leader in the Southeast for alternative fuel fleet use and remains involved in alternative fuel outreach through partnerships with the local DOE Clean Cities program (East Tennessee Clean Fuels) and providing experts at local public outreach and education events. Such events highlight ORNL's experience and expertise in alternative fuel use to help the public make informed decisions regarding the benefits and challenges with alternative fuel use. In addition, ORNL has been invited to give a presentation on the future of optimizing engines for alternative fuels at the 2014 Southeast Alternative Fuels Conference, which was held in October 2014 in Raleigh, North Carolina.

## Plans and Projected Performance

ORNL's planned fleet measures include continuing to replace older vehicles with alternative fuel vehicles (AFVs) as funding will allow, continuing to focus on flexible fuel passenger vehicles, and obtaining approved B20 (biodiesel) capable vehicles when possible. A total of 16 vehicles were purchased in FY 2014, consisting of light-duty, medium-duty, and heavy-duty vehicles and 2 passenger vehicles. Thirteen of these acquired vehicles were AFVs, two were B20 compatible vehicles, and one was a plug-in hybrid sedan. There are now two plug-in hybrid sedans in ORNL's 439 vehicle fleet, and 85% of fleet vehicles are AFVs. ORNL is also continuing to procure electric low speed vehicles (LSVs) as funds allow and when missions can use such equipment.

To continue ORNL's progress toward the goal of zero missed opportunities for fueling AFVs with alternative fuels, AFV fuel use will continue to be assessed on a monthly basis.

Funds and availability of fuels continue to challenge the fleet program. Issues with reported concerns of biodiesel quality during the winter months resulted in a reduction of B20 use for FY 2014.

Budget reductions will impact the purchase of electric and hybrid replacement vehicles. To purchase these vehicles, approval must be granted to ORNL by Congressional appropriation to DOE headquarters. Inconsistency of agency appropriations impedes the replacement vehicle planning process.

# 3.2 Reductions in Fleet Petroleum Consumption

**DOE Goal:** 2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline. (FY 2014 target: 18% cumulative since 2005).

*Note: Fleet vehicle data are available in the FAST system. Fuel calculations are in natural units of gallons, not gasoline gallon equivalents.*

## Performance Status

Fuel data for FY 2014 reflects that ORNL has exceeded the cumulative target of an 18% decrease in petroleum consumption by achieving a cumulative decrease of 55% compared to the 2005 baseline, as shown in Figure 11. Petroleum consumption in 2014 was reduced by 5% over 2013 through an ORNL Fleet Management strategy of focusing on AFVs, high fuel efficiency hybrid vehicles for passenger sedans, and promotion of practices such as an idle time reduction campaign and the use of bicycles on campus. ORNL has strategically placed 100 bicycles throughout the campus for staff use in order to help with sustainability goals, including the reduction of fleet vehicle use. Twenty-seven percent of the LSVs used on campus are EVs.

To ensure this level of progress is maintained, ORNL will continue to increase use of alternative fuels, increase the fuel economy of fleet vehicles, and reduce the number of vehicle miles driven. The DOE Oak Ridge Office (ORO) local utilization mileage goal of 100% utilization has been met with full compliance.

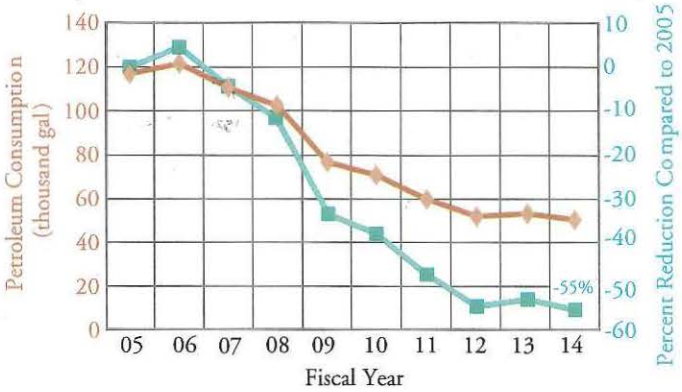



**Figure 11. Petroleum consumption and cumulative percent decrease from FY 2005.**

## Plans and Projected Performance

As funding is provided and the appropriate approvals are granted, ORNL will continue to replace inefficient vehicles with AFVs and hybrids, replace heavy duty vehicles with units that have a smaller gross vehicle weight rating, and, when possible, replace gasoline LSVs with electric LSVs.

ORNL's planned fleet measures include the following.

- Zero waivers for using petroleum fuel in AFVs
- Zero missed opportunities for fueling AFVs with alternative fuels
- Replacement of older vehicles with AFVs and hybrids as funding allows
- Continued emphasis of initiatives that will decrease idling practices by personnel
- Procurement of hybrid vehicles to provide the on-site taxi/shuttle activity with fuel-efficient vehicles
- Continued reduction of vehicle miles traveled through teleconferencing, trip consolidation, use of mass transportation, etc.

The risk assumption associated with this goal is related to the availability of alternative fuels. ORNL currently has four types of fuel available on the site: unleaded gasoline, E85, biodiesel, and diesel. If E85 or biodiesel becomes unavailable, or if any technical problems with these fuels or fueling infrastructure arise, gasoline and diesel fuel will have to be used.

## 3.3 Light Duty Vehicle Purchases Must Be Alternative Fuel Vehicles

**DOE Goal:** 100% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2015 and thereafter (75% FY 2000–2015).

*Note: Fleet vehicle data are available in the FAST system.*

### Performance Status

ORNL continues to support the AFV acquisition requirement by purchasing available FFVs from the General Services Administration (GSA). Additional purchases will continue to depend upon available funding and approval. In FY 2014, 13 light duty vehicles were purchased, representing 100% of vehicle acquisitions.

### Plans and Projected Performance

ORNL will continue to replace vehicles that meet the 41 CFR 102-34.270 criteria with AFVs as funding and appropriations allow.

Costs continue to be higher for hybrid vehicles and/or EVs than for E85- or B20-compatible vehicles. Until initial costs of EVs are comparable to other vehicles, the decision to purchase EVs will continue to be a challenge. In addition, EV selection on the GSA vehicle ordering system is limited compared to FFVs and B20-compatible vehicles.

# Goal 4: Water Use Efficiency and Management

## 4.1 Potable Water Use Intensity

**DOE Goal:** 26% potable water intensity (G/GSF) reduction by FY 2020 from a FY 2007 baseline. (FY 2014 target: 14%).

ORNL has long been aware of the benefits of effective water management. While DOE set potable water use intensity reduction goals relative to a FY 2007 baseline, as a result of a variety of operational initiatives, ORNL had already experienced a 50% reduction in water use by FY 2007 compared with its highest water use established in FY 1985.

### Performance Status

ORNL has developed an aggressive plan to reduce water consumption that includes repairing leaks, replacing old lines in the site water distribution system, and eliminating once-through cooling (OTC) where possible. The cumulative result of these efforts was a water use intensity (WUI) of 138 G/GSF in FY 2014, a reduction of 22% from FY 2007, which exceeds the FY 2014 incremental goal of a 14% reduction.

- Significant WUI improvement activities were initiated in FY 2008 upon the award of an ESPC, resulting in savings of 170 million gallons per year (MGY). The ORNL Utilities Division has worked with two different leak detection companies to identify and repair leaks in the water distribution system across the site. In addition, the Utilities Division has replaced identified sections of piping and repaired leaks found in the process of replacing lines. An effort by FMD to identify and repair leaks within buildings has also resulted in significant water savings. In addition, the research and development organizations have installed stand-alone coolers or flow reducers where OTC could not be eliminated.
- The commissioning of building 4100 moved historically inefficient operations from buildings 3150, 4508, 4500N, and 4500S. Another heavy user, the Physics Division in building 6000, has implemented a project to drastically reduce its use of OTC by installing flow control valves and eliminating cooling water entirely when air-cooled fans can be used.
- In FY 2014, ORNL completed the phase out of a very old and leaky process water distribution system. This was a multiyear effort that required the installation of new backflow preventers in several buildings. The final step was complete when main isolation valves to the system were permanently closed.
- To better understand water use at ORNL, a water-metering plan is being implemented. As a part of this plan, assessments identified the 33 facilities that account for 90% of water use at ORNL. To date, 17 of these 33 facilities have been metered with advanced meters connected to the ORNL CEDS, collecting interval data. In addition, all of ORNL's cooling tower makeup water supplies are metered, with the majority of these devices being advanced meters. In FY 2014, an advanced meter was installed on one of the site's water distribution supply mains. This installation established a foundation for additional distribution side meters in the coming years.
- Finally, ORNL commissions an annual energy and water audit performed by an independent team. Findings and suggestions from each audit are integrated with ORNL's annual planning. Figure 12 shows the WUI from the FY 2007 baseline year to the current year. The current performance status of a WUI reduction of 22% is ahead of the DOE interim goal of 14% established for FY 2014.

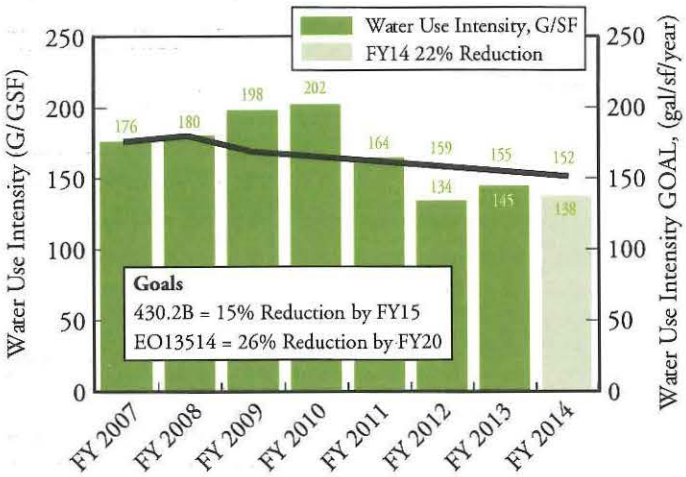



**Figure 12. ORNL performance status to FY 2014. WUI reduction of 22% is ahead of the DOE goal.**

## Plans and Projected Performance

Modernization activities that include both elimination of old facilities and the addition of new facilities, ORNL must consider more water-efficient facilities in order to meet future WUI reduction goals.

- A facility disposition plan has been developed through FY 2020. Facilities totaling 122,827 ft² that use nearly 1.5 MGY of potable water are planned for demolition by the end of FY 2020. This activity is funded by the DOE Office of Environmental Management.
- A strategic plan has been developed through FY 2020 to add new facilities to meet mission goals. Facilities totaling 128,000 ft² that will use an estimated 8 MGY of potable water are planned for completion by the end of FY 2020.
- Planned growth to support ORNL's High Performance Computing (HPC) mission is projected to result in additional water consumption for cooling towers. Water consumption for this additional capacity is expected to peak in FY 2018 at 280 MGY.
- Plans have been made to install advanced water meters in six additional large facilities and on one additional cooling tower during FY 2015. Several new locations on the site water distribution system will be evaluated for advanced metering. Deep analysis of accumulated water meter interval data will be an increased focus area.
- Several water-saving initiatives are under way or planned through FY 2020 that are anticipated to save an additional 11 MGY of potable water.

Figure 13 shows actual ORNL water use in millions of gallons per year from the FY 2007 baseline to the current year, with projections forward to the FY 2020 target year. The declining black line is the DOE FY 2020 water use goal, the actual performance data are in green, and the projections are shown in blue. The projections assume that the project to eliminate OTC in building 4508 and replace it with a closed-loop chilled-water loop will be completed and will save an estimated 80 to 100 MGY. Currently this project is scheduled for FY 2016, but it may be delayed due to funding constraints.

Current performance and future projections indicate that ORNL's water use intensity is subject to rise due to increased demands for cooling tower makeup water to support high performance computing system growth. It's for this reason that ORNL will need to be aggressive in pursuing additional water savings opportunities to offset mission specific demands and bring the WUI trajectory back into alignment with the FY 2020 goal (Figure 13).

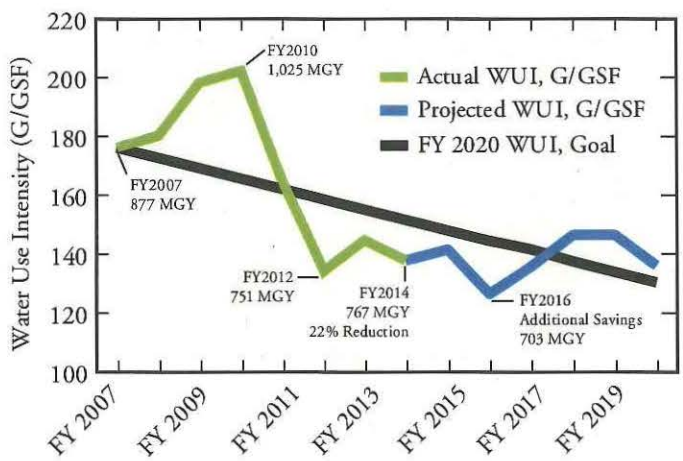



**Figure 13. Profile of ORNL water use from FY 2007 to the DOE target year of FY 2020.**

# 4.2 Industrial, Landscaping, and Agricultural Water Consumption

**DOE Goal:** 20% consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010.

Industrial, landscaping, and agricultural (ILA) water is considered to be nonpotable freshwater used for aiding processes such as cooling, washing, and manufacturing or for irrigation and other uses related to the production of agricultural products. Because all water at ORNL is potable water, all water used at ORNL will be included in the potable water category, and no water will be included in the ILA category.

EPA draft guidance for EO 13514 water goals provides clarification of the proper categorization of various types of water use. The guidance documents clarify that only nonpotable water should be included in the ILA goal and potable water used for ILA should be reported in the potable water goal to avoid double counting.

## Performance Status

Not applicable.

# Goal 5: Pollution Prevention and Waste Reduction

ORNL's pollution prevention (P2) plan embodies the commitment of ORNL management and staff to reduce waste generation and toxicity; to promote sustainable acquisition and resource conservation; to embrace sustainability, stewardship philosophies, and sustainability measures; and to fully comply with state, federal, and US DOE requirements concerning P2.

The regulatory-required P2 program and plan document the elements of the program, capture ongoing and planned activities, and are wholly supportive of DOE's sustainability program initiatives. Accomplishment of the ORNL goals, outlined as follows, requires the merger of administrative and cultural changes with new technologies and procedures.

- The generation of waste and pollutants is minimized through source reduction. ORNL has long focused on source reduction as the primary way of reducing waste generation, including sanitary, hazardous, and radioactive waste.
- The philosophy is incorporated in our work controls for research and operational activities.
  - ALARA practices
  - Chemical hygiene
  - Work control procedures
  - National Environmental Policy Act (NEPA) project reviews
  - Each year, waste generating divisions select one or two projects to implement that will address ORNL's identified targets and objects under the laboratory's Environmental Management System. The divisions select a waste reduction, energy efficiency, or procurement project to implement during the course of the year. The projects are shared with other appropriate divisions and, in many cases, other DOE sites and DOE headquarters as P2 success stories.
- The P2 focus has been to reduce the amount of material going to the landfill.
  - Development of contract language requiring construction contractors to recycle as much construction debris as possible, and report the recycled amounts, has resulted in significant amounts of material diverted from the landfill.
  - For routinely generated waste, it was determined that as least 30% of the material in the trash could have been recycled in established programs. To improve compliance with goals, recycling containers have been distributed to offices and breakrooms. Large recycling bins are provided in many areas, preventing common recycle materials from inadvertently being placed in the trash.
  - A paper towel recycling pilot was performed during the summer of 2014. With over 1,300 pounds collected, the mass was not as significant, especially when labor requirements for collection and recycling were considered. Source reduction options were identified concerning modifying the settings on the touch-less paper towel dispensers to minimize the quantity of paper towels being used.
  - All large paper recycling bins were also evaluated during the summer of 2014 to ensure the containers were in the correct locations, and most of the smaller console-based bins were replaced with larger bins to facilitate and increase recycling.
  - Recycle/reuse is maximized for both municipal solid waste and construction and demolition waste, including off-site recycling of scrap metal and broken furniture.

Based on these and many other efforts to divert municipal solid waste (MSW) and construction and demolition (C&D) waste. In FY 2014, ORNL realized a 35% diversion rate for MSW and a 70% diversion rate for C&D waste.

## 5.1 Solid Waste Reductions (nonhazardous, other than construction waste)

**DOE Goal:** Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris, by FY 2015.

*Note: All MSW generated by ORNL is sent to an industrial landfill located on DOE ORO property. To eliminate double counting of GHG emissions, ORNL MSW data are entered as "0" in CEDR because the environmental management prime contractor counts all MSW for the entire ORO landfill as Scope 1. ORNL is responsible for the reduction of MSW and the reporting in this section tracks goals progress toward DOE waste generation reduction.*

### Performance Status

As shown in Figure 14, ORNL's diversion rate for MSW in FY 2014 was 35% as supported by data reported in CEDR. While this is lower than the FY 2015 goal of 50%, we have achieved a minor increase compared to prior years.

ORNL has continued its initiatives and best management practices to reduce the amount of material going to the landfill, including the following.

- Materials going into trash cans and dumpsters are monitored to determine whether there are additional materials that have the potential for source reduction, recycling, or resale.

- Findings of missed recycling opportunities are presented to personnel to reinforce the mission of P2. A number of targeted meetings were conducted and a division-wide employee recycling seminar was offered in FY 2014.
- Communications with divisions and facility managers concerning which materials are acceptable in the recycling streams (e.g., fiberboard, colored paper) have been enhanced, and efforts have been made to help them find additional outlets for saleable and recyclable materials.

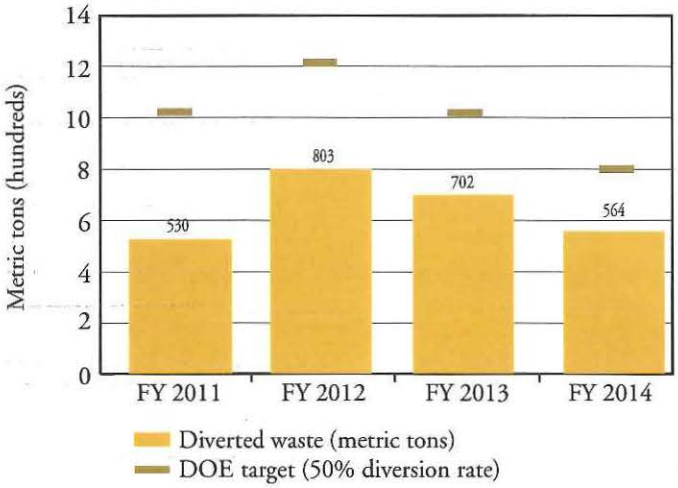



**Figure 14. ORNL municipal waste diversion**

## Plans and Projected Performance

ORNL will continue its initiatives and best management practices to reduce the amount of material going to the landfill, and we recognize that the risk of nonattainment for this goal is high with a current performance of 35% diversion rate, it is unlikely that a 50% diversion rate can be obtained in only one year. The following actions will continue to be implemented as a means to improve the diversion rate.

- Monitoring of materials placed into trash cans and dumpsters.
- Presenting findings of missed recycling opportunities to personnel to reinforce the mission of P2.
- Enhancing communications with divisions and facility managers concerning which materials are acceptable in the recycling streams (e.g., fiberboard, colored paper).
- Reevaluating opportunities for composting by the ORNL cafeteria operator.
- Evaluating and implementing recycling of any new material streams identified, such as cardboard at off-site facilities and polystyrene packaging.

# 5.2 Construction and Demolition Materials and Debris

**DOE Goal:** Divert at least 50% of construction and demolition materials and debris by FY 2015.

## Performance Status

ORNL's diversion rate for C&D debris has consistently exceeded the 50% goal, with the exception of FY 2013. Annual progress is captured in Figure 15.

- FY 2010—86%
- FY 2011—62%
- FY 2012—79%
- FY 2013—39%
- FY 2014—70%

In recognition of cost savings opportunities, certain wastes were disposed as C&D debris rather than low-level radioactive waste as a result of efforts to extensively characterize wastes from demolition activities that would have otherwise been sent off the site for costly disposal as low-level radioactive waste. This effort allowed ORNL to determine that these wastes could be sent to the on-site landfills, which reduced waste management costs but also prevented the laboratory diversion rate from being higher. In FY 2014, 340 cubic yards of asphalt millings were recycled for the Central Avenue paving project.

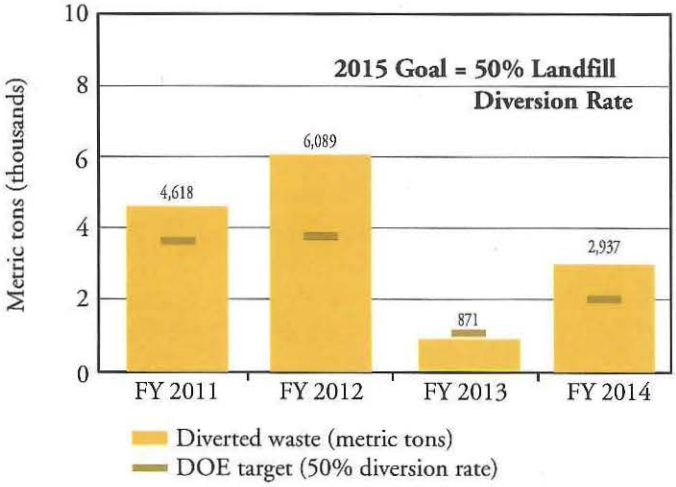



**Figure 15. ORNL construction and demolition waste diversion.**

## Plans and Projected Performance

ORNL will continue efforts to divert C&D wastes such as the following.

- Effective contract language has been developed that requires construction contractors to recycle as much C&D debris as possible and report the recycled amounts. That language will continue to be included in contracted construction projects.
- Building on the successful C&D recycling for construction contracts, ORNL expanded a C&D collection program started

in FY 2011 for remodeling debris from activities in existing facilities. A vendor and storage location are used for recycling wallboard, rubble, wood, ceiling tiles, and metal. The collection of remodeling debris will continue and be expanded across the facility.

- Internal NEPA reviews are conducted for most projects performed at ORNL. These reviews promote discussion with project engineers to plan for the reuse of soils, concrete, asphalt, and other C&D materials. The P2 program team will continue to provide input on these reviews.
- Project managers and engineers include recycling opportunities in the project planning process, ensuring cost-effective diversion results.

## Additional Qualitative Components within Goal 5

In addition to the quantitative components discussed in Sections 5.1 and 5.2, Goal 5 includes qualitative components. These qualitative components address a variety of areas, including the anticipated impact of population change; continuing construction, decontamination, and decommissioning activities; and changing laboratory research initiatives and priorities. These variables will continue to have a strong impact on recycling and waste generation rates and volumes. These and other elements, such as the following, will continue to be addressed.

- Waste generation is intimately associated with the number of people on the site and funding levels. Waste generation can also fluctuate with changes in research and development missions. For example, ORNL saw record amounts of waste generation associated with *American Recovery and Reinvestment Act* funded building demolitions.
- ORNL continues to experience an increase in retirees due to incentive programs, resulting in the one-time generation of waste from office cleanout by the retirees.
- To address ever-changing needs, ORNL has focused on putting systems in place to promote sustainability. The integration of sustainable operations is addressed in the ORNL laboratory agenda, budget planning guidance, internal procedures, and procurement evaluations. ORNL will continue to look for focused opportunities for waste stream reductions but will also concentrate on the more sustainable practice of source elimination.
- ORNL does not currently have a waste-to-energy system. Organizations that invest in these systems often improve their sustainable operation goals.
- During the past 4 years, the Information Technologies Services Division (ITSD) has piloted and implemented an updated printer management approach to maximize network printing and duplex printing as well as to minimize the costs of the operation and maintenance of printers across the Lab. Organization level assessments are performed to ensure printing needs are met, and starting in FY 2015, to increase the use of recycled content paper, where there is still room for improvement. The P2 Program has and will also continue to work with Procurement to increase the use of recycled content paper. In FY 2014, in addition to these assessments, new print servers and print management software were installed and used in conjunction with new standard printers. Furthermore, the print contract has consolidated and updated existing multi-function printer/copier devices onto the new print server and manages defaults for duplex and monochrome printing to further reduce paper usage and print costs.
- ORNL is increasing the use of acceptable nontoxic or less-toxic alternative chemicals and processes while minimizing the acquisition of hazardous chemicals and materials. An operational assessment of chemicals reviewed the acquisition, distribution, storage, use, and reallocation and disposition of chemicals. The Chemical and Materials Science Building (building 4100) was designed to facilitate optimal chemical inventory management, chemical use, and sharing. The Chemical Management Center promotes the transfer of excess materials to new users, and the procurement pathway is designed to promote internal acquisition/exchange before purchase. For instance, during FY 2014, biobased oil was included as part of an elevator cylinder replacement project.
- ORNL implemented an integrated pest management program that includes both interior and exterior strategies for the entire Oak Ridge Reservation. Practices include environmental controls such as ensuring all cracks and holes are sealed to minimize pathways for pests to enter a building and educating building occupants as to the importance of good housekeeping regarding food storage, waste collection, and plant maintenance. The goal is to reduce the exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological, and particulate contaminants that adversely affect air quality, human health, building finishes, building systems, and the environment while controlling potential infestations of insects, rodents, fungi, and invasive plant species.
- ORNL continues to demonstrate its commitment to programs that enhance the physical environment through its landscape management practices, which include (1) planning based on sustainable principles in the *Sustainable Landscapes Initiative 2020*, (2) identification of ecologically important areas in the ORNL vicinity per the *2010 ORNL Campus Master Plan*, a roadmap for the next 20 years; and (3) working with potential mitigation area planning.
- ORNL P2 staff participated in a team review of site property management procedures in FY 2013. As a result, ORNL has increased staff awareness of what materials can be sold and has expedited the process of reducing the amount of materials subject to both recycling and waste deposition. In FY 2014, a comprehensive review of site property management and sales was initiated.
- The ORNL P2 program continues to prioritize minimization of the generation of waste and pollutants through source reduction. Avoiding waste generation will be given precedence over recycling or reuse even if it appears to be a detriment to recycling/diversion goals. For example, two years ago ORNL eliminated the purchase of bottled water except for instances in which staff members do not have access to plumbed water. In FY 2014 ORNL saw a reduction in plastic recycling compared to FY 2013, which can be at least partially attributed to this source reduction effort. The avoidance of generating plastic bottles is the preferred outcome from both a waste and a cost perspective.

# Goal 6: Sustainable Acquisition

## 6.1 Sustainable Acquisitions and Procurements

**DOE Goal:** Procurements meet requirements by including necessary provisions and clauses in (sustainable procurements/ biobased procurements). (DOE Goal: 95% of applicable contracts.)

### Performance Status

ORNL has made significant progress in its efforts to ensure that 95% of all new contracts, including nonexempt contract modifications, require products and services that are energy-efficient, water-efficient, biobased, environmentally preferable, non-ozone-depleting, and nontoxic or less-toxic alternatives and contain recycled content.

- Standard contract terms and conditions, which are made part of all procurement actions for commercial items and services, invoke the pertinent Federal Acquisition Regulation (FAR) contractual requirements for energy, efficiency, and sustainability. Those clauses were included in 100% of the following FY 2014 subcontract actions:
- 22,402 unique subcontracts, purchase orders, and task orders and 57,604 purchase issues against blanket ordering agreements, all of which meet the DOE procurement requirements.
- Terms and conditions issued with blanket ordering agreements not only contain all FAR provisions, but also include additional requirements for promoting and providing environmentally preferable products.
- The Contracts Division includes subcontract language with key commodity suppliers requiring that they provide detailed reports on the purchases of ENERGY STAR– and Electronic Product Environmental Assessment Tool– (EPEAT)–designated electronics products.
- Simplified procurements of minor purchases made using an authorized purchasing card (P-Card) are exempt from provisions related to sustainable acquisition. During FY 2014 there were 28,694 P-Card transactions.
- To reduce use of paper and printer ink, UT-Battelle's Contracts Division established an electronic file initiative, converting all active hardcopy subcontracts to an electronic database. All new subcontracts awarded after October 1, 2012, are maintained electronically.

### Plans and Projected Performance

As standard practice to ensure continued compliance with the DOE goals, ORNL Procurement will include clauses and provisions that stipulate environmentally preferable purchasing requirements in all applicable purchase orders, subcontracts, and task order actions issued in the future. All material releases against blanket ordering agreements will continue to be governed by the provisions included in the standard terms and conditions, also ensuring compliance with goals.

# Goal 7: Electronic Stewardship and Data Centers

## 7.1 Core Data Centers Performance Indicators

**DOE Goal:** All core data centers are metered to measure a monthly PUE of 100% by FY 2015 (FY 2014 target: 90%).

### Performance Status

The electrical distribution systems for all ORNL data centers are metered and captured with significant fidelity, allowing measurement of monthly power utilization effectiveness (PUE), completing the goal. ORNL continues to examine methods and mechanisms that can further reduce energy use, maximize efficiency, and minimize the cost of operations in our data centers. As the data centers change to support the needs of new systems at the leading edge of computing technologies, sustainability efforts continue to help dramatically reduce the energy footprint required to perform great science.

1. **Electrical.** ORNL uses power strips that capture amperage, humidity, and temperature. In the Computational Science Building (CSB), the lighting control system is operating as desired. Past electrical efficiency considerations include the following.
   - Step-down transformers from 13,800 VAC to 480 VAC are located immediately adjacent to the main switchboards, significantly reducing installation costs and operating voltage losses.

- Supercomputers use higher efficiency 480 VAC direct-wired connections, eliminating the need for additional step-down transformers.
- PDUs delivering 208 VAC power are designed to deliver diverse-path electrical service for storage and other infrastructure.
- Use of high efficiency rotary UPS systems.

2. **Mechanical Chiller Plant.** ORNL continues to improve chiller operations to maximize system efficiency, reliability, and resiliency. ORNL is examining near-term methods for optimizing control schemes for the chilled and condenser water systems by running the right equipment in the right way. Modifications being investigated for future implementation include controlling flow through both the evaporator and condenser of the chillers, modifying condenser water flow control to be changed based on refrigerant differential pressure, and allowing condenser water temperatures to modulate lower than current thresholds. It is also desired to modify chiller plant staging to base load specific chillers to allow the chillers to operate at more efficient points. A study will be done to determine the best strategic method to control multiple variable-primary chilled water plants. Based on the fact that we have both constant speed chillers and chillers with variable frequency drives (VFDs), additional energy savings may be possible. Past chiller plant improvements include the following.
   - Converted plant from primary/secondary to variable/primary.
   - Chilled water pumps and cooling tower fans have VFDs.
   - Installed flow limiters to increase temperature differential on chillers.
3. **Mechanical Data Center.** ORNL's data center air flow management continues to improve. The CSB data center uses cold aisle containment systems (CACS) with in-row coolers. This method of cooling minimizes fan energy, allows increased supply air temperatures, and increases the return air temperatures. Rack density in this data center is expected to be 220% more than its predecessor. This consolidation process saves costly facility square footage. The in-row coolers are expected to save 53% of the fan energy, as well, compared with our baseline. Operationally, outages can be taken on a per-CACS basis, limiting the number of data center customers affected by an outage. Environmental conditions within each CACS can be set based on the needs of the individual CACS rather than the needs of the entire data center. ORNL plans to implement reliability improvements which will also impact energy consumption in the data centers. This effort will consist of adding logic to the BAS so that it alarms on conditions reflecting the performance of the cooling equipment. New systems control humidity based on dew point, and the units are networked so they do not fight one another. Relative humidity ranges have been expanded to the extent of those recommended by ASHRAE. A newly formed Data Center Council meets regularly to develop strategic and master plans for ongoing operations and to control modifications to the data centers. Following an established master plan we will continue to push new CACS in the direction of cooling in zones with "right-sized" cooling equipment. In building 5600 E102 Data Center, a study has been initiated to determine if any computer room units (CRU) can be put into standby mode to save fan energy of 1-4 CRUs. Results will be implemented late this year. Past air flow improvements include the following.
   - All data centers are arranged into hot and cold aisles.
   - Floor penetrations outside the cold aisles are sealed.
   - Cabinets with good internal air flow are used.
   - Blanking panels are used in the racks.
   - Perimeter CRUs use supply air controls where possible.
   - CACSs continue to be implemented in E102 where possible and are the standard equipment in CSB.
   - Electronic fans or VFDs are used in all data center air handlers.
   - CRUs are put in standby rotation where N+1 is available, with the standby unit automatically started if needed.
   - Centralized humidity sensors were added to limit CRUs fighting one another while trying to control humidity.
   - Night setback is implemented on the pressurization and fresh air supply in all data centers.
   - Reheat was disabled in variable-air-volume boxes supplying the data centers.
   - CRU sensors were calibrated, and password protection enables restriction of setpoint changes.
   - Filtering was reduced on CRUs to reduce pressure drops.
   - Where applicable, backflow dampers were added to prevent air from short-circuiting in data centers with perimeter-based cooling.

## Plans and Projected Performance

**Electrical.** For all new installations, metered power strips are part of the standard installation, and all current equipment is being retrofitted with the standard meters as budgets allow. This is an educational effort, as it gives the research community insight into the energy consumption of their systems, and the data gathered are readily available.

**Mechanical.** ORNL continues to examine the process for and impact of increased chilled water supply temperatures for future HPC systems, an advance that holds the potential for energy savings. The elevation of chilled water supply temperatures must incorporate the humidification control requirements within the data centers, but could still allow an increase in the chilled water supply temperature of approximately 10 degrees Fahrenheit. A study will be performed to analyze the impacts of elevating the chilled water supply temperature to help determine what is possible. Future HPC systems are expected to use less chilled water as their loads shift to waterside economizers due to favorable (warmer) inlet temperatures. As part of the Reliability and Maintainability Program's continuous improvement agenda, plans are to hold equipment performance optimization sessions to identify performance indicators and alarm thresholds that can be implemented immediately, as well as indicators that are desired. This effort is to improve reliability, but it will also impact the efficiency of the operating systems. Inside the CSB data center, we plan to methodically

increase the supply air temperatures in one area of CSB that contains most of the CACSs. We will also implement performance indicators to bring potential issues to light as early as possible.

A representative with intimate knowledge of the data center's infrastructure has been selected to receive the Data Center Energy Practitioner (DCEP) Generalist and Specialist training in November 2014.

## 7.2 Annual Weighted Power Utilization Effectiveness Goals

**DOE Goal:** Core data centers maximum annual weighted average PUE of 1.4 by FY 2015 (2014 target: 1.5).

### Performance Status

The FY 2014 PUE for ORNL's CSB data center is calculated at 1.27 which exceeds the DOE goal. ORNL has been metering power use at most of its facilities for several years. During July 2009 the calculated PUE averaged 1.336. Since that time, cooling, electrical distribution, and power metering improvements have been implemented. As planned, an automated real-time PUE calculation for all data centers was installed in 2014. With improvements in the data center metering program, our ability to provide monthly and annual PUE calculations will continue to progress toward the FY 2015 goals as the final reporting plan is developed.

Chilled water is supplied for HVAC and the data center from multiple chiller plants. Accurate PUE calculation, therefore, requires metering of water flow and temperature at several different locations to determine cooling. Further integration of BAS and CEDS is needed to calculate proportions of flow, a measurement required for a more accurate PUE calculation.

### Plans and Projected Performance

Plans for FY 2015 are to address longer term solutions including the following considerations in reference to servers and equipment.

The selection of equipment used within a data center is crucial to the level of energy consumption at a location. The changes that can be made to reduce energy consumption range from purchasing the most efficient and modern equipment to simply configuring existing equipment differently within the data center. Thus comprehensive knowledge of best practices encompassing policies and technologies is the best means toward the reduction of data center energy use. In the 2013 SSP ORNL proposed to study and implement best practices as they relate to servers and associated equipment. Most of the air-cooled information technology (IT) equipment in the data center with the highest PUE will be consolidated into a new data center that has implemented industry best practices. This effort will improve ORNL's average PUE. Previously recorded PUE data suggest ORNL is already ahead of the PUE goal for 2015, but we have internal goals for even better continuous improvements. ORNL has set a goal of PUEs in the 1.10 to 1.15 range for its future HPC systems. Current upgrades to the HPC systems have resulted in great improvements in the amount of computing per kilowatt (a 3–4 times increase). Table 7 lists potential savings by project.

**Table 7. Potential savings identified by project**

| Project Description | Savings |
|---|---|
| Optimized chilled water system control | 3,816,000 kWh and 2,223,000 gal water |
| Data center air management | 60,000 kWh per year |

One potential barrier to improving ORNL's PUE is obtaining the funding needed for lake water cooling. This could be critical for future HPC systems that will be brought online in the coming years.

## 7.3 Power Management of Electronic Equipment

**DOE Goal:** 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012.

### Performance Status

ORNL has successfully met the electronic stewardship goal of power managing 100% of the eligible personal computers, laptop computers, and monitors in use by laboratory staff since 2009. The progression of power management electricity savings is shown in Figure 16. In FY 2015, the ORNL IT Services Division (ITSD) plans to upgrade the Lab device power management software to provide security enhancements, improved reporting, and easy to use power management functionality to devices that were previously exempt such as Macintosh computers and on-network laptops.

The following Green IT policies and procedures are still in active use at ORNL.

- ORNL IT offers standard computer hardware through three vendors on Marketplace, the ORNL online order entry system. The vendors are required to sell only EPEAT certified computers, monitors, and laptops. Exceptions must be approved by senior management.

- All ORNL Windows computers including servers, desktops and laptops are required to have a secure screen saver (password required) with a timeout setting between 1 to 15 minutes. Windows Screensaver configuration settings are enforced by System Center Configuration Manager, which is managed by ITSD.
- All ORNL Mac systems (except those with an exception) are required to have a password protected screensaver with an inactivity timeout between 1 and 20 minutes (the GUI only allows users to select 10 minute intervals). Settings are checked (and changed if necessary) every 12 hours by CFEngine.
- Linux screensaver settings vary based on operating system version and desktop environment. Because of the large number of configurations and the lack of centrally configurable policies for some desktop environments, screen-savers on this platform are managed on a best-effort basis.
- All windows desktops are required to be power managed. The ORNL power management tool collects power use data on all laptops but is not used for managing power. Laptop power management is performed within the operating system by the user. Devices registered as instruments or servers are excluded from power management.
- Where possible, duplex printing is set as default on all print queues managed by ORNL IT.

IT sustainability efforts at ORNL now provide a shared network printer services model to help reduce paper, toner, and power consumption. Older network printers and small desktop printers are in the process of being retired in favor of fewer centralized printers for organizations that adopt the new services model.

The shared network printer services model is helping to standardize equipment, reduce energy consumption, reduce landfill waste, reduce cost of operations, improve printing services in general, and provide more efficient use of consumable products. Currently, printer use assessments are being conducted for each organization to determine what suggested changes can be made to reduce printer hardware. Over time, ORNL plans to shrink the printer equipment footprint and save essential overhead costs by reducing toner purchases, support costs, and power demands.

## Plans and Projected Performance

ORNL's Green IT sustainable campus roadmap for FY 2015 includes the following.

- Continued implementation of shared printer services across the laboratory.
- A marketing and communication campaign that encourages greater use of ORNL network printing.
- Upgrade of the ORNL power management software to support Macintosh power management and improved laptop provisioning.

While we expect to remain fully compliant with the power management goal, of 100% of eligible equipment, it is possible that restricted budgets could interfere with the necessary labor, materials, and/or software needed to achieve sustainability goals.

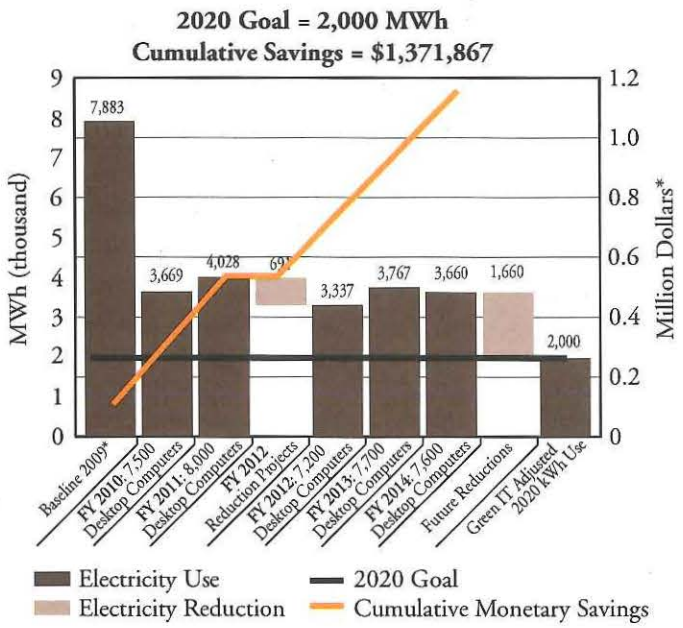



**Figure 16. ORNL electricity and cost savings from power management.**

# 7.4 Electronic Stewardship

**DOE Goal:** 95% of eligible electronic acquisitions meet EPEAT standards.

## Performance Status

In FY 2014, ORNL continued to move toward widespread adoption of desktop, application, and server virtualization technologies. ITSD in partnership with the Acquisition Management Services (AMS) Division completed a virtual desktop pilot in which thin clients were used as replacements for traditional personal computers. The thin clients are more energy efficient than a traditional computer. As a result of the success of the pilot program, AMS has committed to moving the pilot program into operational status. A successful pilot within ITSD resulted in the expansion of the thin client program to include ITSD-managed public conference rooms and the summer intern loaner program. Both of these programs have moved into operational status.

ORNL continues to expand the use of virtual servers as part of the IT enterprise infrastructure and can now report that more than 85% of the servers supporting the enterprise reside on virtual hosts. The move to virtual hosts promotes reduced energy consumption and smaller hardware footprints.

ORNL IT continues to offer standard computing hardware through its Managed Hardware Program (MHP). MHP vendors are required to sell EPEAT-certified computers, monitors and laptops. ORNL staff that have needs outside MHP are required to complete a nonstandard request that is reviewed by ITSD for compliance, EPEAT, cyber security, and system configuration requirements. ORNL continues to exceed 95% compliance with EPEAT standards for computers, monitors, and laptop purchases.

### Plans and Projected Performance

ORNL's Green IT sustainable campus roadmap for FY 2015 includes the following.

- ORNL will continue to work to expand its use of zero client computers and virtual desktops into FY 2015.
- ORNL will continue to closely monitor requests for nonstandard (i.e., non-EPEAT) computers, monitors, and laptops.

# Goal 8: Renewable Energy

## 8.1 Renewable Energy Performance

**DOE Goal:** 20% of annual electricity consumption from renewable sources by FY 2020 and thereafter (FY 2014 Goal: 7.5%).

*Bethel Valley Road photovotaic array.*

ORNL plans and actions are moving toward achievement of the DOE O 436.1 goal of providing 7.5% of the site's electrical consumption from renewable sources by FY 2014 and 20% by FY 2020 and beyond. Until recently, renewable energy (RE) was generated primarily by small research-oriented PV systems. A 5 kW PV array was brought online in early FY 2008, and a 50 kW PV array began providing electricity in FY 2009. A 47 kW PV array for the parking canopy went online in FY 2011 and can also be used to offset the power used for 25 EV charging stations. A smaller rooftop PV array (30 kW) at building 4100 also contributes to ORNL's on-site RE generation capabilities.

### Performance Status

Currently, ORNL has identified multiple sources of RE to offset the site total electrical consumption of 589,335 MWh, including the following.

- 102.7 MWh of electricity produced on site from the four solar arrays account for approximately 0.035% of ORNL electricity, which includes the double bonus allowed for on-site generation at federal facilities. Associated RECs are retained for use by the site.
- ORNL participated in the TVA Southeastern REC pilot by purchasing 6,000 MWh of renewable energy in FY 2014.
- ORNL purchased 47,513 MWh of RECs from wind resources in 2014.
- Total RE (production plus all RECs) of 53,718 MWh exceeds the 7.5% FY 2014 goal at 9%.

As an additional benefit of meeting the RE goals, energy generated from approved renewable sources—either generated on-site or purchased from off-site vendors—can be allocated to new or significantly renovated buildings to assist in achieving LEED certifications for the rating desired. This approach will ensure that new buildings and major renovations maintain their dedicated renewable resource in case future funding is limited and would not permit a laboratorywide REC purchase.

### Plans and Projected Performance

Because of the high cost of on-site RE projects, the search for renewable production is challenging. The following strategies have been mapped to meet the annual progression toward the 20% goal by FY 2020.

- RECs—ORNL will periodically monitor the REC open market and consider purchases as they are needed to meet the renewable goal.
  - ORNL will use multiple purchases throughout the year based on energy consumption projections and REC pricing to allow strategic purchasing of RECs to best fit the interim target 10% goal for FY 2015 and may use annual incremental increases to achieve the 20% goal for FY 2020.
  - RECs are likely to be considered in the short term until a cost-effective, feasible solution for on-site electrical generation can be developed and implemented. ORNL's primary strategy is to develop on-site capabilities before considering other options.

- As an extra benefit, REC purchases can also help to offset Scope 2 emissions and are counted toward Scope 2 GHG reduction goals.
- It is anticipated that the growing demand for RECs in general, and specifically the demand for REC projects that have been online for less than 10 years, will drive an open market price increase for RECs. Additional purchasing strategies will be considered to determine the best value for future purchases, including potential purchases from federally recognized Indian tribes.

- Renewable methane—ORNL has investigated the use of renewable methane as a means of meeting RE goals and has a strategy that can be implemented with limited capital investment. Working with ORNL's natural gas broker, it is possible to purchase renewable natural gas via pipeline delivery for use in reciprocating or turbine generators. ORNL has performed careful financial analyses and found this to be the best non-REC method of meeting its RE goals. The opportunities have been discussed with the ORNL Leadership Team.
- SMR—ORNL is supporting a strong regional commitment to clean energy, facilitated by the potential construction of an SMR that could be built by TVA with prospective financial support (possibly clean energy certificates) provided by DOE, ORO, and/or ORNL.
  - In December 2012, DOE announced a 5-year cost sharing agreement with a team lead by Babcock & Wilcox aimed at promoting SMR clean energy technology. It will eventually lead to construction of an SMR on a site in Oak Ridge on former ORO land. The DOE investment will help the design vendor obtain Nuclear Regulatory Commission licensing and achieve commercial operation with a target year of 2022, helping provide TVA with low-carbon energy options. Although this project is beyond the 2020 goal period, it demonstrates an overall commitment to reducing GHG emissions into the future.

# Goal 9: Climate Change Resilience

## 9.1 Climate Change Resilience

### Objective 1: DOE Climate Change Adaptation Screening Assessment

In the summer of 2014, ORNL management and SCI team members volunteered to provide input to and act as reviewers for the initial survey questions developed by DOE for the Climate Change Adaptation Screening Assessment Survey. ORNL will complete and submit the voluntary screening assessment survey by December 8, 2014. Before final submission of the site-level survey, appropriate operations and emergency experts will be consulted to ensure the accuracy of the answers to the assessment questions.

### Objective 2: Determining Risk

In FY 2014, an ORNL Climate Change Resiliency (CCR) team was chartered. It includes representatives from F&O and research programs to ensure continued collaboration and focus on this topic between operations and scientific research staff. Included on the team are F&O senior management, site strategic planning, environmental management, natural resources, SCI, and the deputy director for the Climate Change Science Institute at ORNL. The CCR team held multiple extensive work sessions during the year to review climate change risk elements and event categories and their potential impacts on the ORNL mission and operations in light of our specific geographic location.

For example, the 2014 National Climate Assessment report, *Climate Change Impacts for the United States*, locates ORNL in the southeast region. One of the major vulnerabilities for the Southeast as a whole is that the rise in sea levels poses continuing threats to both natural and manmade environments. However, this specific threat is not a high-risk probability for ORNL operations because of ORNL's protected inland location and valley-and-ridge topography. Therefore, sea level changes are not a high-priority risk for ORNL, and impacts from this threat are considered a very low probability.

Appendix C, page 39, contains the detailed draft ORNL Climate Change Resilience Risk Table. The CCR team will update the table as the program continues to develop.

### Objective 3: Current Activities

In conjunction with the ORNL CCR team meetings that worked to determine the risks in Objective 2, ORNL is undertaking activities that seek to address climate events that could impact critical missions, operations, and personnel. Care is being taken to increase awareness of climate change issues in programs responsible for facility operations, emergency planning and response, environmental protection, and natural resource management. ORNL is working to identify systems and programs that may need to be enhanced to address applicable risk categories. The CCR team is in the evaluation stage and is considering which policies/procedures need to be added or modified to address the risk elements identified.

In addition to conducting its own internal review, at the request of Battelle Corporate, ORNL served as the lead for assembling a team of recognized sustainability and energy managers to review the DOE climate change resiliency pilot planned at the National Renewable Energy Laboratory (NREL). The review team spent time at NREL evaluating NREL's planned pilot and met with NREL staff, including the outside consultants hired to support the pilot. At the end, the team presented NREL with a summary of comments and recommendations to use in its path forward.

## Objective 4: Future Activities

As a result of establishing the CCR team, ORNL is better positioned to address the need for climate change resiliency elements in all future plans. The team will continue to ensure that the appropriate events and risk elements are considered as part of ORNL programs and planning activities. Policies and procedures will be evaluated to determine whether they should be modified to consider climate risks.

Planning steps for future activities include the following.

- Continue to develop knowledge of the impacts of climate change risks and their effects on ORNL.
- Apply this knowledge to missions and operations.
- Develop and prioritize actions based on site-specific risks and threats.
- Build awareness and improve skills to respond to potential events.

## Objective 5: Real Property and Supply Chain Resilience

The incorporation of Objectives 2, 3, and 4 into ORNL policies and procedures will ensure that climate change adaptation and resilience objectives are included in procurement, acquisition, real property, and/or leasing decisions.

## Objective 6: Regional and Local Coordination

ORNL has numerous agreements in place with state, local counties, communities, and regional agencies to address emergency response and preparedness. These include the Tennessee Department of Environment and Conservation, the City of Oak Ridge and Roane County fire departments, emergency medical services, and first responders.

## Objective 7: Removing and Reforming Barriers

No high-level or critical barriers were identified as part of the initial climate change risk assessment. However, the following are "Medium Risk" actions that the ORNL CCR Team will pursue.

**Table 8. ORNL Climate Change Risks and Actions**

| Consequence | Actions |
|---|---|
| Increased cooling costs for buildings and equipment | Review and analyze design standard changes |
| Decreased heating costs | Identify impacts of discharged heat in White Oak Creek through an engineering study |
| Potential flooding from White Oak Creek | Modify flow restrictions in White Oak Creek |
| Increased water damage to buildings, equipment, utilities | Ensure debris is removed from White Oak Creek to reduce overflow into facilities |
| Operational delays due to weather | Ensure pumps are in place |
| Bypassed permits on water limits | Rework emergency plans to include handling "flooding situations"<br>Run sensitivity analysis on all land use and planning variables |
| Increased landscaping costs | Confirm wildfire protection plans are adequate |

# Goal 10: Energy Performance Contracts

## 10.1 Energy Performance Contracts

At ORNL, the ESPC with JCI is the primary mechanism for achieving the goals established to meet the EPACT directives. A delivery order with JCI was awarded in July 2008 and formally accepted in July 2012. The ECMs implemented by the ESPC included steam system decentralization, lighting upgrades, water conservation, building automation system modernization, mechanical equipment upgrades, and steam production improvements. This ESPC is creating opportunities for ORNL to improve its depth of experience in performance contracting and develop an understanding of the most effective utilization of this funding mechanism.

ORNL continues to consider opportunities to leverage alternative financing to make improvements that will aid progress toward sustainability goals. Most recently, ORNL has engaged in informal discussion with TVA regarding its utility energy savings contract program that is open to direct-serve customers like ORNL. At this stage, ORNL is assessing the ECM focus areas to discuss recommendations for next steps with laboratory management.

The perceived complexity of savings calculations and measurement and verification methods is a challenge to the use of performance contracting vehicles. This challenge may be addressed with expanded training and awareness instruction developed for site and agency personnel who are involved with project implementation and performance.

# III. Fleet Management Plan

**To address recommendations in a recent DOE Inspector General audit report, it is important that sites provide summaries of site-level policies and procedures for the management of fleet inventory, to include fuel and vehicle acquisition and fleet inventory optimization.**

ORNL has a total of 439 agency-owned vehicles, and the average age of the fleet is 63 months. A total of 16 vehicles were purchased in FY 2014, consisting of light-, medium-, and heavy-duty vehicles and 2 passenger-carrying vehicles. Thirteen of these acquired vehicles were AFVs, two were B20 compatible vehicles, and one was a plug-in hybrid sedan. There are now two plug-in hybrid sedans in ORNL's 439-vehicle fleet. As of 2014, 85% of the total fleet consists of AFVs. If funding is maintained and vehicle appropriations are granted, ORNL anticipates purchasing 12 to 14 new AFVs each year.

ORNL is required through ORO to meet an annual motor vehicle local-use objective of 94%. ORNL's local-use objectives are summarized in Table 9. Each year, a certain mileage requirement is assigned per vehicle and submitted to DOE ORO Fleet Management in an annual report. If a vehicle does not meet this mileage requirement, a justification is required as to why the vehicle needs to be retained in the fleet. ORNL's mileage use for the past 3 years continues to be at 100%, according to the local-use standard goals (Figure 17).

**Table 9. ORNL local use objectives for FY 2014**

| Vehicle category | Local use goals (Miles required per fiscal year) |
|---|---|
| Small geographical area | 1200 |
| Operations/maintenance | 1500 |
| DOE Site Office | 1200 |
| Buses/taxis | 3000 |
| Special purpose | No mileage standard—justification required |

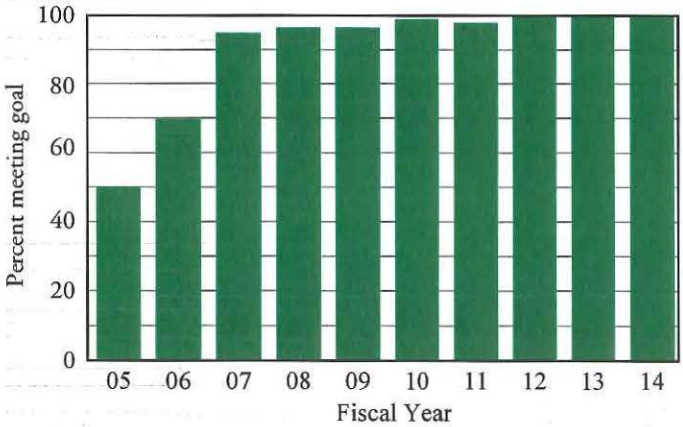



**Figure 17. ORNL vehicle mileage utilization FY 2005 through FY 2014.**

In 2005, the GSA determined that it was not feasible to incorporate the ORNL fleet into GSA's vehicle lease service. At this time, there are no plans to pursue the GSA lease option.

ORNL has no plans to increase or decrease its fleet size during the next fiscal year. In support of the 2012 fleet reduction initiative, ORNL reduced its fleet by 58 vehicles, bringing the total fleet count to 439. All of the 439 vehicles are deemed to be necessary for the safe and cost-effective operation of ORNL facilities and missions and are assigned to critical functions. Additional reductions would impact critical mission elements or the ability to provide for a safe, secure, and environmentally sound work environment on a 50 square mile site with more than 4,500 employees. Figure 18 demonstrates how ORNL has reduced its fleet ceiling and maintained the current ceiling based upon mission criticality.

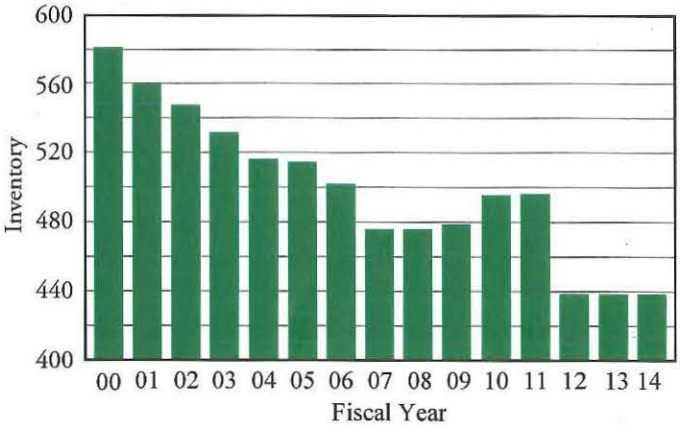



**Figure 18. ORNL vehicle inventory from FY 2000 through FY 2014.**

ORNL has been aggressively and effectively managing its fleet since 2000. It has pursued vehicle reductions; converted to alternative fuels; modernized the fleet; and employed alternative modes of transportation such as taxis, LSVs (electric and biodiesel), a fleet of shared bicycles, and convenient walking paths.

# IV. Funding

ORNL assesses the environmental, economic, and social benefits of proposed activities on an individual, project-specific basis. Through the Mission Readiness process, ORNL determines the ability of its facilities and infrastructure to accomplish mission objectives now and in the future. Projects are identified to further the safe, compliant, efficient accomplishment of mission objectives, including sustainable operations. Funding sources for projects are evaluated and established considering all available and appropriate funding venues, including private sector financing, cost sharing, institutional investment, and programmatic appropriations. Allocation of funds is based on multiple considerations, including mission impact, sustainability, and return on investment.

ORNL's SCI managed 25 dynamic roadmaps in FY 2014 all at varying stages of implementation. Each roadmap has specific fiscal year deliverables that are kept on schedule through regular review meetings held between individual roadmap owners and the SCI leadership. In addition, the F&O director, an SCI sponsor, has made success on these roadmaps a part of the directorate's performance plan. All roadmaps are also reviewed with the SCI sponsors (from the ORNL SCI Leadership Team) on a quarterly basis. This scheduled review also provides a forum for presenting present new roadmap proposals developed by ORNL staff.

Opportunities for ECMs are routinely considered and are screened by facility managers and engineers before being selected. In addition to technical and energy savings feasibility, each project is analyzed in terms of financial return. Most of the projects considered good candidates for ECMs have a financial payback estimate of less than 2 years. Table 10 shows funding for actual and planned projects.

**Table 10. Funding for actual and planned sustainability projects**

| ORNL summary of sustainability project funding ($K) | | | | |
|---|---|---|---|---|
| **Category** | **FY 14 Actual** | **FY 15 Planned** | **FY 15 Projected** | **FY 16 Projected** |
| ESPC contract payments | $ 7,146 | $ 5,397 | $ 5,397 | $ 9,702 |
| Renewable energy credits (RECs) purchases | $ 69 | $ 102 | $ 102 | $ 118 |
| ECM (Energy/water efficiency) | $ 1,728 | $ 1,800 | $ 1,800 | $ 1,900 |
| Sustainable Campus Initiative | $ 641 | $ 641 | $ 641 | $ 800 |
| **Total** | **$ 9,584** | **$7,940** | **$7,940** | **$12,520** |

# V. Electrical Energy and Utility Cost Projections and HEMSF

ORNL's utility services include electrical power, steam, chilled water, and potable/process water to support ORNL's mission and the research community. Electrical services include basic power needs, as well as chilled water service and direct cooling applications. Steam is generated from a combination of fuel oil and natural gas. Natural gas and fuel oil are also used in direct heating applications. Potable water usage supports mission critical process applications as well as domestic water use including restrooms and drinking water.

## Utility Usage

Electricity is the largest energy commodity for ORNL, at 71% of the total energy consumption (in million Btu; see Figure 19). Electrical services dominate ORNL's energy, in part because of HEMSF operations. In FY 2014, the HEMSF buildings consumed 72% of ORNL's electrical energy; and current projections show an increase to 79% by the FY 2020 target/goal year. HEMSF buildings currently consume 50% of all ORNL water, and that number is expected to rise to 59% by FY 2020.

The Biomass Gasification Steam System was not operational in 2014, so steam was generated from dual-fuel boilers (natural gas and fuel oil). Natural gas is also used for the Melton Valley Steam Plant, SNS, and other direct heating/research applications for a total of 27% of energy consumption. Fuel oil was used for steam generation during curtailment and maintenance periods, as well as direct heating applications and emergency generator services for a total of 2% of the energy consumed.

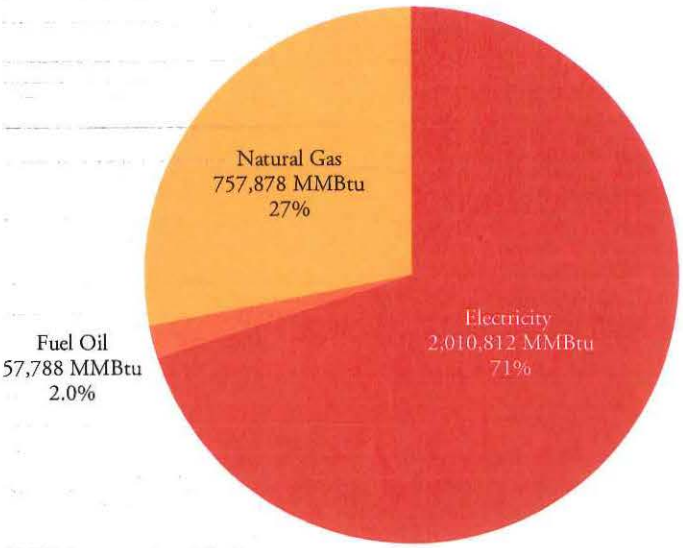



**Figure 19. FY 2014 utility energy consumption and percentages.**

## Utility Costs

As electricity is by far ORNL's largest purchased energy source, it is also the most costly at $34,863,617 in FY 2014 (Figure 20). ORNL uses the TVA seasonal manufacturing rate for the best value based on its high and consistent demand load. SNS uses TVA's seasonal time-of-use rate to take advantage of process cycles and scheduling within the rate structure.

Natural gas and fuel oil follow electricity, with respective costs of $3,692,580 and $1,320,440. Water is the next largest purchased commodity at $1,104,322 in FY 2014.

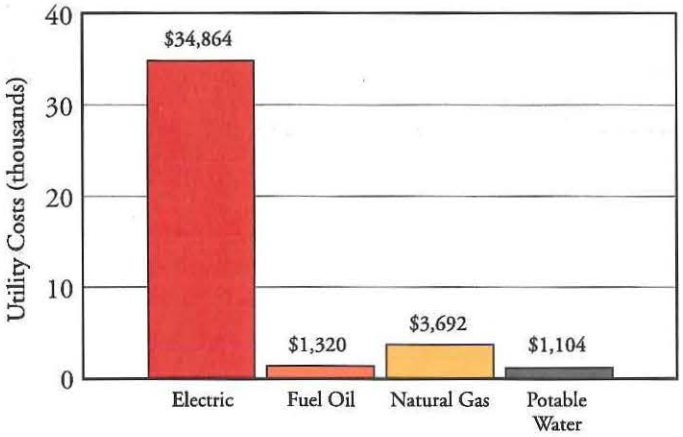



**Figure 20. ORNL utility costs for FY 2014.**

## Electrical Cost Projections

TVA rate structures include basic rate components for demand and energy. An increase in the basic structure will occur in FY 2015, which will increase the overall effective rate. However, a major factor in the overall rate is the total fuel cost, a variable that accounts for the fuel mix TVA uses to generate power and changes each month with respect to the fuel mix consumed.

TVA periodically issues a basic rate structure increase, but it is also strongly affected by the actual total fuel cost. TVA strives to provide competitive electrical rates and to improve its fuel mix for positive economic and environmental benefits to its customers.

Figure 21 includes anticipated TVA rate increases and indicates a strong growth in electrical consumption for HEMSF through FY 2020.

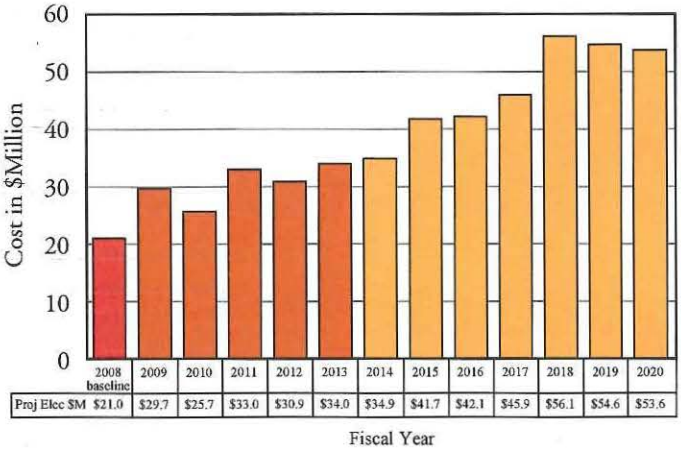



**Figure 21. ORNL projected electrical energy cost.**

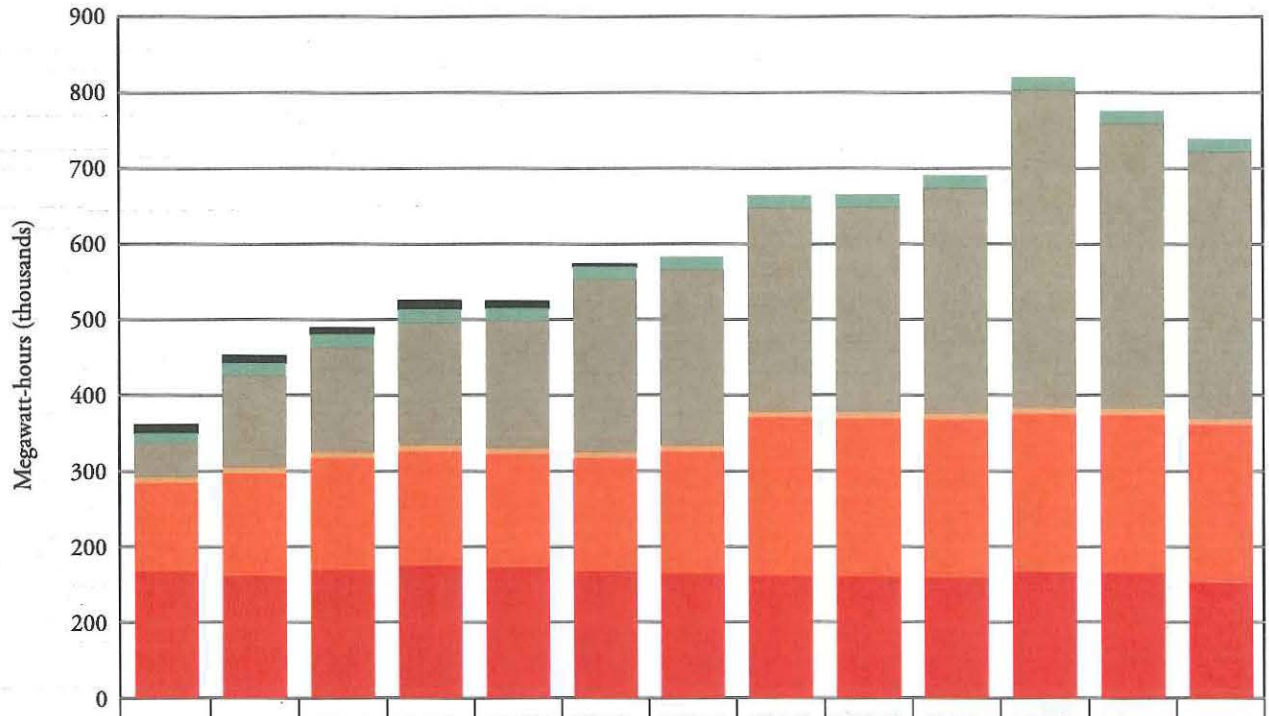
## High Energy Mission Specific Facilities

ORNL has defined four facilities as HEMSF. These facilities use a substantial portion of ORNL's total electrical power. In the DOE goal baseline year of FY 2008, they consumed 194,751 MWh, more than half of all ORNL power consumption. By the GHG reduction target year of FY 2020, ORNL's HEMSF are projected to use 588,789 MWh, accounting for about 79% of all power consumed on the site.

Figure 22 illustrates the historical and projected power consumption for ORNL's HEMSFs, all of which are designated as excluded facilities in the DOE FIMS database. The following is a list of ORNL HEMSF with definitions; a brief narrative describing each facility is included in this section. In FY 2014 the Holifield accelerator, known as HRIBF, was removed from the HEMSF inventory due to a major reduction in mission.

**Identification of ORNL HEMSFs:**

| | | |
|---|---|---|
| HFIR | High Flux Isotope Reactor | Fission reactor |
| HPC | User Facilities | High performance computing |
| SNS | Spallation Neutron Source | Accelerator |
| CNMS | Center for Nanophase Materials Sciences | Nanoscience facility |
| Base Site Usage | Power usage in addition to that of HEMSFs | Offices/labs/support |



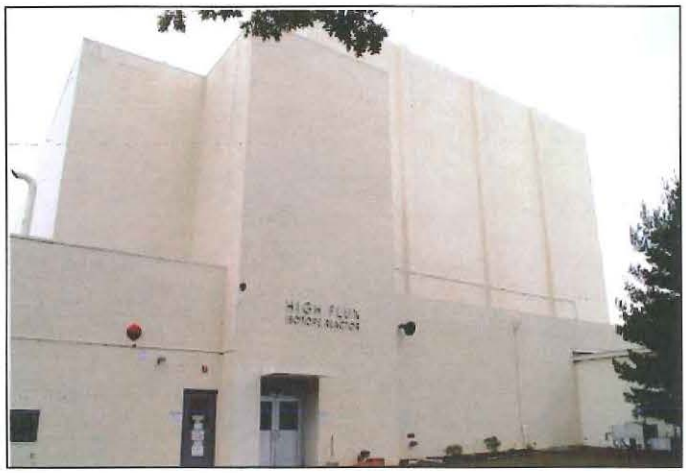

| | FY 2008 | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | FY 2018 | FY 2019 | FY 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HRIBF | 10,582 | 9,212 | 7,620 | 10,955 | 8,780 | 3,238 | - | - | - | - | - | - | - |
| HFIR | 13,557 | 17,611 | 18,298 | 18,700 | 17,233 | 17,102 | 17,546 | 17,546 | 17,546 | 17,546 | 17,546 | 17,546 | 17,546 |
| HPC | 45,586 | 121,470 | 138,293 | 161,465 | 168,460 | 228,694 | 232,936 | 269,434 | 272,156 | 298,919 | 420,771 | 377,660 | 353,727 |
| CNMS | 8,147 | 8,311 | 8,075 | 8,828 | 8,413 | 8,230 | 8,328 | 8,328 | 8,328 | 8,328 | 8,328 | 8,328 | 8,328 |
| SNS | 116,879 | 135,138 | 148,457 | 151,058 | 149,937 | 149,978 | 161,348 | 209,188 | 209,188 | 209,188 | 209,188 | 209,188 | 209,188 |
| Base Site Usage | 167,274 | 161,437 | 168,902 | 175,049 | 174,359 | 168,589 | 169,444 | 181,052 | 164,993 | 163,701 | 171,390 | 170,082 | 157,190 |

**Figure 22. ORNL HEMSF utility consumption compared with base site usage.**

## Facility Summary and Update on Electrical Projections

Significant growth is projected for the HPC areas. It anticipates a 13% boost in technical power by FY 2020 above FY 2014 power levels, peaking at a 45% increase in FY 2018. Research activities at SNS are also expected to increase in FY 2015 and beyond. ORNL anticipates a 9% increase in campus development in FY 2015, further increasing electrical demand going forward. The new development is expected to be in the form of energy-efficient facilities, and efforts to transition from older, less-efficient facilities will continue in order to optimize campus energy consumption.

### High Flux Isotope Reactor



Operating at 85 MW, HFIR provides one of the highest continuous fluxes of neutrons of any research reactor in the world, and its cold source is the brightest in the world. The neutron scattering research facilities at HFIR include 15 world-class instruments either in operation or planned, including two cold source instruments. The thermal and cold neutrons produced by HFIR allow scientists to study the molecular and magnetic structures and behavior of a variety of materials, including high-temperature superconductors, polymers, metals, and biological samples. These studies are leading to scientific and technical advances in a wide range of fields, such as physics, chemistry, materials science, engineering, and biology. The reactor is also used for isotope production, materials irradiation, and neutron activation analysis.

### Computational Sciences Building

CSB is part of the Oak Ridge Leadership Computing Facility (OLCF) established at ORNL in 2004 with the mission of standing up a supercomputer 100 times more powerful than the leading systems of the day. Since that time, ORNL has more than met that goal, producing a number of supercomputers, each bearing the title "world's fastest computer" in its time. In November 2012, Titan was named the world's fastest computer at 17.59 sustained petaflops—10 times faster than its predecessor. In 2014, Titan remains the second fastest computer in the world on the Top 500 list. Equally important, total energy consumption for Titan increased by only 10%, making Titan the third most efficient computer in the world—and Titan dwarfs the system capability of the two small systems that are slightly more efficient.

As a result, OLCF gives the world's most advanced computational researchers an opportunity to tackle problems that would be unthinkable on other systems. The facility welcomes investigators from universities, government agencies, and industry who are prepared to perform breakthrough research in areas running the gamut of scientific inquiry. Because of its unique resources and capabilities, OLCF focuses on the most ambitious research projects—projects that provide important new knowledge or enable important new technologies and that cannot be accomplished anywhere else.

On November 14, 2014, Dr. Mason joined Energy Secretary Moniz and members of Congress on Capitol Hill for the announcement of DOE's newest supercomputers. Facility improvements will begin early next year in preparation for Summit. The CORAL (Collaboration of Oak Ridge, Argonne and Livermore) project began in 2014, with the three lab working together to develop a path for building the best supercomputing possible as the next step toward exascale computing. ORNL's IBM system will be located in the CSB and is expected to be available to users in 2018. Summit will be at least five times as powerful as Titan while still maintaining a similar carbon footprint as Titan.

**Spallation Neutron Source**

SNS is an accelerator-based neutron source that provides the most intense pulsed neutron beams in the world for scientific research and industrial development. SNS is a versatile scientific tool that gives researchers more detailed snapshots of the smallest samples of physical and biological materials than ever before possible. With resources that will eventually include 25 best-in-class instruments, scientists can count scattered neutrons, measure their energies and the angles at which they scatter, and map their final positions. SNS allows measurements of greater sensitivity, higher speed, higher resolution, and in more complex sample environments than had been possible at the existing neutron facilities. The diverse applications of neutron scattering research are providing opportunities for research on the structure and dynamics of materials in practically every scientific and technical field. In FY 2014, the SNS has delivered a total of 3,800 neutron production hours at 91.5 percent reliability.

**Center for Nanophase Materials Sciences**

The Center for Nanophase Materials Sciences (CNMS), co-located with SNS on the Chestnut Ridge part of the ORNL campus, offers expertise and instrumentation for user research in a broad range of disciplines that address forefront research in nanoscience, nanotechnology, and related phenomena. CNMS integrates nanoscale science with neutron science; synthesis science; and theory, modeling, and simulation. The facility is equipped with a wide range of specialized tools for synthesis, characterization, and fabrication of nanoscale materials and assemblies, including the integration of hard and soft materials.

# A Appendix A

DOE BUILDING EXCLUSION
SELF-CERTIFICATION FORM
FY 2014

FROM: Oak Ridge National Laboratory
Johnny O. Moore, Manager
Oak Ridge National Laboratory Site Office

TO: Sustainability Performance Office

DATE: December 4, 2014

SUBJECT: Self-Certification Form for the Energy Intensity Goal of EISA 2007

Each building or group of buildings excluded under the criteria for a Part G or Part H exclusion is/are metered for energy consumption and their consumption is reported annually.

No buildings have been excluded under Part H. If they had been, then all practicable energy and water conservation measures with a payback of less than 10 years would have been installed. A justification statement explaining why process-dedicated energy in the facility may impact the ability to meet the goal would have been provided in the FIMS Report 063.

I certify that the buildings listed on the Excluded Buildings List produced by FIMS as Report 063 dated 6 November 2014 for Oak Ridge National Laboratory and listed on pages 2 through 5 below meet the exclusion criteria in Guidelines Establishing Criteria for Excluding Buildings published by FEMP on January 27, 2006.

Johnny O. Moore

DOE Site Office Official – printed name

M. L. Broxton for JOM

DOE Site Office Official – signature

December 5, 2014

Date

Contact:
Mary H. Rawlins
Federal Project Director
Phone: (865) 576-4507
eMail: rawlinsmh@ornl.gov

| Name of Building(s) from FIMS data base (Property Name) | FIMS -Property Sequence Number | Part (check one) | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | B | C | D | E | F | G | H | |
| 161 kV Substation | 0901 | | | | | | X | | This is a primary substation for ORNL electrical power. Electrical loss across transformers is inherent in their design. Energy loads are not influenced by conventional building energy conservation measures. |
| Computer Center (part of Multi-Program Research Facility) | 5300 | | | | | | X | | This is a relatively new (2008) high performance computing center in the Multi-Program Research Facility. Energy is required for computational science and other missions, and energy intensity in the data center is 13 times that of standard buildings at ORNL. Significant energy reductions are not practical without affecting mission operations. |
| Computer Center (part of Computational Sciences Building) | 5600 | | | | | | X | | This is a relatively new (2003) modern facility with a high performance computing center. Energy is required for computational sciences research missions (i.e., supercomputing), and energy intensity in the data center is 32 times that of standard buildings at ORNL. Significant energy reductions are not practical without affecting research operations. |
| 161 kW Substation | 7640 | | | | | | X | | This is a primary substation for ORNL electrical power. Electrical loss across transformers is inherent in their design. Energy loads are not influenced by conventional building energy conservation measures. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Waste Processing Facility process buildings, as follows:*** | *See comment at right:* | | | | | | | | The Waste Processing Facility (WPF) buildings listed below make up the process buildings required for transuranic (TRU) waste processing. Energy is required for the operations mission. The facility's energy intensity is about 60% higher that that of standard buildings at ORNL. Significant energy reductions are not practical without affecting TRU waste processing activities. |
| Waste Processing Facility | 7880 | | | | | | X | | --- see WPF comment above --- |
| WPF Control Room | 7880D | | | | | | X | | --- see WPF comment above --- |
| WPF Boiler | 7880E | | | | | | X | | --- see WPF comment above --- |
| WPF Air Compressor | 7880F | | | | | | X | | --- see WPF comment above --- |
| WPF Electrical Equipment Building | 7880G | | | | | | X | | --- see WPF comment above --- |
| Backup Air Compressor | 7880S | | | | | | X | | --- see WPF comment above --- |
| High Flux Isotope Reactor Facility | 7900 | | | | | | X | | The energy is required to support the research mission. The reactor is an 85-MW isotope production and test reactor with the capability of performing a wide variety of irradiation experiments. When operating the energy intensity of the facility is about three times that of a standard building at ORNL. Energy loads are not influenced by conventional building energy conservation measures. Significant energy reductions are not practical without affecting research operations. |
| Center for Nanophase Materials Sciences | 8610 | | | | | | X | | This is a relatively new (2003) modern facility. Energy intensity is required for research missions involving materials, neutron and X-ray scattering, electron microscopy and spectroscopy, and other processes, and the facility also incorporates 10,000 square feet of Class 100, 1000, and 100,000 clean room space. The energy intensity of the facility is about three times that of a standard building at ORNL. Significant energy reductions are not practical without affecting research. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Spallation Neutron Source (SNS) process facilities, as follows:* | *See comment at right:* | | | | | | | | The SNS buildings listed below make up the process buildings required for SNS operations. At full power, the SNS will provide the most intense pulsed neutron beams in the world for scientific research and industrial development. Completed in May 2006, SNS has ramped up to near full-power capability. Energy intensity is required for research missions. Energy loads are not influenced by conventional building energy conservation measures. Significant energy reductions are not practical without affecting research operations. (The Central Laboratory and Office Building at SNS are not exempt from energy goals, but only the buildings required for process operations.) |
| (SNS) Front End Building | 8100 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Beam Tunnel | 8200 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Klystron Gallery | 8300 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Central Helium Liquifier Facility | 8310 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Superconducting Rad Freq. Bldg. | 8320 | | | | | | X | | --- see SNS comment above --- |
| (SNS) RF Test Facility | 8330 | | | | | | X | | --- see SNS comment above --- |
| (SNS) HEBT Service Building | 8340 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Ring HVAC Building West | 8413 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Ring HVAC Building East | 8423 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Ring Injection Dump | 8520 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Ring Service Building | 8540 | | | | | | X | | --- see SNS comment above --- |
| (SNS) RTBT Service Building | 8550 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Target Building | 8700 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Target Building #1 Beam Line 1 | 8702 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Target Building #1 Beam Line 5 | 8705 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Target Building #1 Beam Line 7 | 8707 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Target Building #1 Beam Line 11 | 8711 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Target Building #1 Beam Line 13 | 8713 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Target Building #1 Beam Line 14B | 8714B | | | | | | X | | --- see SNS comment above --- |
| (SNS) Helium Compressor Building | 8760 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Switch Yard | 8911 | | | | | | X | | --- see SNS comment above --- |
| (SNS) Central Exhaust Facility | 8915 | | | | | | X | | --- see SNS comment above --- |

# B Appendix B

## Policy and Program Statement

**ORNL operates a Standards-Based Management System (SBMS) which serves to translate external and internal requirements into laboratorywide policies and procedures to assist staff in achieving the Laboratory's mission in a safe and compliant manner.**

In support of the missions of the DOE, ORNL conducts basic and applied R&D to create scientific knowledge and technological solutions that:

- strengthen the nation's leadership in key areas of science;
- increase the availability of clean, abundant energy;
- restore and protect the environment; and
- contribute to national security.

The mission of ORNL is to deliver scientific discoveries and technical breakthroughs that will accelerate the deployment of solutions in clean energy and global security, and in doing so create economic opportunity for the nation.

**The following Statement was issued by ORNL's Laboratory Director August 25, 2014**

## UT-Battelle Policy for ORNL

Policies represent the philosophy of UT-Battelle for the conduct of research, operations, and other activities at ORNL. It is my expectation that all individuals performing work at the Laboratory will adhere to these policies, and that these policies will be incorporated in all activities at ORNL.

Thomas E. Mason
Director
(Signature on file)

# C Appendix C

## Draft ORNL Climate Change Resilience Risk Table

| | Operations | | | Personnel | | | Productivity | | |
|---|---|---|---|---|---|---|---|---|---|
| **Climate Hazard** | **Consequence** | **Risk** | **Actions** | **Consequence** | **Risk** | **Actions** | **Consequence** | **Risk** | **Actions** |
| **Average Temperature** | • Increased rate of material degradation<br>• Potential increase in disease and pests<br>• Permit and compliance issues | L | • None | | L | | | L | |
| **High Temperatures** | • Increased cooling costs for buildings and equipment<br>• Decreased heating costs<br>• Increased landscaping costs<br>• Increased demand on equipment (e.g. chillers/ substations)<br>• Peak demand may exceed TVA contract limits or risk curtailments; resulting fees | M | • Review and analyze design standard changes<br>• Identify impacts of discharged heat in White Oak Creek through engineering study | • Increased heat-related illness (outdoor/field work)<br>• Reduced building thermal comfort | L | | • Increased heat-related illness (outdoor/field work)<br>• Loss of productive working hours<br>• Reduced building thermal comfort | L | |
| **Average Rainfall** | • Strain on sewage and wastewater treatment plants | L | • Update and increase design capacity of sewage and wastewater treatment plants<br>• Change policy to include climate change actions in future designs (SBMS) | | L | | | | |
| **Heavy Rainfall** | • Potential flooding from White Oak Creek<br>• Increased water damage to buildings, equipment, utilities<br>• Operational delays due to weather<br>• Unintended remobilization of unearthed hazardous materials<br>• Bypassed permits on water limits | M | • Modify flow restrictions in White Oak Creek<br>• Ensure debris is removed from White Oak Creek to reduce overflow into facilities<br>• Ensure pumps are in place<br>• Review south side flow<br>• Rework emergency plans to include handling "flooding situations"<br>• Run sensitivity analysis on all land use and planning variables | • Increased potential of flood-related injury/death<br>• Reduced site access; longer commuting times | L | | • Increased rate of flood-related injury/death<br>• Reduced site access; longer commuting times<br>• Loss of productive working hours | | |
| **Severe Weather (Droughts, Thunderstorms, Tornadoes, Hail, Hurricanes, Wildfire)** | • Increased landscaping costs<br>• Potential inability to access water from Melton Lake due to droughts<br>• Increased risk of wild fires<br>• Possible permit violations and increased costs for White Oak Creek<br>• Increased damage to buildings and/or equipment<br>• Impacted electrical reliability<br>• Increased safety risks<br>• Loss of productivity<br>• Increased damage/ maintenance costs<br>• Increased operational delays due to weather | M | • Confirm wildfire protection plans are adequate:<br>– Emergency Action Level Plans in place<br>– Master Agreements in place with neighboring agencies<br>– Current Actions in place<br>• Confirm safety practices are adequate:<br>– Procedures, regular drills, public address announcements<br>– Wide Area Rapid Notification System in place<br>– "Alert Us" system in place | | L | | | | |