SUSTAINABILITY AT

OAK RIDGE NATIONAL LABORATORY

Gov Energy 2010

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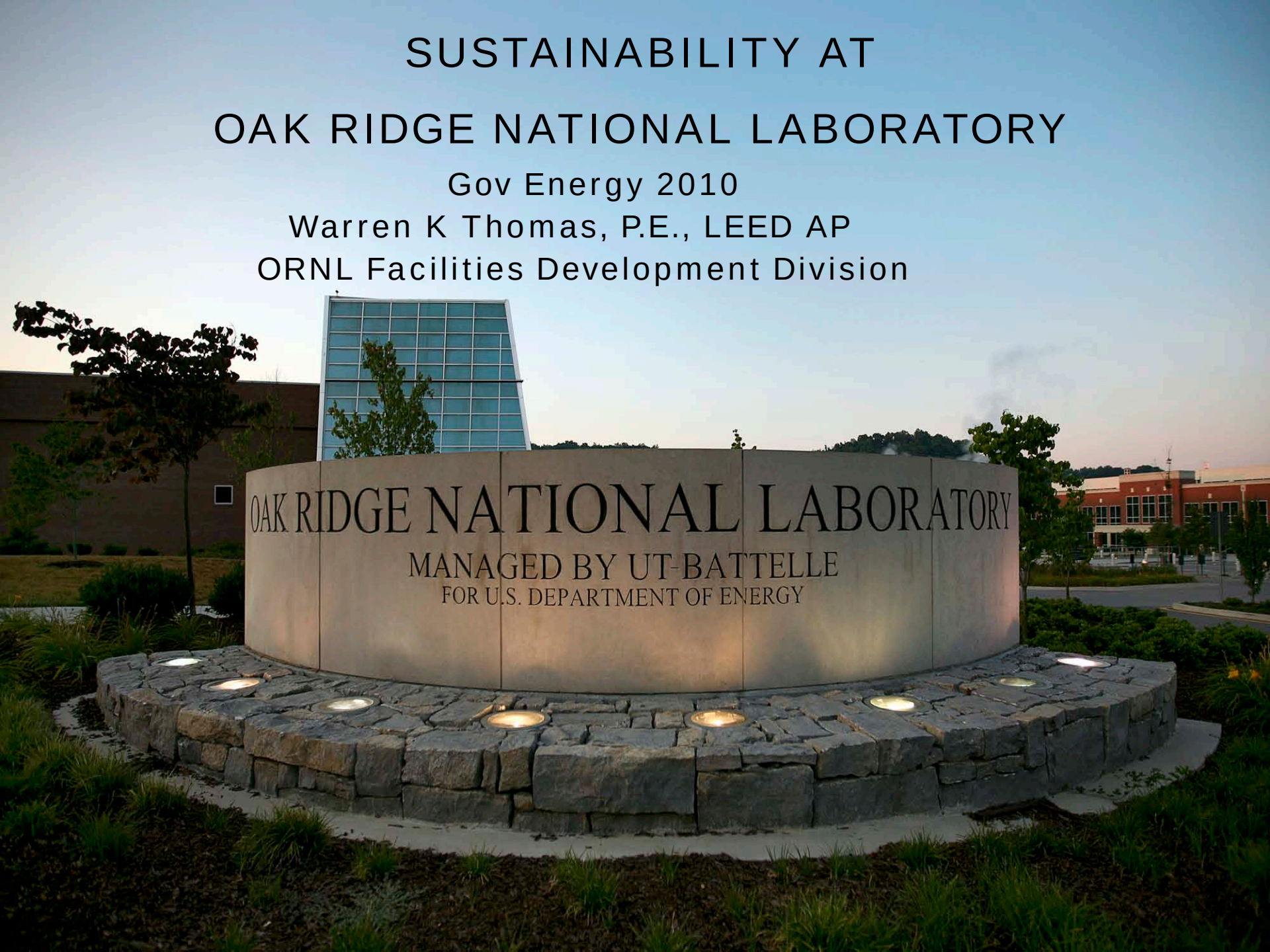
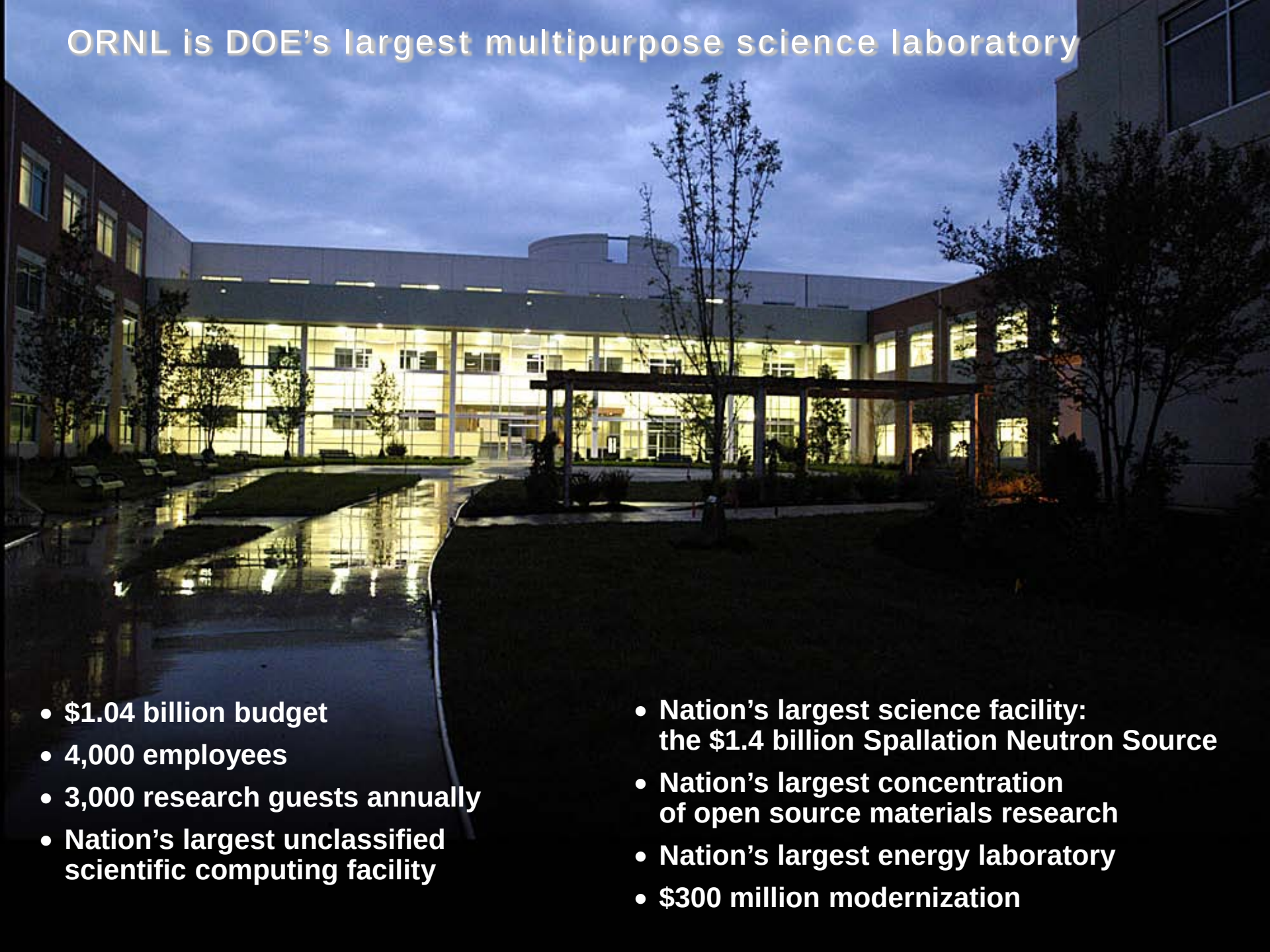


ORNL SUSTAINABILITY – Gov Energy 2010

- **OVERVIEW**
  - **ORNL Factoids**
  - **ORNL Challenges and Sustainable Vision**
  - **Sustainable Results**
  - **Sustainable Designs for Campus & Facilities**
  - **Sustainable Mobility Initiatives**
  - **The Sustainable Future**
  - **Questions**

ORNL is DOE's largest multipurpose science laboratory



- **$1.04 billion budget**
- **4,000 employees**
- **3,000 research guests annually**
- **Nation's largest unclassified scientific computing facility**

- **Nation's largest science facility: the $1.4 billion Spallation Neutron Source**
- **Nation's largest concentration of open source materials research**
- **Nation's largest energy laboratory**
- **$300 million modernization**

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- **ORNL has the Nation's largest unclassified scientific computing center..**

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ORNL Challenges and Sustainable Vision

Aging Infrastructure

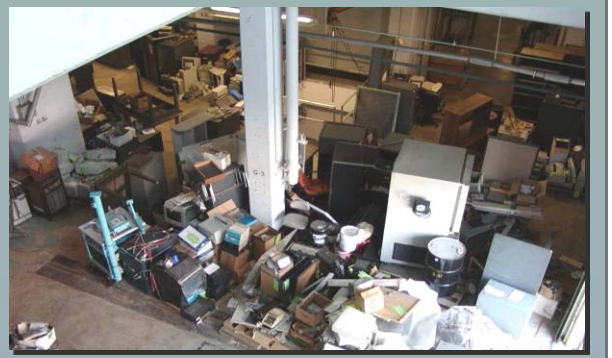
World Class Facilities

Award Winning Results

The Challenge - ORNL East Campus as it appeared in March 2002

ORNL SUSTAINABILITY - *The CHALLENGE >>>* Aging infrastructure limits ORNL ability to perform science.





- **Outdated facilities are unable to support next-generation equipment**
- **Utility systems do not comply with current regulations and are approaching end of service life**
- **High costs of operations, maintenance, and utilities for older facilities drive up overall cost of R&D**
- **Legacy materials and equipment have accumulated over the last 30 to 50 years**

These challenges make it difficult to maintain a safe work environment

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Common Sustainable Challenges for DOE Labs - Regulatory

Water use reductions – 26% by 2020

Zero Energy facility designs starting in 2020 and all construction by 2030

GHG reduction – 28% Scope 1 and 2 emissions by 2020

ASHRAE 90.1 30% by 2015

Renewable energy use of 7.5% by 2013

Executive Orders - 13514, 13423 and DOE High Performance Sustainable Building Guiding Principles, USGBC LEED Requirements

ORNL SUSTAINABILITY – Gov Energy 2010

Common Sustainable Challenges for DOE Labs - Technology

Water use reductions – Occupants vs processes

- Process >> occupants

Low grade heat recovery utilization

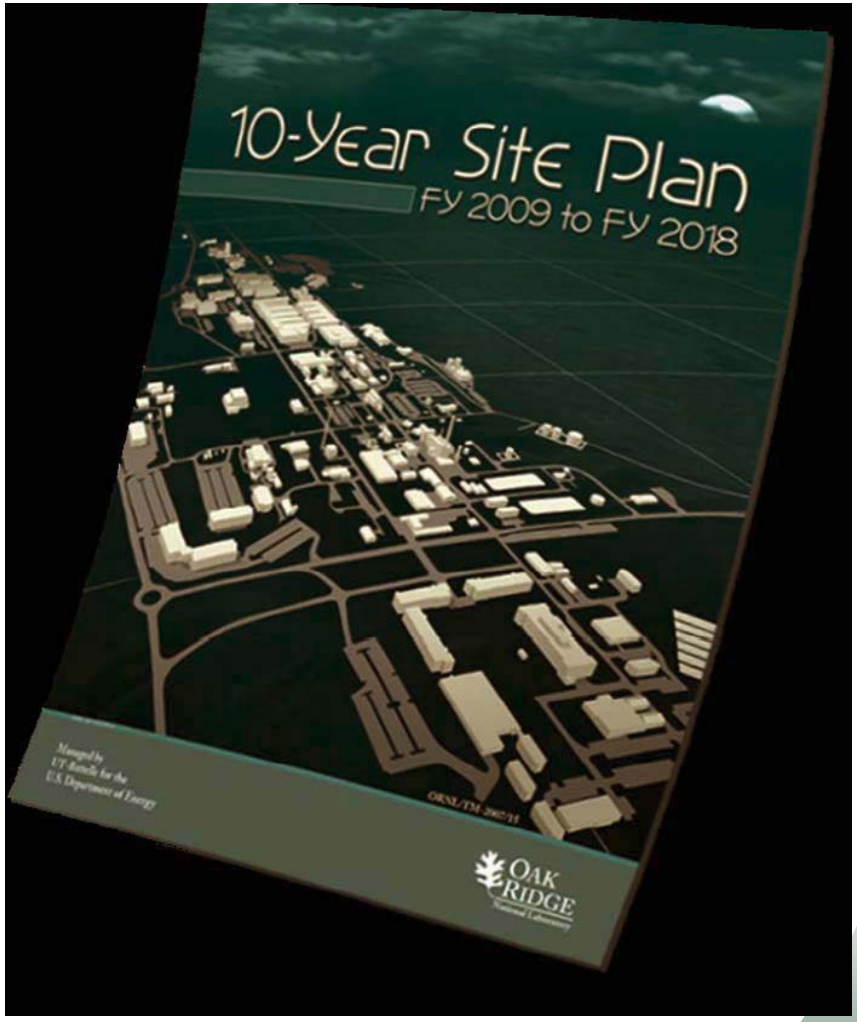
Specifications of commercially available and efficient/green leading edge technologies vs prototype technology development

Program needs/wants and project budget vs …

- Renewable energy source integration
- Once through cooling elimination

ORNL SUSTAINABILITY - *The VISION >>>* Transform ORNL into a modern research campus for the 21st century.

- **Sustainable approach…**
  - **Possess world-class technical and support facilities that attract the best and brightest**
  - **Be seen as a vibrant campus setting where staff have opportunities to interact and conduct multidisciplinary science safely and securely**
  - **Maintenance investments are sufficient to sustain the facilities and infrastructure**
  - **Our operations protect and restore the environment**



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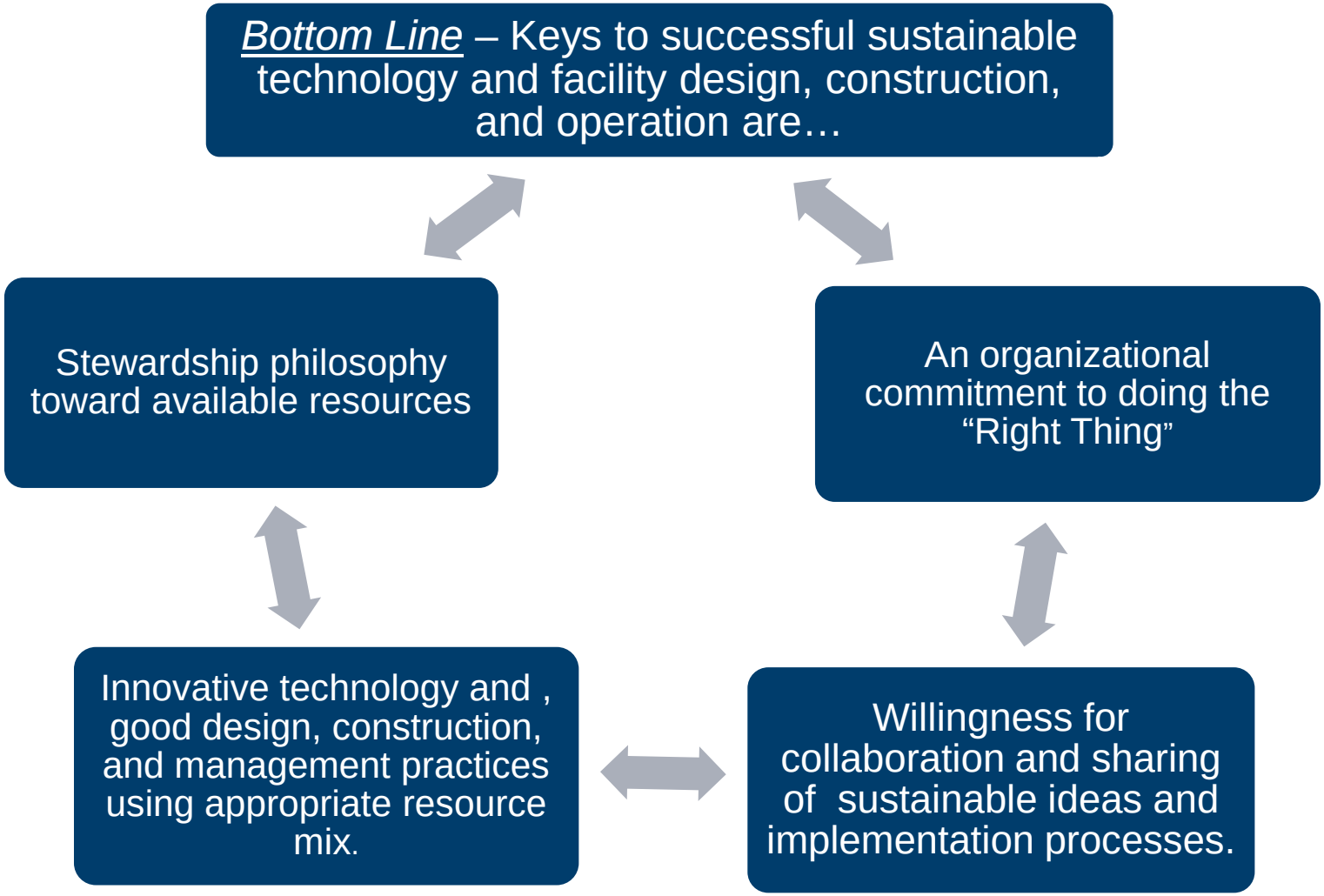

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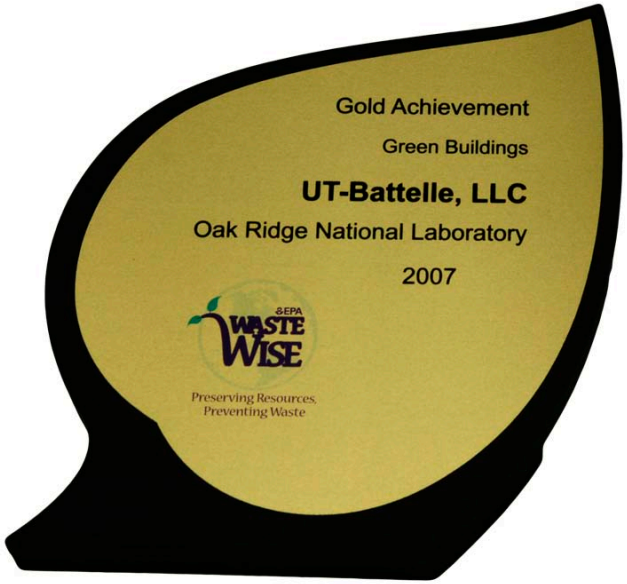
…AND THE AWARD WINNING RESULTS!!

Vision Realized - ORNL EAST CAMPUS TODAY

A LEED CAMPUS, the first for DOE and Tennessee!

ORNL SUSTAINABILITY – Gov Energy 2010

- **Resource Conservation, Environmental Stewardship, and Pollution Prevention…**

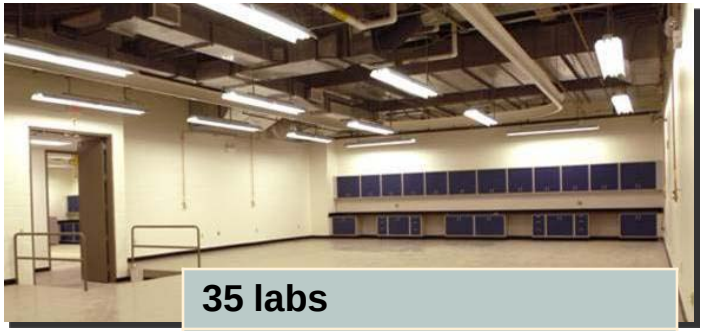


ORNL SUSTAINABILITY –
Sustainable Facilities for world-class science and technology research

406 offices

14 conference rooms

40,000 ft^2 of computer space



35 labs

High bays

2 Class 1000 clean rooms

3 Class 100 clean rooms

96 offices

Secure infrastructure

211,000 gft^2 – two wings

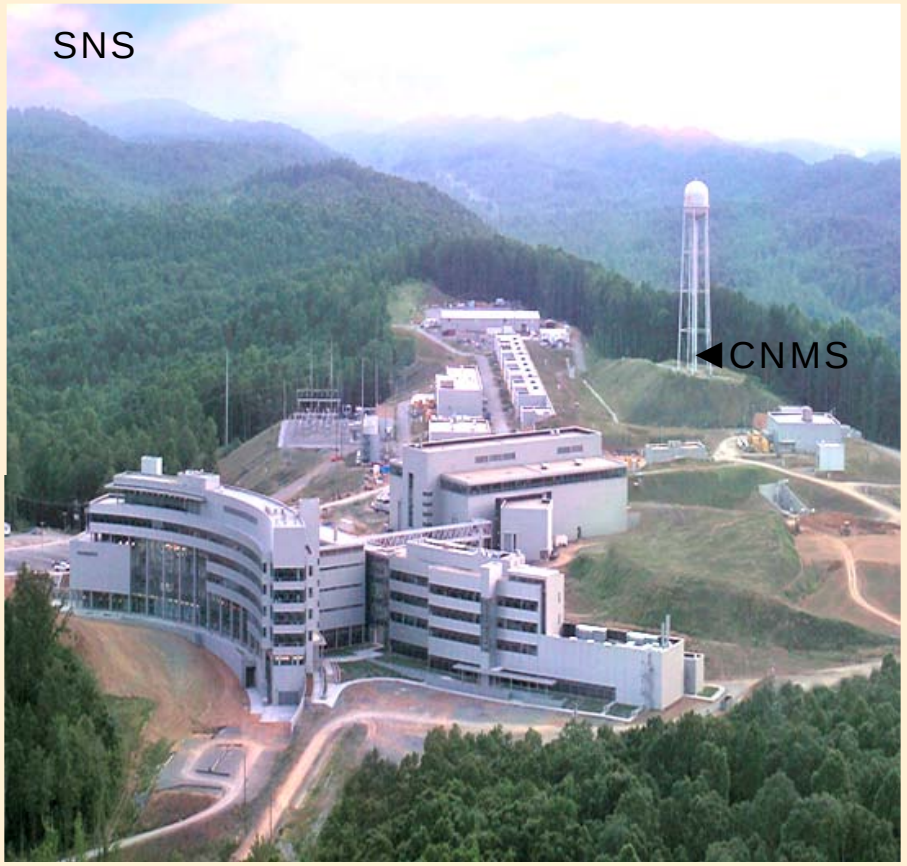
Houses 350 staff

2 computer rooms

14 research labs

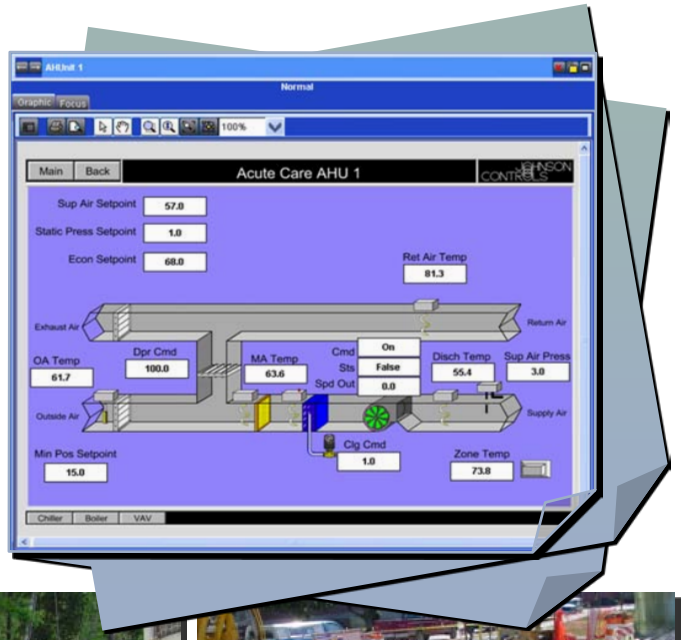
1 fabrication lab

ORNL SUSTAINABILITY - New facilities for world-class science and technology research



ORNL SUSTAINABILITY - Infrastructure improvement is visible across the Campus

- **New ORNL facilities being leveraged to provide the backbone for current technology in building monitoring and control**
- **Multiple projects are providing upgraded infrastructure capability in electrical, sewage, storm water, fire protection, steam, communications, and natural gas**



HVAC Upgrades

Telecommunications Upgrades

Electrical Systems Upgrade

Sanitary and Storm Sewer Projects

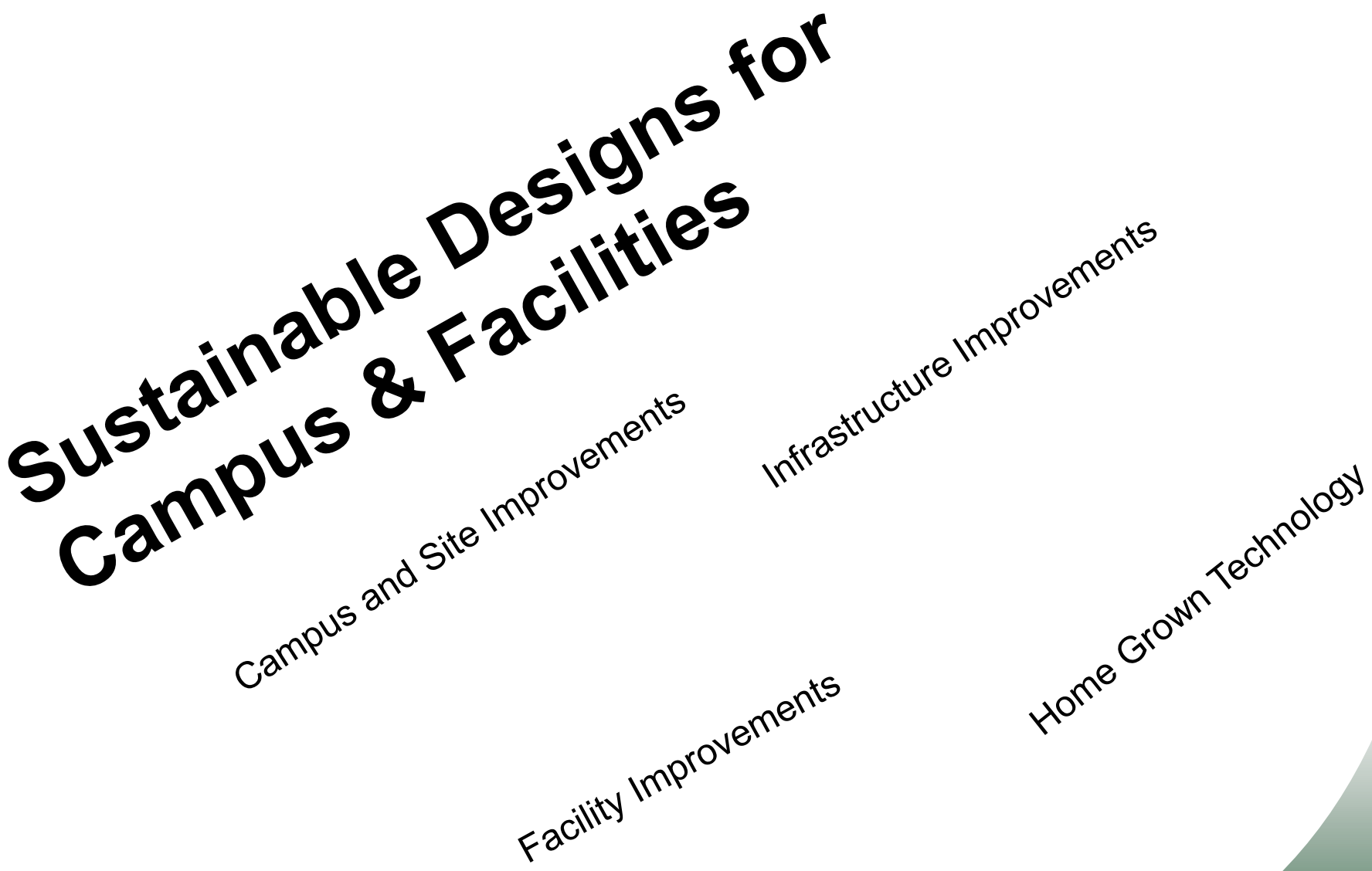
BOTTOM LINE…

Increased facility square footage by 33%…

With an increase in energy usage of only 5%.

Sustainable efforts pay back!

ORNL SUSTAINABILITY – Gov Energy 2010



ORNL SUSTAINABILITY – Gov Energy 2010

- 22 roadmaps to reach sustainability goals by integrating cutting-edge technologies, resource efficiency, and associated behavior

- $89M 3rd Party Financed Project:
- $8M annual savings, 12 year
- Payback
- 50 Kw Photovoltaic Array
- First commercial net-zero energy retrofit (NG to biomass)
- Pilot initiatives: smart grid, energy storage, wireless energy data, and solar
- Biomass boiler to reduce scope 1 emissions

World's most powerful computer with a superior power usage effectiveness (Less than 1.3)

Verdiem software results in 40% power reduction across 7500 computer systems

High performance buildings incorporating LEED standards in new construction and modifications

ORNL SUSTAINABILITY – Gov Energy 2010

Leveraging sustainable best practices and proven technology across the DOE laboratory complex and ORNL Campus

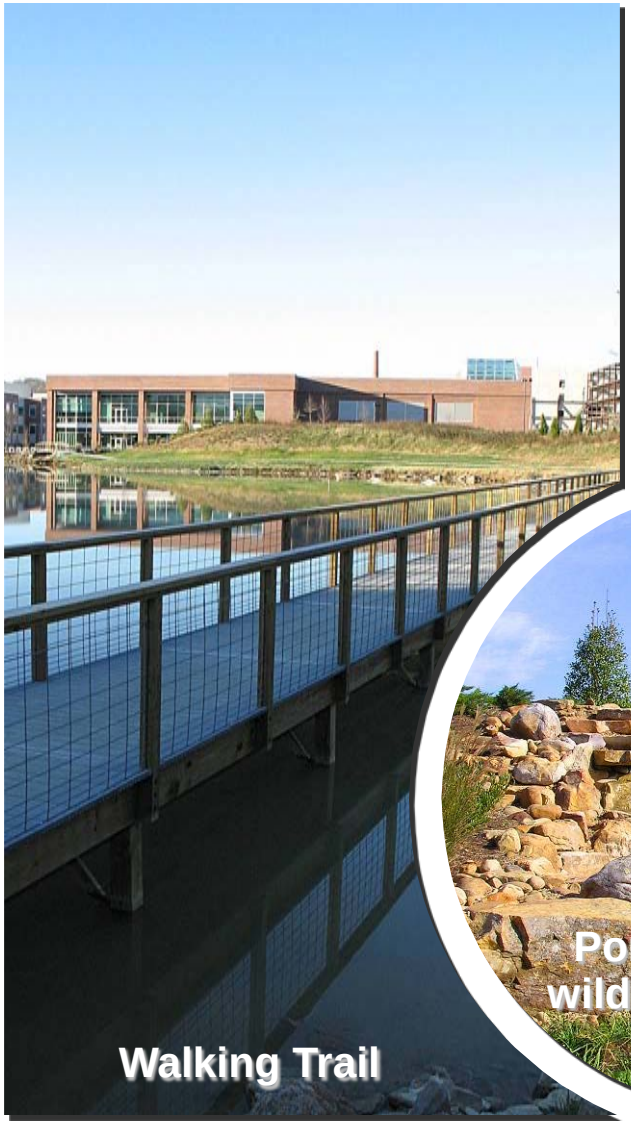
Leveraging ESPC – Energy Savings Performance Contracts to improve infrastructure and facility performance

Technology

- Variable Flow Refrigerant equipment
- Heat wheels, coil run-around loops
- VFD - pumps, AHU's
- Thermal envelop, roofs, fenestration
- Lighting controls, day lighting
- Low static systems - first costs vs energy
- BMS campus std – control, diagnostics
- Hood efficiencies - lower face velocity
- Green stacks – lower velocity vs higher
- CO2 sensors, occupancy sensors

Smart correlation between LEED credit selection and DOE HPSB Guiding Principles mandates.

ORNL SUSTAINABILITY – Gov Energy 2010



- ***Area Lighting…***

Down lighting systems to reduce night sky illumination effects

- ***Hardscapes & Parking Area…***

Reflective high albedo concrete to reduce heat islands

Pervious pavement and drain system in visitor parking area


ORNL Sustainability – Gov Energy 2010
Natural gas condensing boilers – 98% efficient
Benchmark
Benchmark
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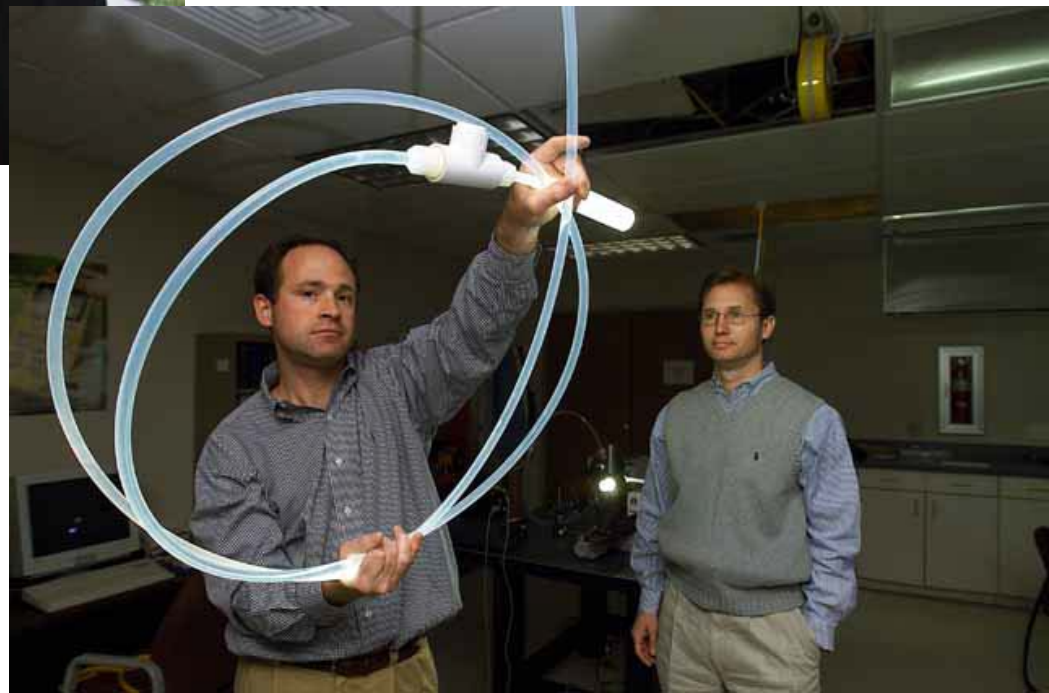
ORNL SUSTAINABILITY – Gov Energy 2010

Home Grown Technology - Hybrid Lighting



Energy Star Roofing

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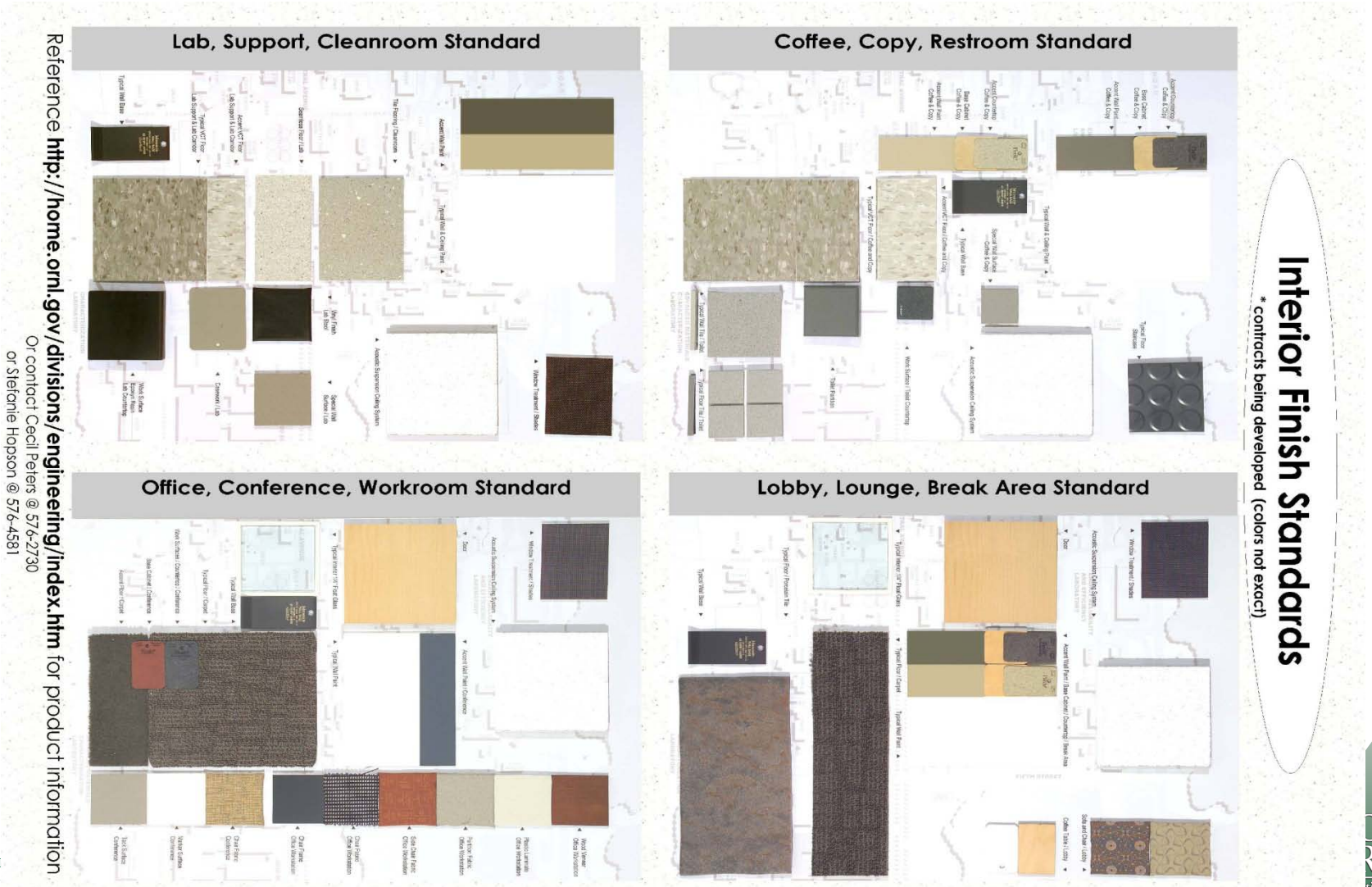
Day Lighting and views

- **Architectural Interior Finish Standards…**



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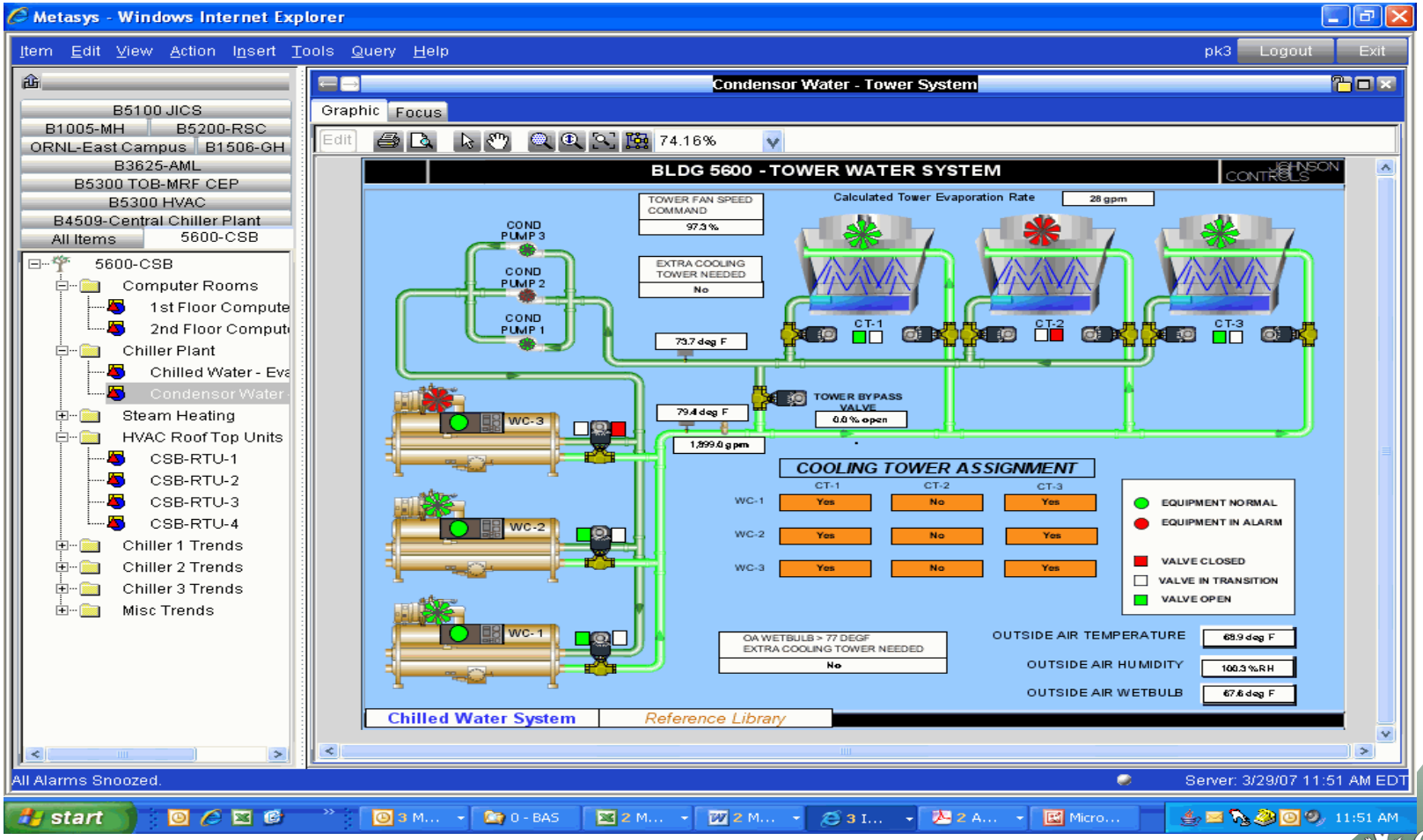
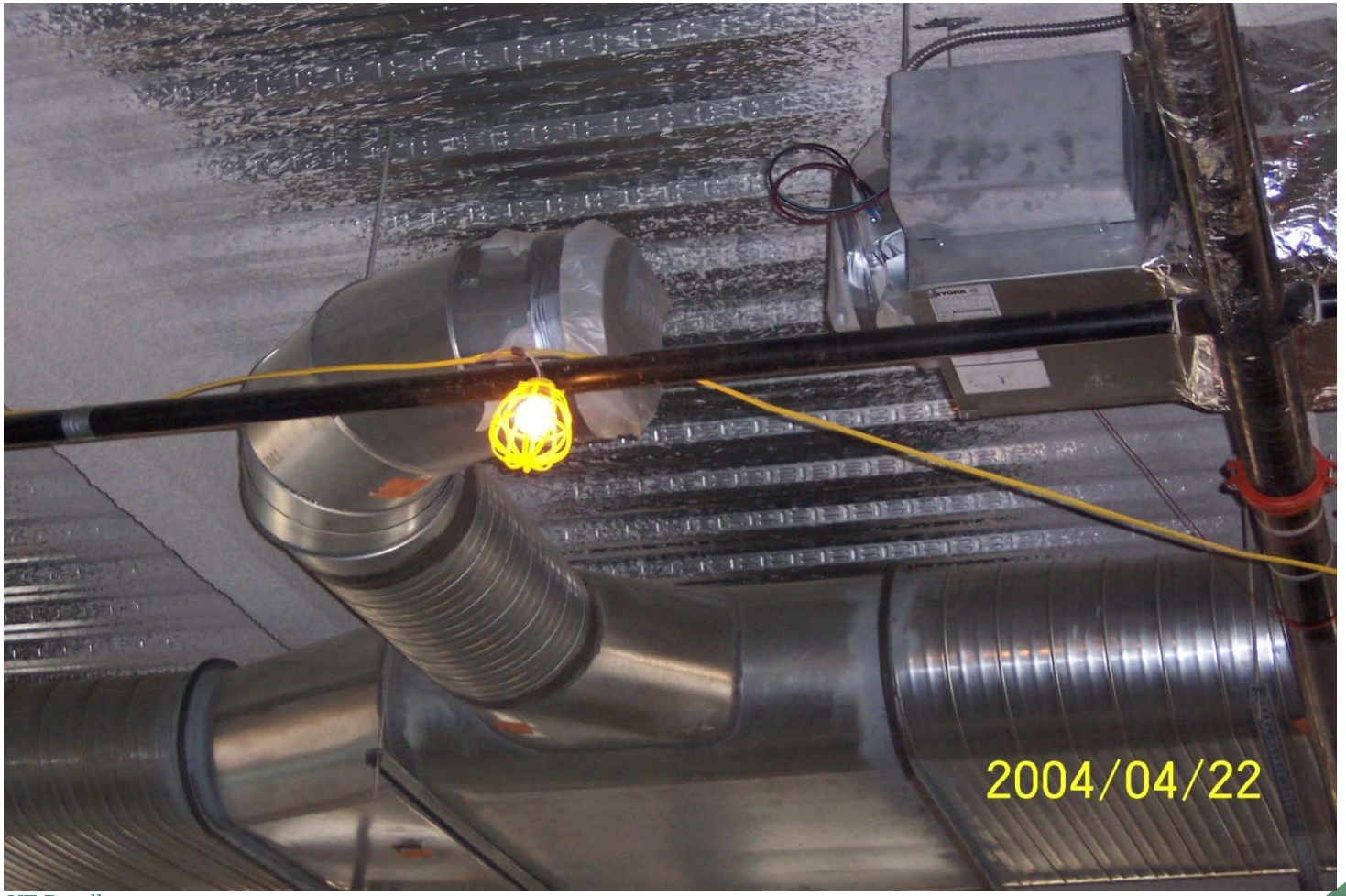
- ***Energy Efficiency…***
  - **Johnson Metasys BMS – campus standard, trending capabilities for diagnostic work and Cx**



- **Indoor Environmental Quality…**



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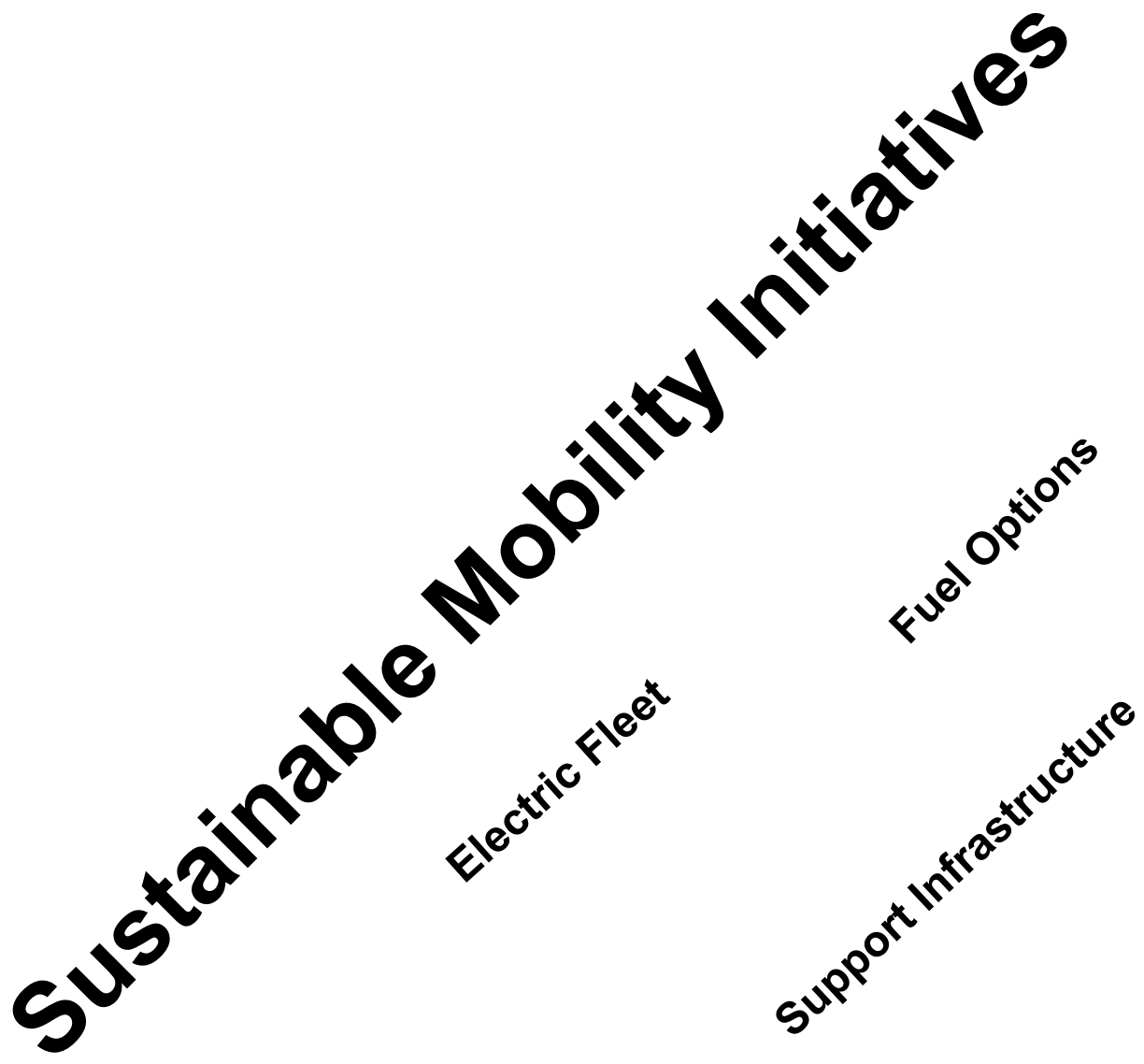


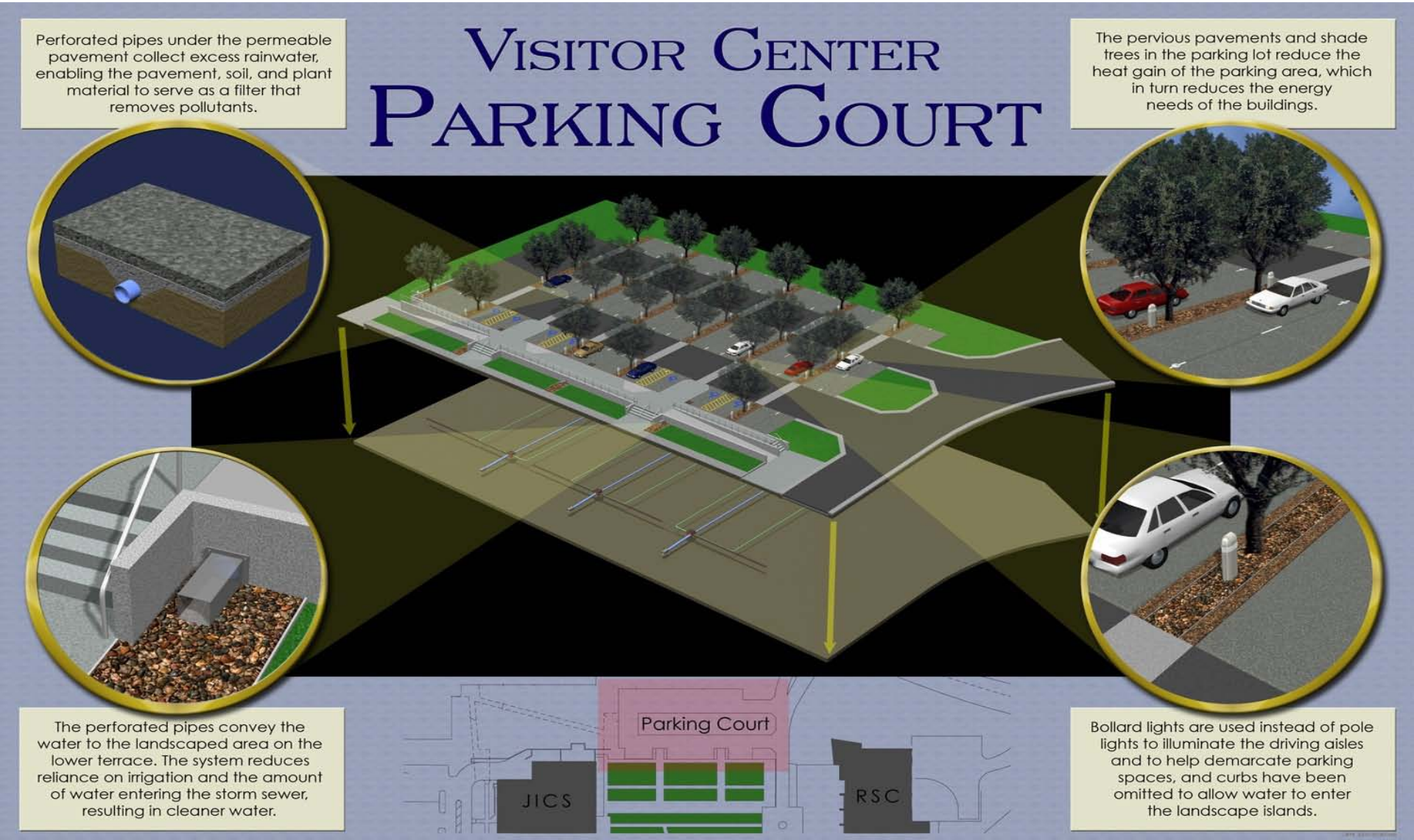
- **Electrified Fleet**

- **Fleet Fuel Options…**
  - **Biodiesel**
  - **E-85 bio-fuels**

ORNL SUSTAINABILITY PRESENTATION FOR VW AG

- **Fuel efficient traffic features**

- **Pervious Parking Pavement**



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- **The Ultimate in sustainable mobility…**

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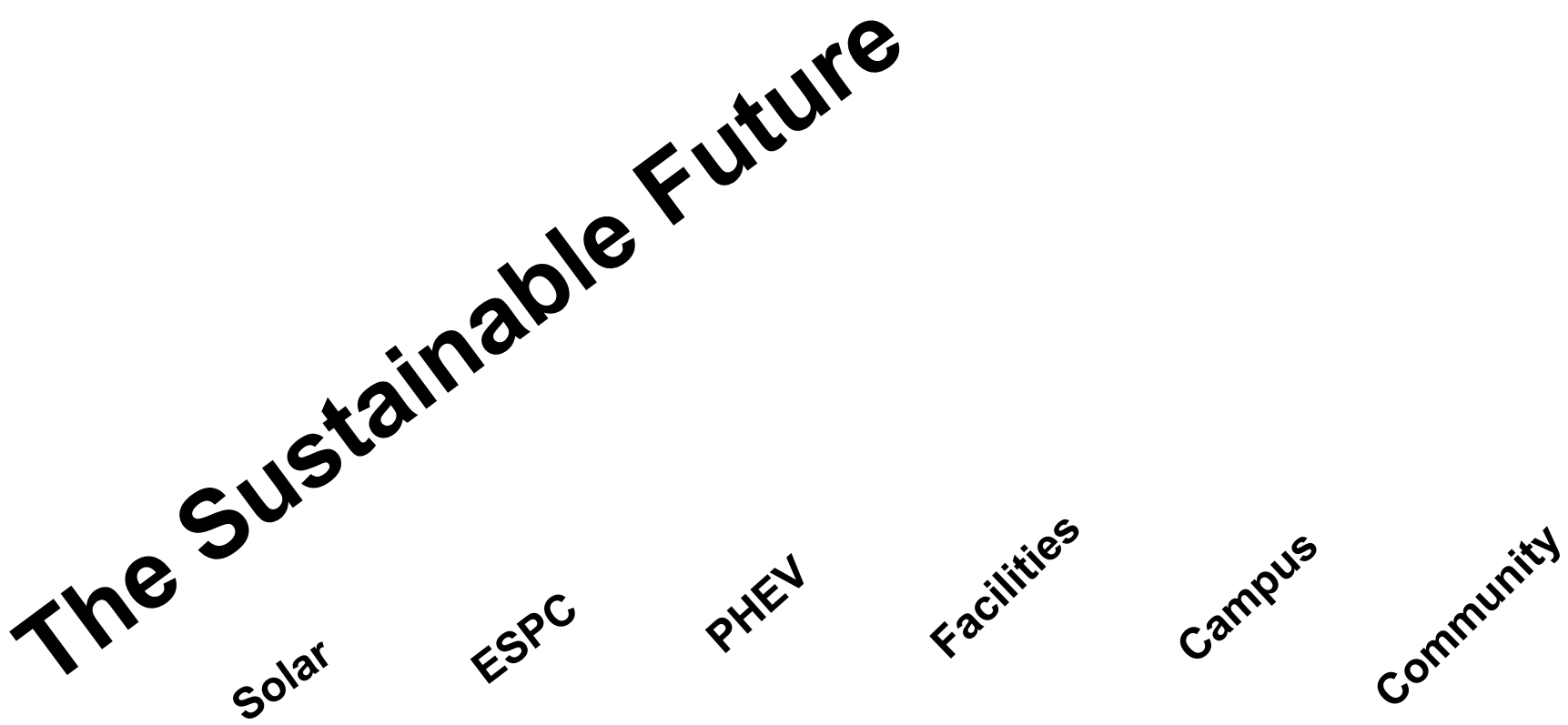


ORNL SUSTAINABILITY – Gov Energy 2010

- **50 MW/hr-yr PV array to power zero energy facilities…**

ORNL SUSTAINABILITY – Gov Energy 2010

DOE's first net-zero energy building retrofitted commercial building

IT computer power settings, central printers and smart power strips: 10 MWh/yr saved

New PTHPs: 5 MWh/yr saved

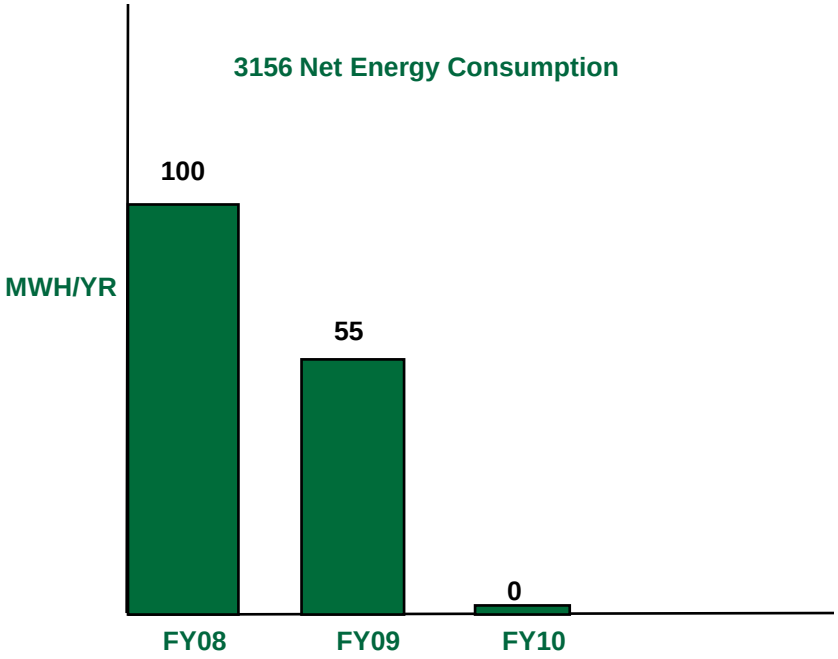
Occupancy Sensors: Day time savings of 5 MWh/yr saved

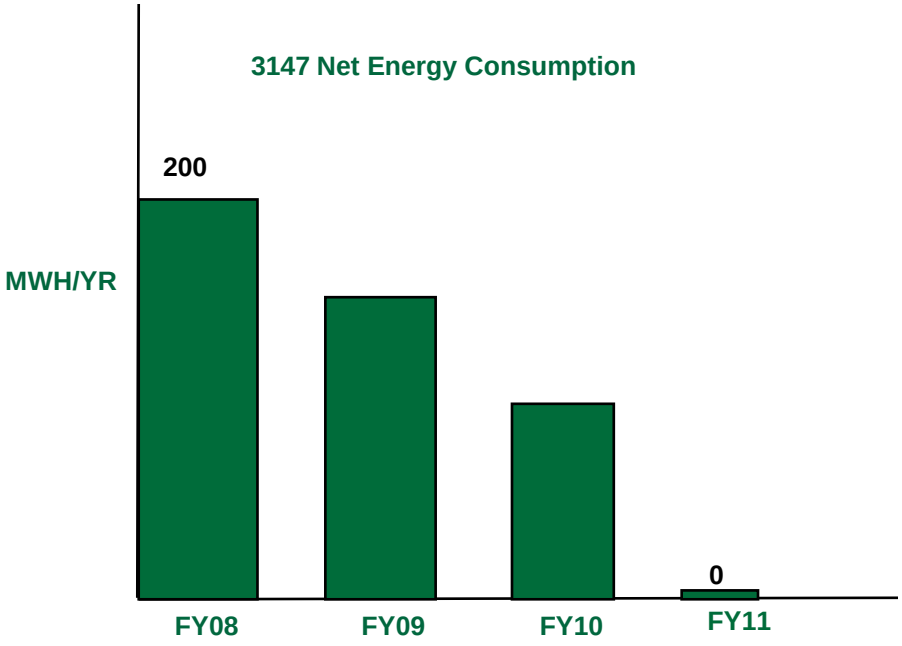
Solar PV array: Provides 50 MWh/yr

Building 3156 reaches net-zero energy Consumption reduced from 100 to 50 MWh/year, solar provides remaining demand

New Metasys: HVAC Shed during unoccupied periods, 30 MWh/yr saved

ORNL SUSTAINABILITY – Gov Energy 2010

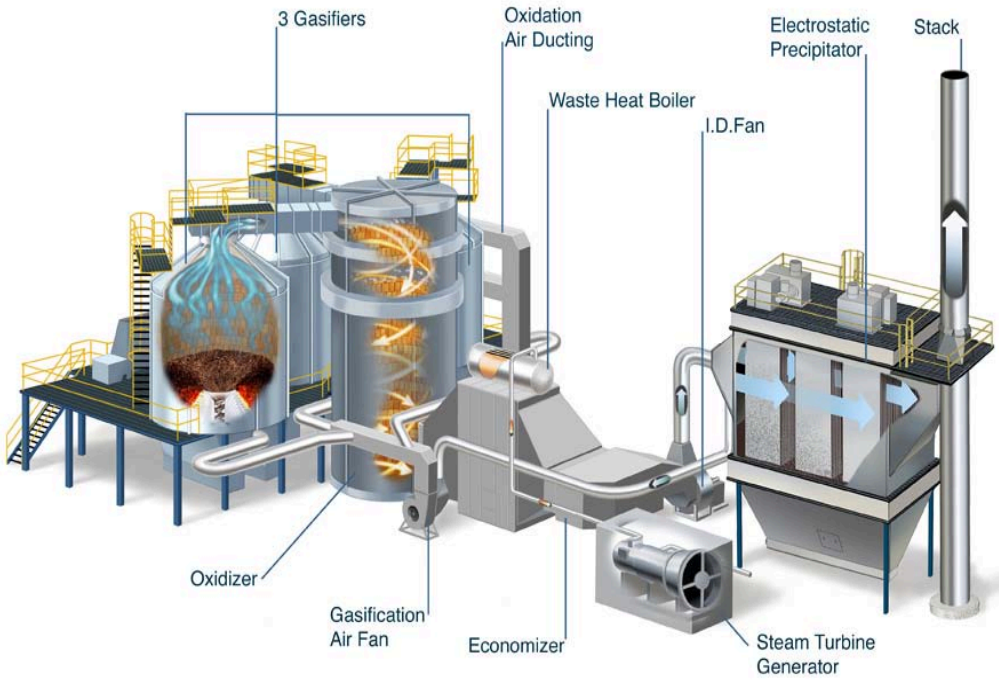




ORNL SUSTAINABILITY – Gov Energy 2010

- **Leveraging ESPC – Energy Savings Performance Contracts to improve infrastructure and facility performance**
  - **Lighting**
  - **Steam distribution**
  - **Steam generation**
  - **HVAC controls**
  - **Fossil Fuel reduced by 80%**
  - **Reduce carbon footprint**

ECM 12.1 Steam Biomass Plant



Nexterra Biomass Gasification System at Johnson Controls' University of South Carolina Cogeneration Project.

- **PHEV Research…**
  - **Our employees will be driving more electric personal transportation to the campus within the 10-year site planning horizon . . .**
- **. . . and they will want to re-charge during the day in a sustainable manner.**
- **“Plugging In” for Integration and Innovation**
- **Direct Solar Charging**
  - **Off-Peak Charging**
  - **Smart Metering**
  - **Energy Storage for the Grid**
  - **Solar covered parking with PHEV**
- **User Incentives/Convenience**

ORNL SUSTAINABILITY – Gov Energy 2010

- **Modernization of Laboratory Facilities (MLF)**
- **A LEED GOLD FACILITY**
- **160,000 SF OFFICE AND LABORATORY FACILITY**
  - **Chemistry and Nano mat'l research**
- **Currently in construction**
- **Submitted for ASHRAE Technology Award**

ORNL SUSTAINABILITY – Gov Energy 2010

- ***ORNL Bldg. 1059***

  LEED EB Gold

  - **Expectation for first LEED EB on ORNL campus, and first Gold EB at a DOE site.**
  - ***Sustainability Features:***
    - ***Occupancy, dimming, and daylight sensor lighting features***
    - ***Building automation system***
    - ***Energy awareness dashboard located in lobby for real-time representation of building's electrical and water usage***
    - ***Low flow plumbing fixtures***
    - ***Individual office recycling containers***
    - ***Roof upgrade with additional insulation***
    - ***Dyson hand dryers eliminate paper towel waste***

Finish Materials Selected for Sustainable and Environmental Characteristics

Finish Material	Recycled or Sustainably Sourced Content	Indoor Air Quality Impact Mitigation	Local Sourcing
Carpet	14.22% Post-consumer	CRI Green Label Plus	North Carolina, Georgia
Porcelain Tile	40% Pre-consumer	Low VOC sealant	Tennessee
Glass Tile	23% Post-industrial	Low VOC sealant	Illinois
Restroom Partitions	33% Post-industrial	N/A	Georgia
Stair Treads	10% Pre-consumer	PVC free, low VOC adhesive	Ohio
Entry Way Walk-off Mats	90% Post-consumer	Low VOC adhesive	Ohio
Cabinetry	KCMA ESP	ARB compliant	North Carolina
Furniture Partitions	3% Post-consumer 23% Post-industrial	SCS Certified	Michigan
Paint	N/A	No VOC	Ohio

ORNL SUSTAINABILITY – Gov Energy 2010

- **New Computing Center (MCDC) in planning stage…**
  - **260,000 sq ft potential**
  - **LEED Gold**
  - **40 acre site**
  - **25 MW initially, expandable to 200 MW capacity**
  - **Waste heat park for green house complex**

ORNL SUSTAINABILITY – Gov Energy 2010

- **Oak Ridge can be a net-zero-energy, carbon-free DOE site**
- **Reduce energy demand as far as possible**
- **Install clean power to make up the difference**
- **Accelerate deployment of SMR**
  - **Previously characterized reactor site**
  - **Receptive community**
  - **Energy park initiative**
  - **Wealth of technical expertise**

ORNL SUSTAINABILITY – Gov Energy 2010

ORNL emissions for FY2008

• Scope 1- all sources account

for 16% of total.

• Scope 2 – electricity purchased for TVA – accounts of 68% of the total.

This graph shows the comparison between purchases for traditional

buildings and process facilities. As the ORNL mission grows, the process

facilities will continue to grow to support the new research.

• Scope 3 – the three primary

sources of scope 3 emissions

account for 16% of the total.

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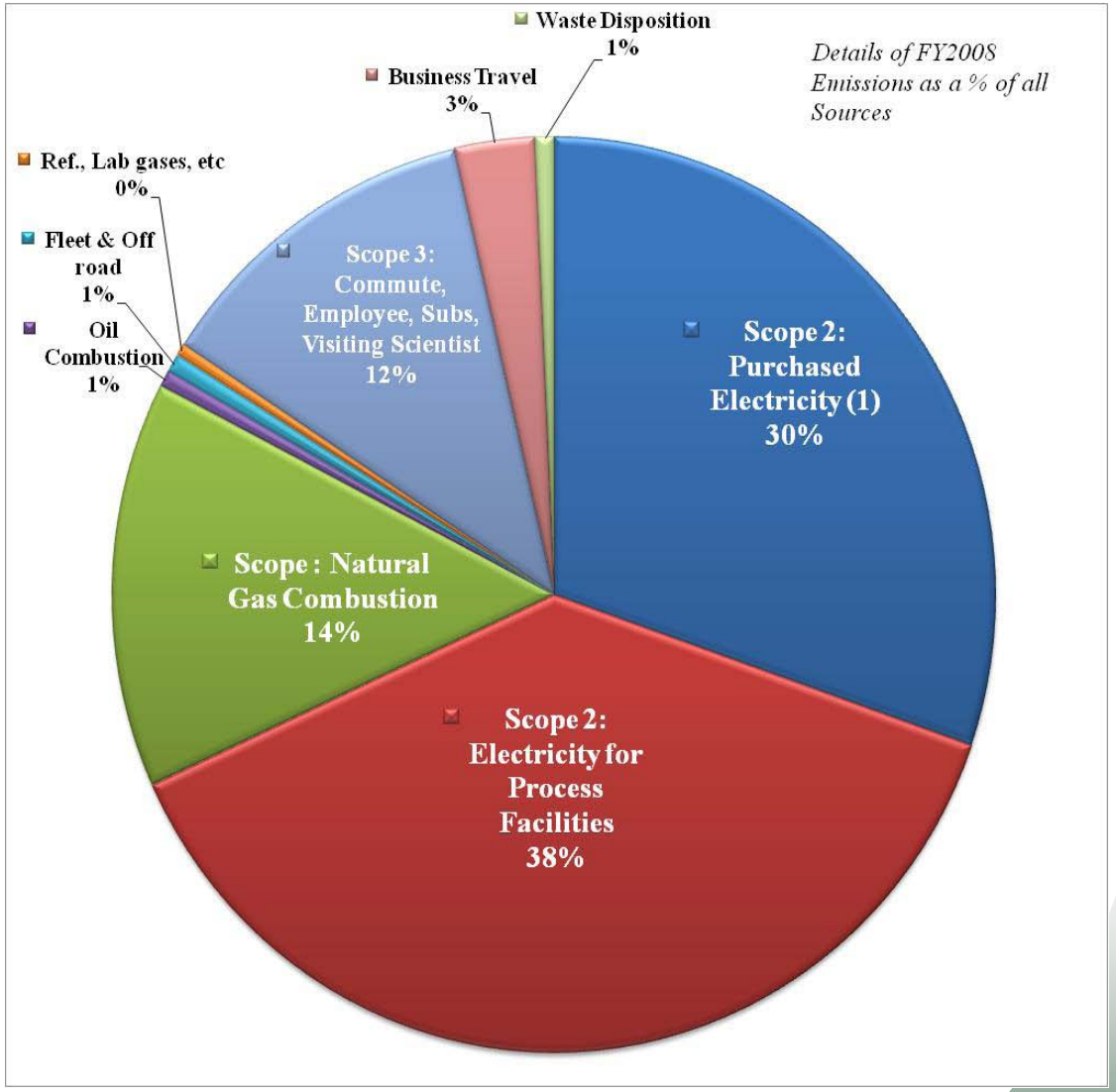

ORNL SUSTAINABILITY – Gov Energy 2010

- **Small modular reactors offer a unique opportunity to make Oak Ridge a net-zero energy**

- **One 125 Mwe SMR reduces GHG emissions by 550,000 metric tons (48% of DOE's 2008 GHG reduction goal).**

- **Mission power needs continue to rise.**

- **GHG emissions regulation continues to tighten.**

- **Community Outreach with Re-use of Recycled Construction Waste**
  - **Grind up waste sheet rock + Agriculture soil supplement = Happy Local Farmer!!**


QUESTIONS????