

Energy Conservation and Sustainability Efforts at Brookhaven National Laboratory

*Community Advisory Committee Meeting
March 11, 2010*



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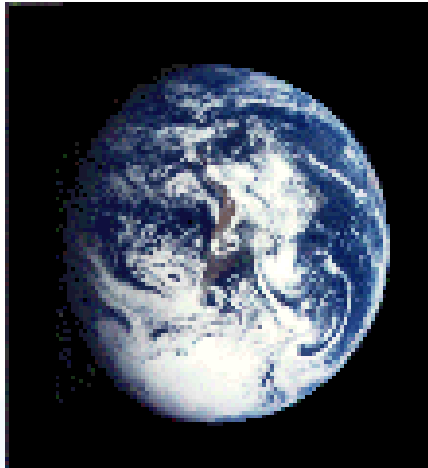
BROOKHAVEN
NATIONAL LABORATORY

a passion for discovery



Today's Discussion

- **Energy and Environment**
- **Brookhaven National Laboratory (BNL)**
- **Energy Conservation and Sustainability Efforts at BNL**



Some General Definitions

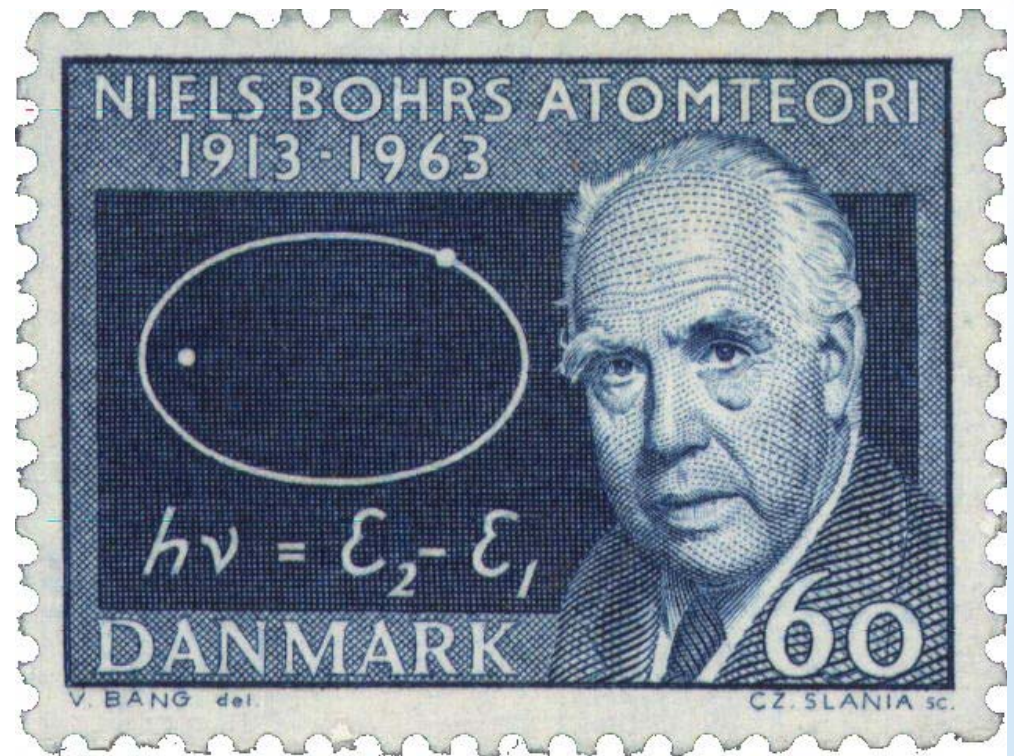
- **Green:** (i.e. to be) Minimal negative impact to the environment, with an emphasis on conservation of resources, energy efficiency, and healthful living.
- **Sustainability:** Countless definitions, but in the broadest sense, the capacity to endure.
- **Biomass:** An energy resource derived from organic matter such as wood, agricultural waste and other living cell material.
- **Carbon Neutral:** Net discharge of carbon dioxide into the atmosphere is zero. Can be offset by things that absorb carbon, such as trees.
- **LEED:** Leadership in Energy and Environmental Design. LEED is a point based rating system to evaluate environmental performance from a “whole building” perspective over its life cycle.
- **Life-Cycle Cost (LCC):** Total cost of acquiring, owning, operating and disposing of a system or building over its entire useful life.
- **Net Zero:** Requiring no additional energy from outside sources.

Energy and Environment

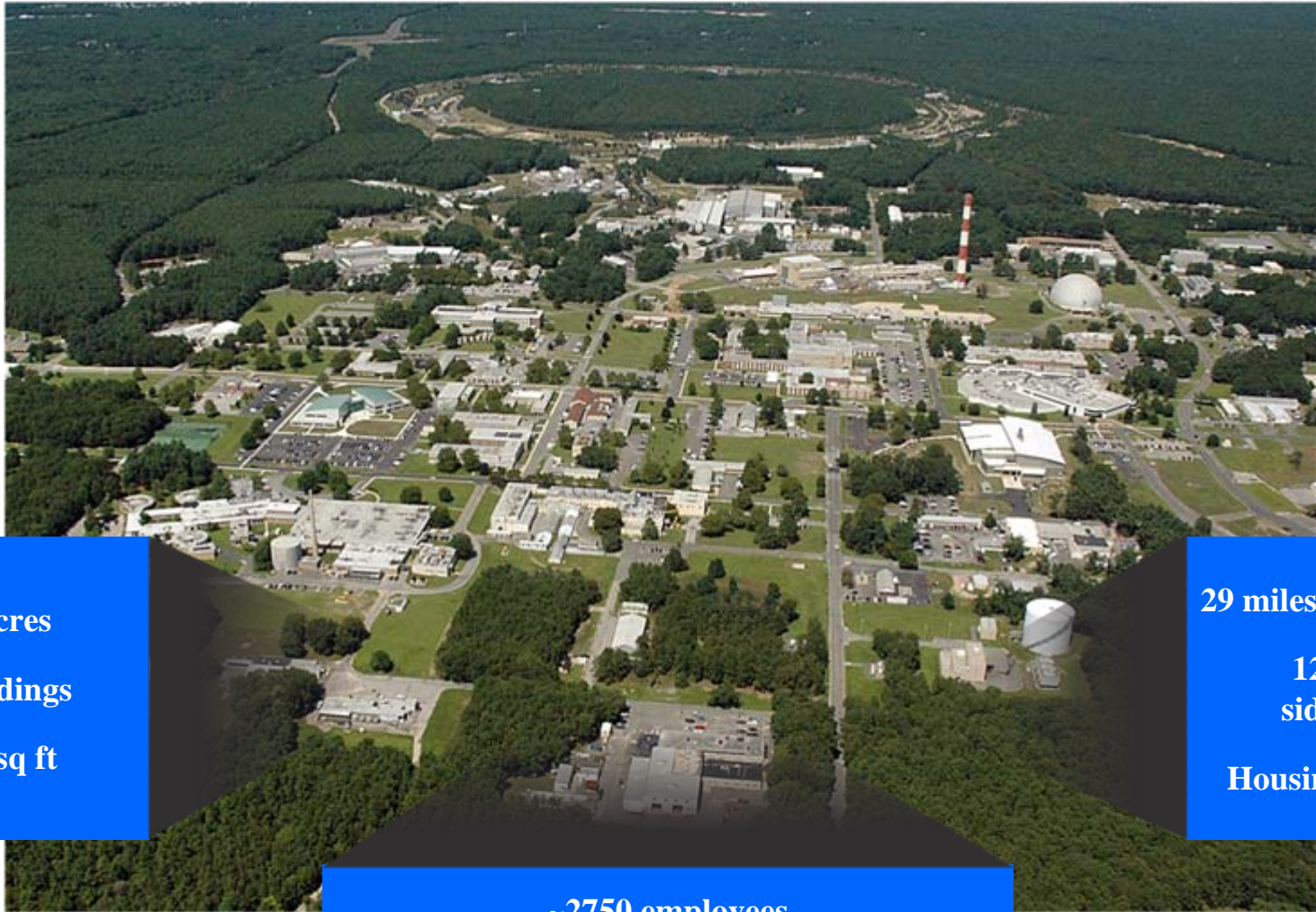
- **Conventional Energy Sources - Supplies Limited**
 - Coal, Oil, Natural Gas, Nuclear, Hydro
- **Burning of Fossil Fuels Adds CO₂ to Atmosphere**
 - Global warming
 - Climate change
 - Potential to impact to all of us and future generations
 - Other negative impacts – pollution, health, etc.
- **We Must Find Alternatives and Be Efficient**
 - *Innovation will be key*
 - *Challenges and opportunities*



*Prediction is difficult,
especially about the future.*
– Niels Bohr



Brookhaven National Laboratory *A passion for discovery*



5265 acres

350 buildings

~4.2M sq ft

29 miles paved roads

12 miles
sidewalks

Housing for ~800

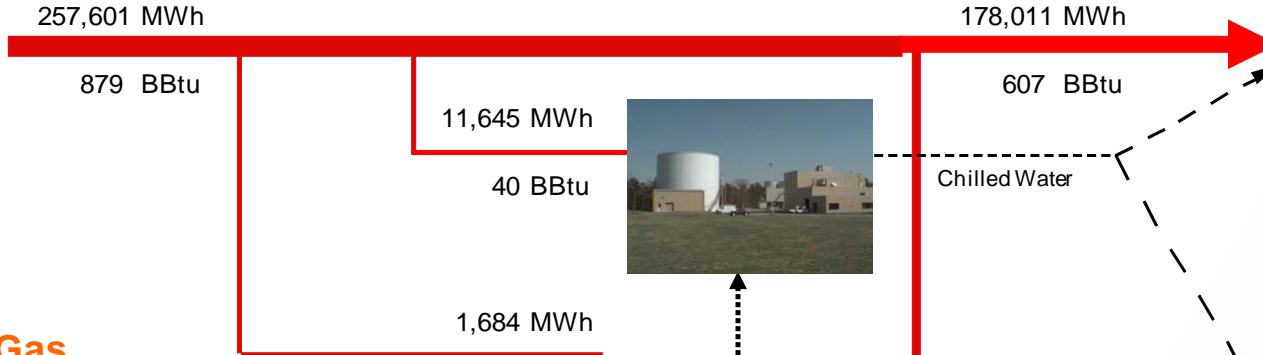
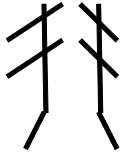
~2750 employees

>4000 guest users per year

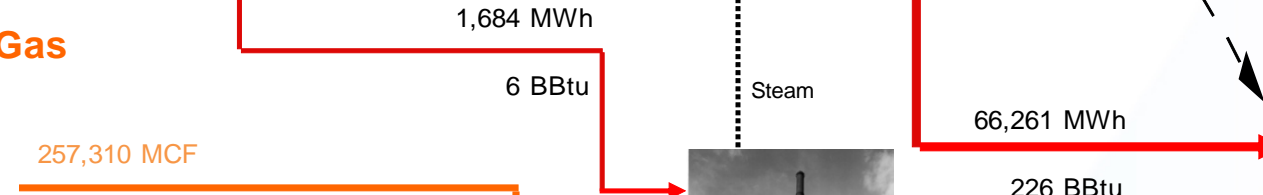
FY08 Funding \$532M

Brookhaven National Laboratory Energy Use FY 2009

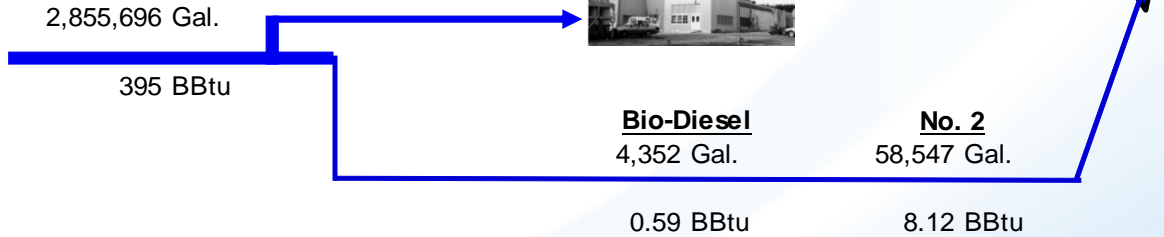
Electricity



Natural Gas



Oil/LPG



Process



Buildings



Brookhaven Strategic/Business Plan

BNL Initiatives

CFN/Nanoscience



NSLS II



New York Blue



Core Programs BES BER EENS

Materials for Catalysis: New nanocatalysts with enhanced loading/activity/tolerance

Solar Nano-materials: Create nano-structured *materials and assemblies* for higher efficiency, cost-effective photovoltaic devices/fuel generation.

Energy Storage Materials: Create and understand materials to increase density and stability of storage

Electric Grid Materials: Improve our understanding of strong electronic correlations for enhanced physical properties (e.g. T_c , J_c , ZT) of grid materials.

Biofuels: Lignocellulose breakdown, biomass enhancement, engineered plant production.

Collaborators/Joint Appointments



Discovery to Deployment

BNL Energy Portfolio

Basic and applied research underlying breakthroughs
in efficient use of renewable energy

Production/ Conversion



Biofuels
Solar Fuels
Solar PV

Transmission



Superconductivity

Storage



Catalysis/Electro
chem.
- Fuel Cells
- Batteries

End Use



Biofuels
(Combustion)

← CFN, NSLS I, II, New York Blue →

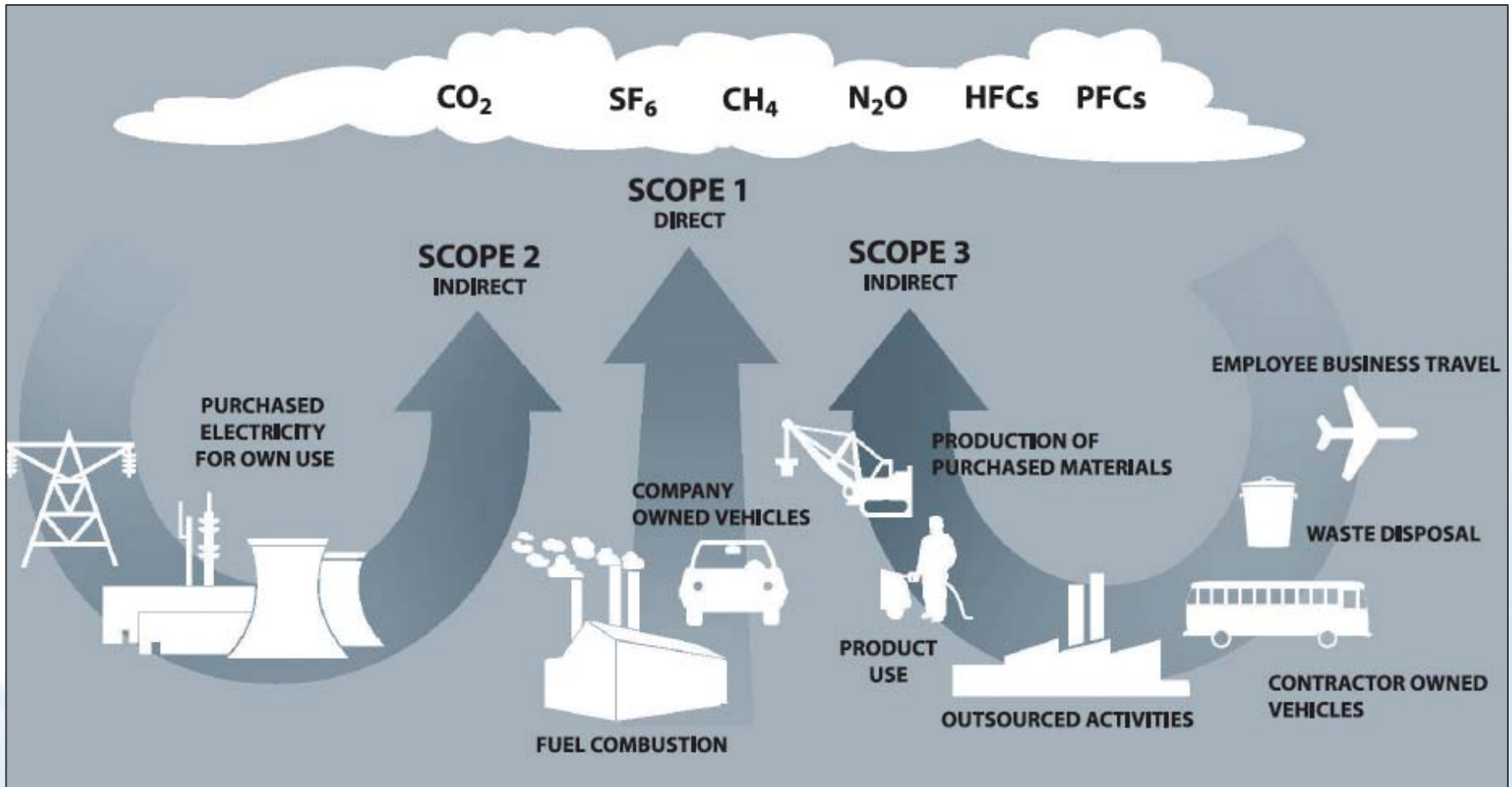
DOE's Energy Goals - Summary

1. Reduce energy consumption by 30% and water consumption by 16% in all DOE facilities.
2. **Acquire at least 7.5% of all energy from renewable sources.**
3. Build alternative fueling stations on all sites by 2008, and replace all conventional fuel vehicles in the DOE fleet with alternative fuel vehicles by 2010.
4. **Attain a LEED Gold standard on all new buildings and on all buildings that go through major renovations.**
5. Incorporate sustainable design standards on 15% of all current buildings by the end of fiscal year 2015.
6. **Give preference to bio-based, environmentally friendly sources of energy and water, while reducing the use of hazardous and toxic chemicals and managing the production of waste.**
7. Improve the energy efficiency of all data centers by 10% by 2011.

Other DOE Requirements

- Complete energy audits for all facilities
- **Operate all alternative fuel vehicles on alternative fuels**
- Meter all facilities for electricity, thermal, and water
- **Install advanced electricity metering**
- Purchase low-carbon fuels to the maximum extent possible.
- **Must purchase WaterSense products, where available**
- Must participate in Demand Response programs
- **Increase overall vehicle fleet economy and reduce miles driven**
- Track environmental and energy goals and requirements with the Environmental Management System
- **Temperature Set-Back requirements**

Executive Order 13514



Executive Order 13514 – Goals

- **Federal agencies required to measure, manage, and reduce greenhouse gas emissions towards agency-defined targets**
- **30% reduction in vehicle fleet petroleum use by 2020**
- **26% improvement in water efficiency by 2020**
- **50% recycling and waste diversion by 2015**
- **95% of all applicable contracts will meet sustainability requirements**
- **Implementation of the 2030 net-zero-energy building requirement**
- **Develop and carry out an integrated strategic sustainability performance plan**

Executive Order 13514 – Other Goals

- **Implement strategies to support low-carbon transit, travel, commuting**
- **Avoid on-site water extraction that depletes existing supplies**
- **Establish and implement policies to enable duplex printing and other environmentally preferable features**
- **Ensure EPEAT registered electronic product compliance**
- **Continue towards 100% compliance of meeting guiding principles for existing buildings**

Executive Order 13514 – Goal Summary and Status

	Requirement	DOE 09 Status
Scope 1&2 Greenhouse Gas (GHG) emission reduction from 2008 to 2020 – supported by existing mandates:	*25% *DOE selected target	new
• Energy Intensity reduction (Btu/ft ²)	30% (2003-2015)	17.2%
• Renewable electricity use	7.5% (2013 forward)	4.2%
• Fleet petroleum reduction	30% (2005-2020)	16.3%
Other sustainability goals:		
• Select scope 3 Greenhouse Gas (GHG) reduction target	June 2, 2010	new
• Potable water intensity reduction (gal/ft ²)	26% (2007-2020)	2.6%
• Industrial/other water consumption reduction (gal)	20% (2010-2020)	new
• Recycling & waste diversion	50% (by 2015)	49%
• Procurements meet sustainability requirements	95%	new
• Buildings meet sustainability principles	15% (by 2015)	1.6%
• Net-zero energy in new facilities	100% (by 2030)	new
Submit Strategic Sustainability Performance Plan (SSPP) includes Scope 3 GHG reduction target and execution structure	June 2, 2010	new

BNL GOALS

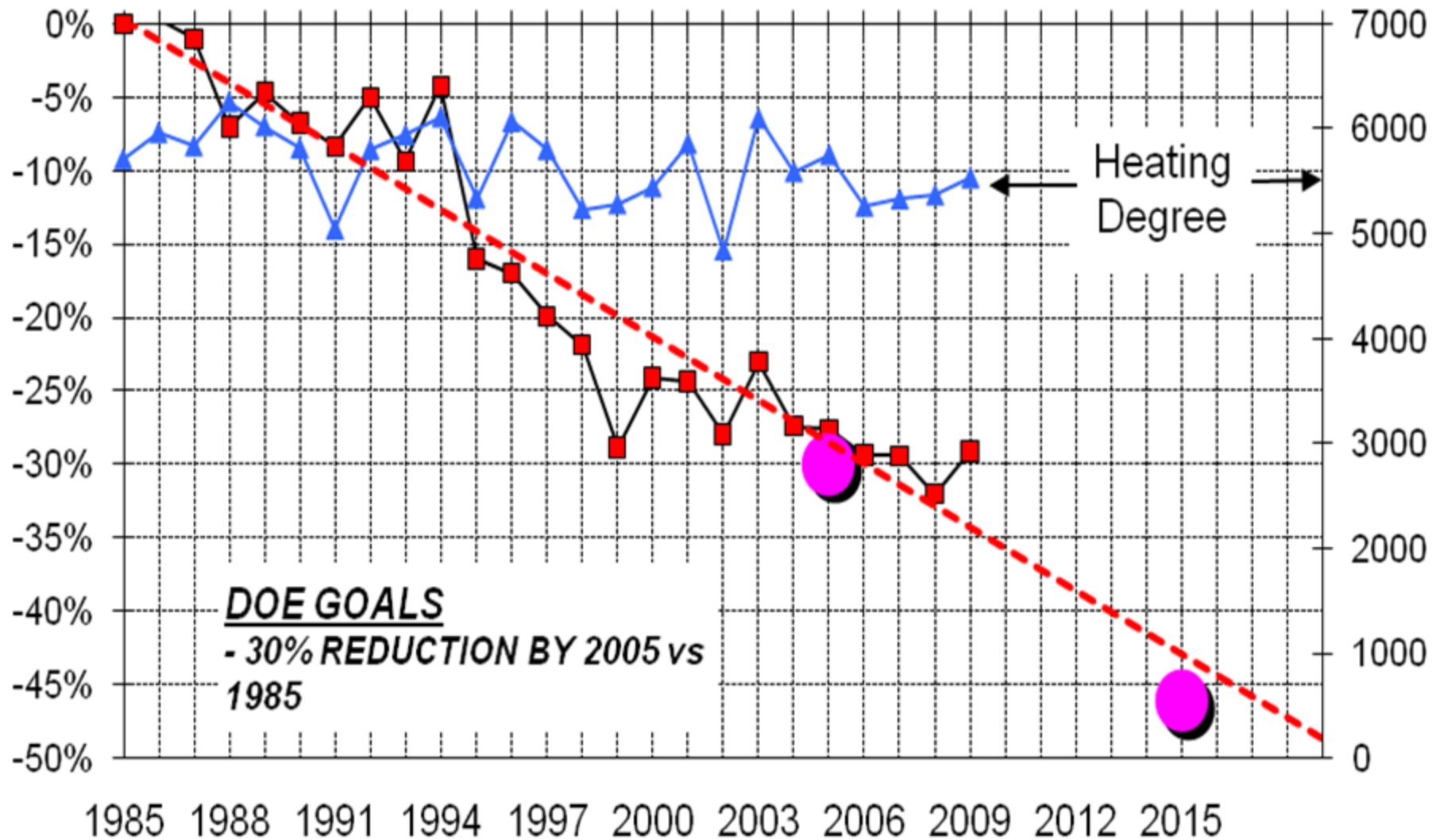
- **Continue to meet or exceed energy reduction goals**
- **Reduction of CO₂ emissions**
- **Move BNL to use of sustainable fuel/energy sources**
- **Apply best existing technologies**
- **Integrate innovations resulting from basic research into the full-scale implementation on a continuous basis**
- **Create innovative partnerships between BNL, government agencies, industry, universities, and public groups**
- **Develop a world-class sustainability program**

BNL's Energy Efforts – Some History

- **BNL has a long and successful history of identifying and implementing energy conservation projects**
- **Began an energy conservation program in the 1970's to combat high energy costs**
- **Over \$60 million has been invested in a wide range of efforts that has curbed BNL's energy consumption dramatically**
- **Energy intensity (Btu/GSF) has been reduced by over 57% comparing FY2009 to FY1973**
 - **Saves about \$17 million/year in energy costs**

BUILDING ENERGY PERFORMANCE

% INCREASE/DECREASE OVER FY85





Conservation – What BNL is Doing Now

243,000 mmBtu/yr reduction (Btu/Sq. Ft. -31%)

- **Energy Savings Performance Contract**
 - Should provide over 165,000 mmBtu savings/year
- **Steam Metering/Direct Charging**
 - Charge steam costs directly to users
 - Encourages conservation and good habits
 - Estimated annual savings 62,000 mmBtu
- **Infrastructure Modernization/Building Consolidation**
 - Estimated annual savings 12,000 mmBtu
- **Lighting and Controls**
 - Estimated annual savings 4,000 mmBtu



SUSTAINABLE ENERGY OPPORTUNITIES

- BNL/DOE commissioned a study in 2008 to evaluate possible sustainable energy opportunities at BNL
- Looked at use of solar, geothermal, biofuels, wind, etc.
- Biofuels were determined to be suitable for use
- Biodiesel and wood-derived gas for BNL steam and possible electric production potentially viable
 - May be able to produce ~80% of steam needs (500k mmBtu)
- Further evaluation of a wood (clean wood waste) gasification facility at BNL is underway
- BNL is developing a comprehensive, Laboratory wide sustainability program

Renewable Energy



- **Renewable Energy Credits (REC's)**
- **NYPA Hydro**
 - Will reduce carbon footprint by ~ 91,000 tons/yr
- **Biomass Facility Under Consideration**
 - Evaluate long-term fuel source potential
- **Small Scale Solar Hot Water Heating**
 - Identify potential opportunities for solar hot water heating
- **Solar Demonstration Project**
 - Solar Combisystem that will integrate flat panel solar collectors and a high efficiency condensing oil-fired boiler.
- **Utility Scale Solar PV**
 - 32 MW of solar PV may be located at BNL by LIPA

TEAM Initiative – Water Reduction



- **Impressive reductions in water consumption**
 - 46% reduction comparing 2009 to 1999
- **These reductions have been made through a number of initiatives, including**
 - Elimination of many once-through cooling systems
 - Identification and repair of leaks
 - Implementation of Best Management Practices (BMPs)
- **Planned Projects and Activities**
 - Continued replacement of single-pass equipment
 - More aggressive management of cooling tower operation
 - Completion of another leak detection survey
 - Replacement of plumbing fixtures with water conserving components

Transportation

- **Compressed natural gas (CNG) fueling infrastructure is already installed and operating on site**
 - **77 CNG vehicles displaced 21,730 gge (~50% of total) in 2009**
- **BNL provides compressed natural gas refueling to local governments that partner with DOE Clean Cities**
- **E85 refueling infrastructure should be in place in 2010**
 - When E85 infrastructure is available it may be shared with local governments as has been done with the CNG facility
- **Biodiesel use will displace about 20% of the vehicle diesel consumption beginning in CY 2009**
- **Neighborhood electric vehicles to replace some conventional-fuel vehicles**



TEAM Initiative – Sustainable Design

■ Two LEED Silver Buildings

- Research Support Building - 64,820 GSF
- Center For Functional Nanomaterials - 95,950 GSF

■ Third Building in Construction

- National Synchrotron Light Source II - 385,000 GSF

■ Fourth in Design (going for Gold)

- Interdisciplinary Science Building Phase I - 75,000 GSF

■ Incorporate “sustainable design” to existing

- 15% of current buildings by the end of fiscal year 2015

A Thoroughly Modernized BNL

Moving beyond the 40-65 year old buildings

- Safe, secure and sustainable
- Attractive, reliable, and cost efficient campus
- World-class scientific user facilities
- Modern, state-of-the art, flexible science laboratories
- Fosters new ideas and initiatives
- Attracts and retains top talent
- Encourages collaboration & interaction



Other Sustainable Practices

Pollution Prevention Program – Goal is to create a systems approach that integrates pollution prevention and waste minimization, resource conservation, recycling, and affirmative procurement into all planning and decision-making.

Carpooling – The Laboratory participates in NuRide, a computer-based ride-sharing program in which employees can find partners in their neighborhoods for carpooling. Approximately 300 employees had signed up to use NuRide since it was introduced at the Lab.

Green Product Purchasing – 30% of custodial products purchased are Green-Seal approved, promoting environmental sustainability. Consequently, the inventory of over 80 chemicals for custodial work has been reduced to 30.

Employee Involvement - Employees are asked to take an active role in pollution prevention. Asked to submit pollution prevention ideas to its environmental experts.

Recycling – Brookhaven Lab was a recent winner of the Office of Federal Environmental Executive's Electronics Reuse and Recycling Campaign

- Reused or recycled 53 tons of electronics during fiscal year 2008.
- The Lab currently recycles up to 90 percent of construction debris.

Businesses across Long Island are turning over a new leaf and leading their employees, customers and communities to a greener future. Once a month, we'll use this space to recognize those organizations as GreenLeaders.

Brookhaven National Labs

Energy conservation is nothing new to Brookhaven National Laboratory. BNL, a Department of Energy facility that conducts cutting-edge research to create solutions to our country's energy and other critical needs, began addressing its own energy use during the oil crisis of the 1970s.

Since that time, eco-consciousness has hit every part of BNL's operations, explains Mark Toscano, Energy Manager. "We've accomplished a 30% reduction in energy use since 1985 and reduced carbon dioxide emissions by 41,000 metric tons per year." That translates into an \$8 million per year savings for taxpayers.

BNL's wide-ranging efforts also include a Pollution Prevention Program that makes reducing its impact on the environment an integral part of its operating philosophy. "Through our efforts to reduce waste, purchase environmentally preferable products such as recycled paper, and conserve natural resources, we've not only saved millions of dollars and reduced our carbon footprint, we've also created a safer workplace," says Peter Pohlot, BNL's Pollution Prevention Coordinator.

Part of that program involved recycling all of BNL's electronic equipment—computers, printers, and more—in an environmentally sustainable way. That effort resulted in an Excellence in Recycling award from the Office of the Federal Environmental Executive for 2008.

BNL also participates in NuRide, a computer-based ride-sharing program in which employees can find partners in their neighborhoods for carpooling. And it's greened its transportation further by using 15 small electric vehicles and 70 government fleet vehicles fueled by compressed natural gas. "Plus, our garbage truck and motor pool uses environmentally friendly vegetable oil, thanks to employees' pollution prevention ideas," says Pohlot.

Solar is the next wave, with a demo project to install solar-powered LED lights for the parking area in the works. "We are working with LIPA to potentially locate a utility-scale photovoltaic generating project at BNL," says Toscano, "which underscores our commitment to renewable energy."

For more information on the GreenLeaders program or to nominate a local company you know, go to GreenStreetLI.com.



Mark Toscano (left) and Peter Pohlot climb the stairs of Brookhaven National Laboratory's 71-foot chilled water facility, which has reduced electric demand by 2,000 kilowatts during peak daytime periods, saving over \$2 million in energy costs since 1998.

DOE Agency Wide Sustainability Initiative

Senior Sustainability Steering Committee

Chair: Deputy Secretary **Members:** Under Secretaries, CFO, GC, MA, HSS, EERE

Align DOE business practices—budget, acquisition, metrics and reporting—with EO goals

Power
Marketing
Administration

Sustainability Integration Team

Co-Chairs: MA-1 & LLNL Site Manager **Members:** Reps from S-2, S-3, CFO, GC, NA, SC, EM, FE, NLDC, EFCOG, OPAM, CIO, FEMP, OECM, & HSS

Manage preparation of Strategic Sustainability Performance Plan

Procurement &
Acquisition

Electronics &
Data Centers

Fossil Fuel,
Energy, &
Renewables

High
Performance
Buildings

Environmental
Stewardship

Co-chairs: OECM/DOE Site

Cap & Trade

Behavior
Change

Business
Planning

High Energy
Mission
Specific Facility

Summary

- **Numerous energy conservation and sustainability challenges, and opportunities**
 - Most are manageable but will require additional resources
- **Large Investment is needed**
 - Perhaps \$100 million or more just for BNL
 - Operating and maintenance cost increases
 - Required to ensure savings materialize and continue
 - **Conservation of Capital is Crucial**
 - Do the projects that get the most done, first
- **More requirements are coming**
 - Energy Security Act of 2007
 - New Executive Order and DOE Orders
 - Cap and Trade

Discussion

