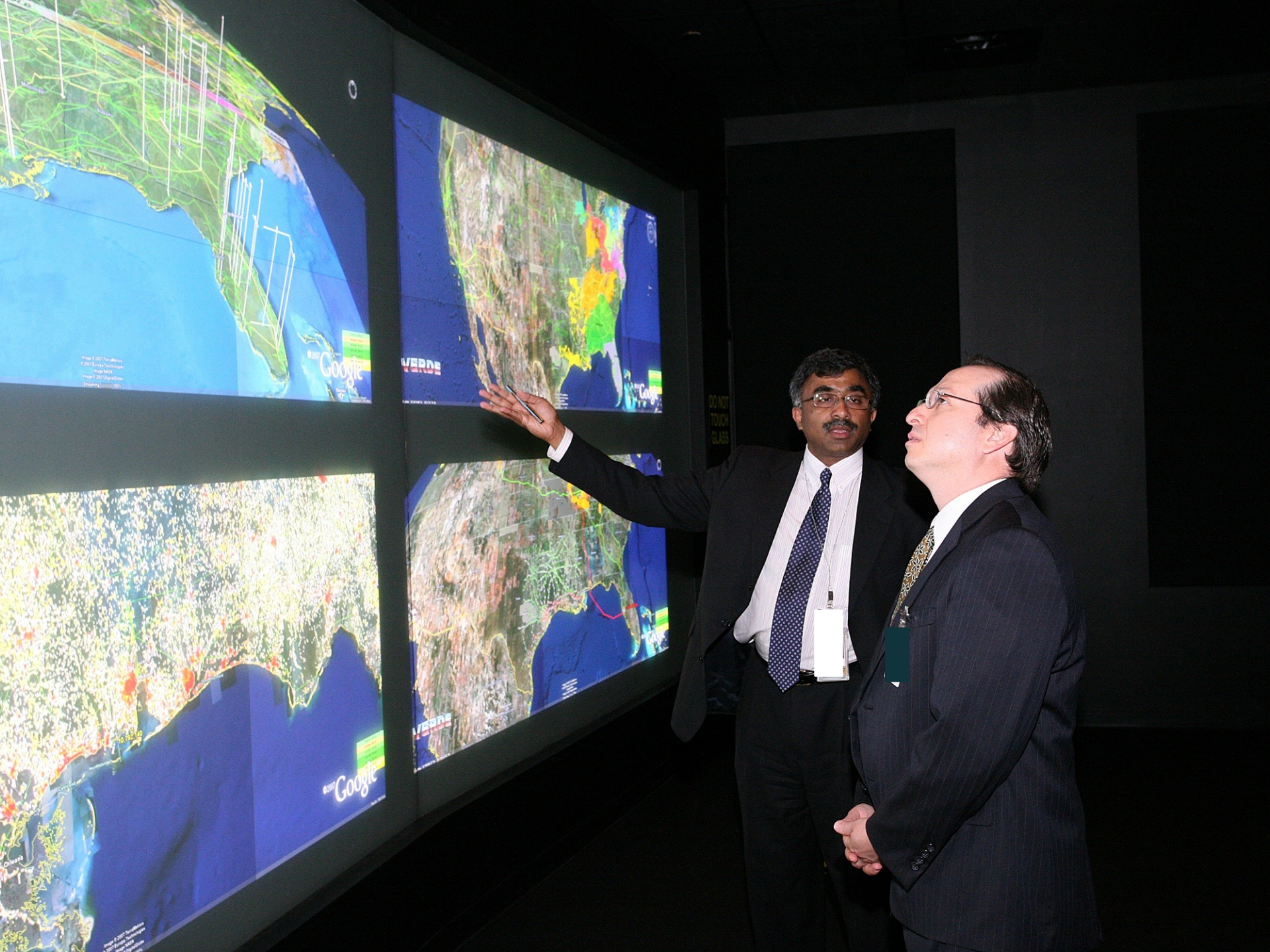
Assistant Secretary Alexander "Andy" Karsner, Energy Efficiency and Renewable Energy

Visit

June 4-5, 2008


OAK RIDGE
National Laboratory


DO NOT TOUCH GLASS


The Nobel Prize in Physics 1994
THE GRAPHITE REACTOR
The Graphite Reactor was a research reactor – a tool used for conducting nuclear research as well as for producing radioisotopes. The five basic features of the reactor's system include: fuel, moderator, control system, cooling system, and shield. Follow the yellow-colored signs found here and in the reactor's Control Room for a description of each feature.
ELEVATOR AND FUEL CHANNELS
This electric elevator allowed access to the fuel channels for loading fuel and other materials into the reactor. A shield plug is located at the opening of each fuel channel. To load the reactor with fuel, these shield plugs were removed, and the uranium fuel slugs were used to center the slugs inside the reactor.
When the reactor was unloaded, the long rods were used to push the slugs into the exit air duct. They fell onto a neoprene slab and down a chute into a canal of water 20 feet deep. Fuel slugs were stored in the canal until they were transferred to a chemical separations facility next to the reactor building for processing.
RADIATION ZONE
FUEL
MODERA


RADIATION
ZONE
THE GRAPHITE REACTOR
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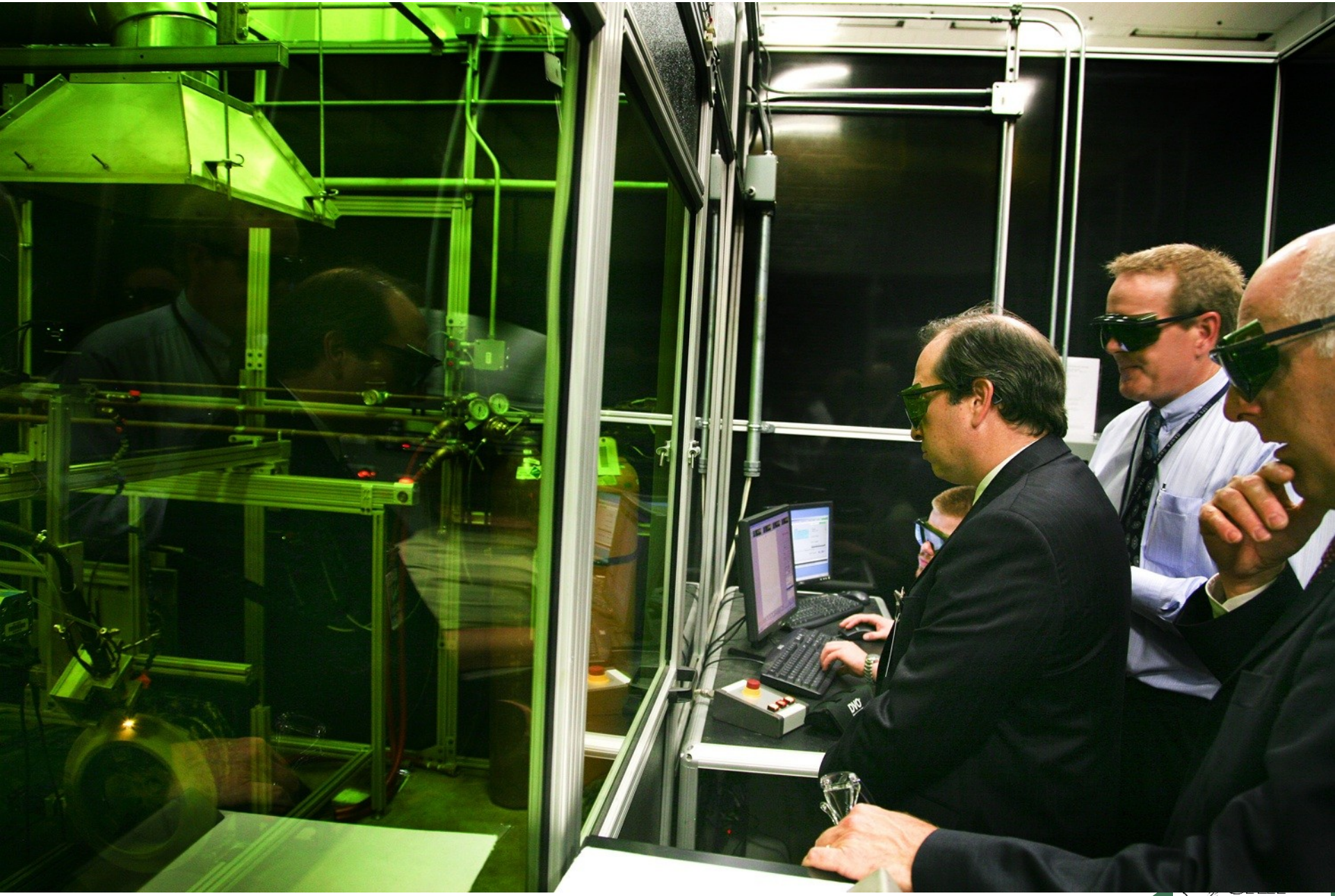


Boss | Allen | Hamilton


Wide Bandgap Materials
Objectives:
Technology Importance:
Target Applications:
Motor and HVAC Compressor Drives
Objectives:
Technology Importance:
Target Applications:
Advanced Power Electronics
ORNL PHEV Integrated Charger
ORNL Triple Output DC-DC Converter


Assess the impact of replacing silicon (Si) power devices in transportation applications with devices based on wide bandgap (WBG) semiconductors
Develop device models for system-level simulation studies and analyze the impact of WBG semiconductor based devices on the system performance
Build WBG semiconductor based prototype inverters/converters to validate the simulation results
Investigate novel concepts to take advantage of the superior properties of WBG semiconductors
Comparison of efficiencies between All-Si and Hybrid inverters
SEMIKRON
Si-SiC Hybrid Semikron inverter unit
Forward characteristics of a 1.2 kV, 15 A SiC MOSFET
Drain Current (Id), A
Drain to Source Voltage (Vds), V
Technology Importance:
WBG semiconductor devices have the potential to operate at higher efficiencies than their Si counterparts
Reduced thermal management requirements (smaller heat sinks) due to high temperature operation capability of WBG semiconductor based power devices
Smaller passive components are required since WBG semiconductor based power devices can be switched at higher frequencies
Smaller heat sinks and passive components result in higher power density converters
DSP
Snubber
Heatsink
Gate Driver
IGBT Module
DC bus Capacitor
Si-SiC Hybrid Inverter benchtop test prototype with 600 V, 300 A devices
Target Applications:
High temperature converters/inverters
High power motor drives
Dc-Dc converter
Power factor correction circuits
Utility applications
UT-BATTELLE
Objectives:
Reduce cost, size, volume, and complexity by integrating the traction motor and compressor drives to reduce the number of switches and other components
Technology Importance:
Fuel cell powered vehicles require an electric motor driven compressor for HVAC
The electric compressor enables HEVs to shut off the engine during vehicle stops for reducing emissions and improving fuel economy
Target Applications:
Hybrid electric vehicles
UT-BATTELLE
Bi-Directional Triple-Vol
DC/DC Converter
Silicon IGBTs
DSP Control Card
ORNL Integrated Traction and Compressor Motor Drive


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National Laboratory
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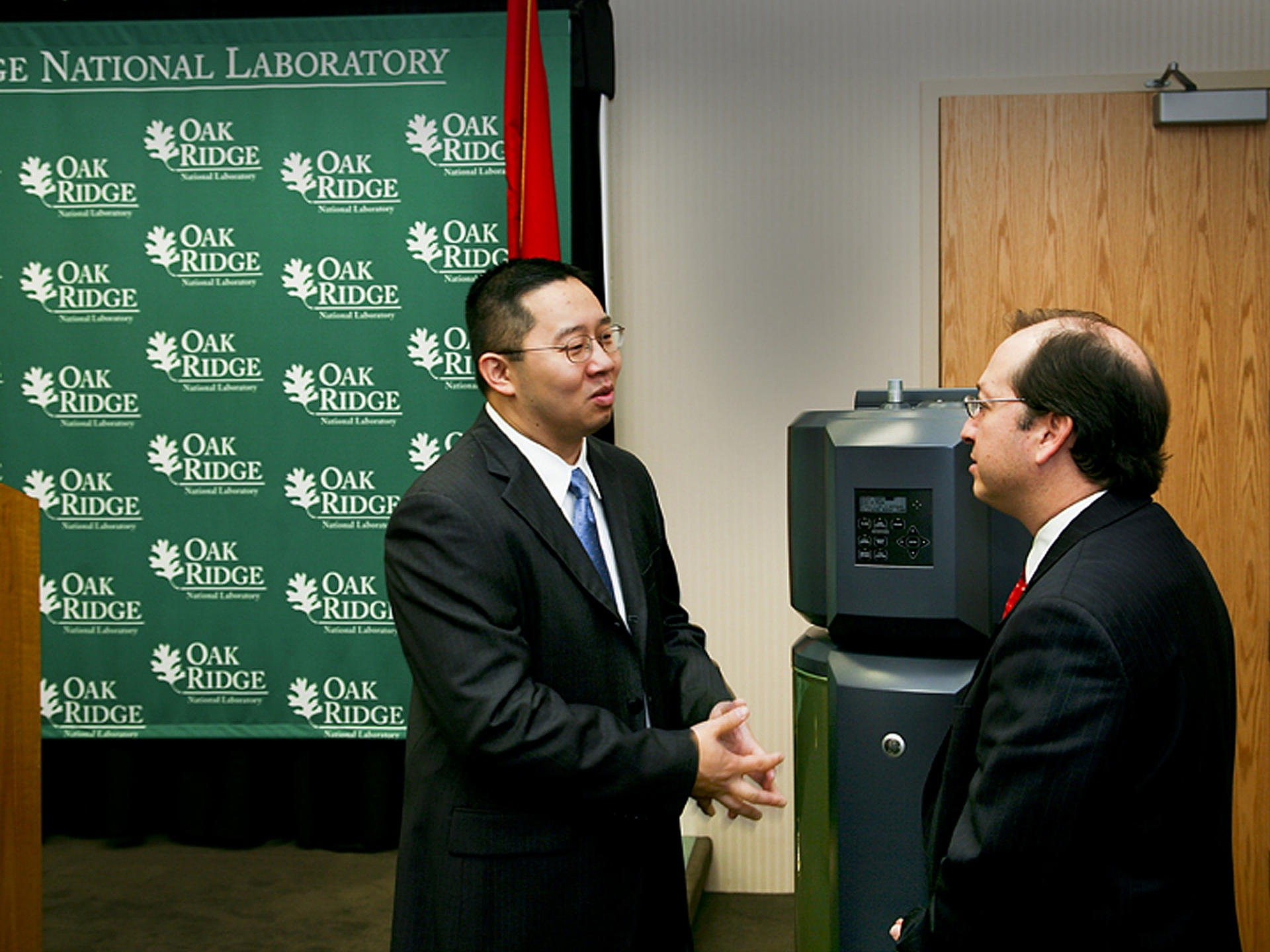
GE NATIONAL LABORATORY
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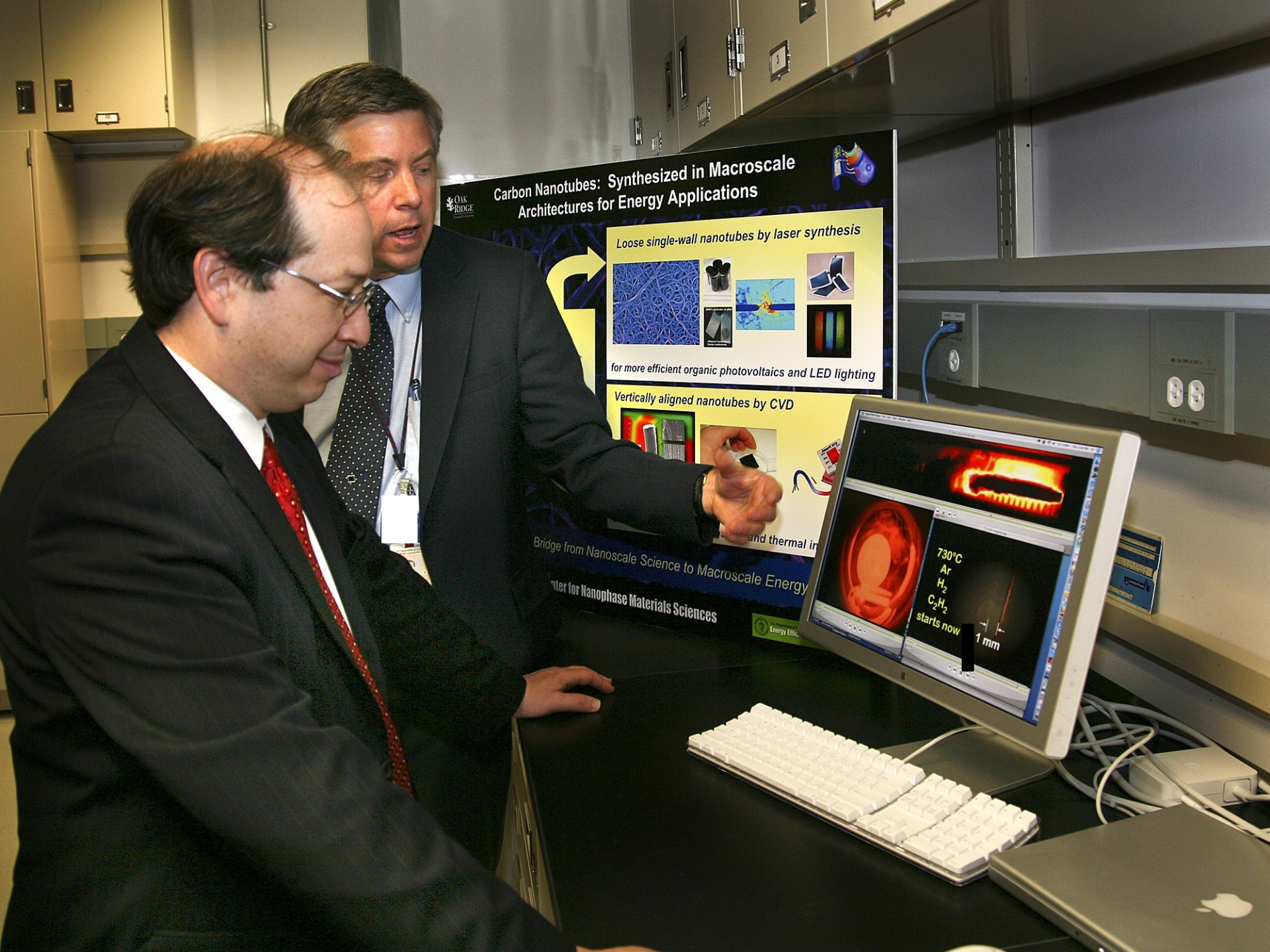
Carbon Nanotubes: Synthesized in Macroscale Architectures for Energy Applications
Loose single-wall nanotubes by laser synthesis
for more efficient organic photovoltaics and LED lighting
Vertically aligned nanotubes by CVD
Bridge from Nanoscale Science to Macroscale Energy
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Ar
H_2
C_2H_2
starts now
1 mm


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ENERGY
EXIT


urce &. Engineering Systems
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Environmental Sciences Division
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• Where are the feedstocks?
• What are the sustainability constraints?
• What are the supply options?
A Research
Develop
that is e
break d
into sug


Resource & Engineering Systems
OFFICE OF THE BIOMASS PROGRAM
Environmental Sciences Division
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Increase efficiency of the biofuel production process
CURRENT PROCESS
Cellulose Hydrolysis


Biofuel Powered
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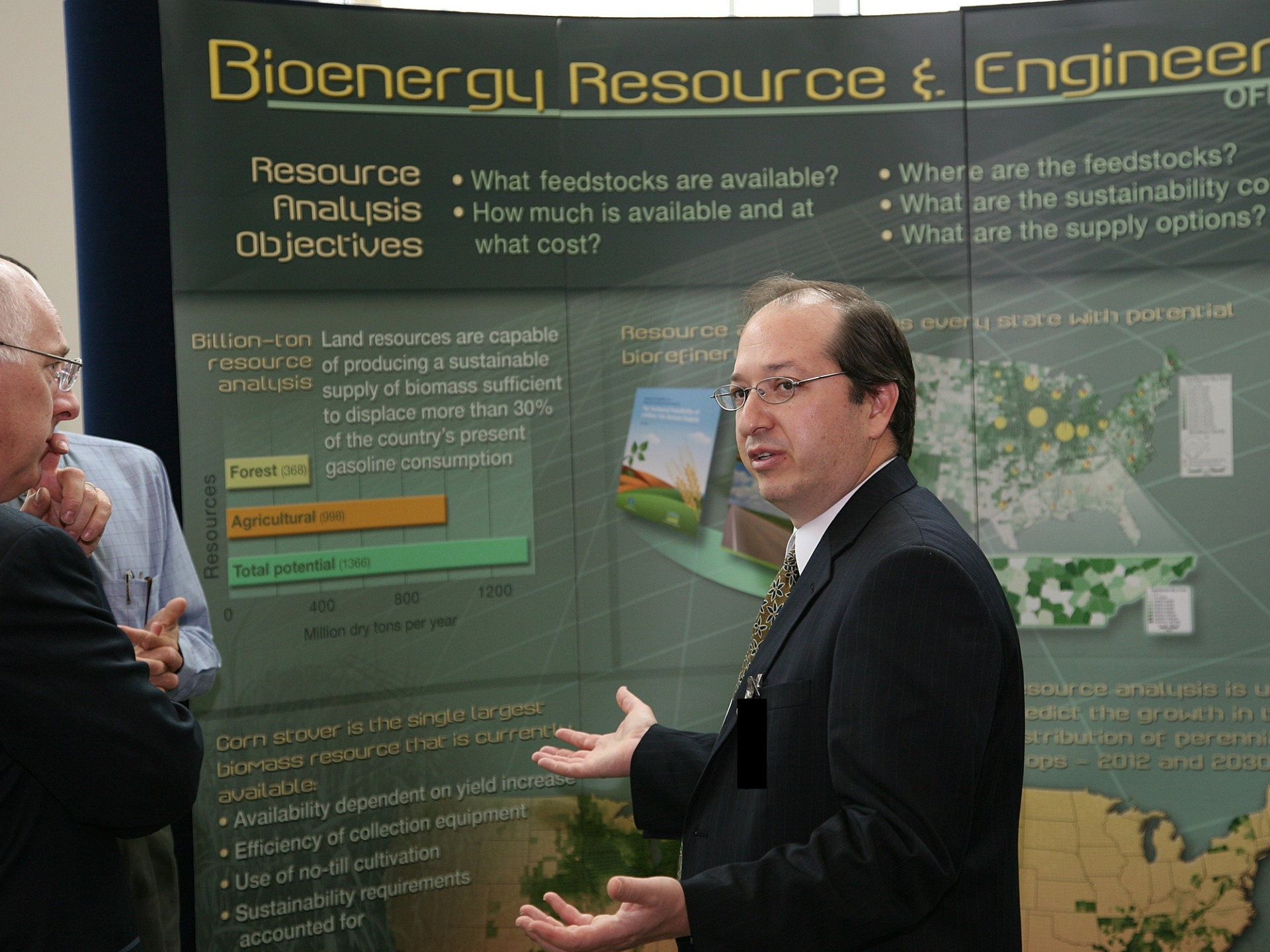
Center Mission
CLEAN AND
GREEN
for Biomass Supply Chains
Energy Efficiency and Renewable Energy
Biomass
OAK RIDGE
Transportation and Storage
Biomass Supply Analysis and
Model (IBSAL)
IBSAL simulates equipment and processes along the biomass supply chain from the field to the biorefinery. It can be used to estimate costs, energy requirements, and carbon emissions of harvest, handling, storage, transport, and preprocessing of a feedstock.
Bioenergy Cycle
ornl
NREL


BESC
BioEnergy Science Center
Increase efficiency of the
production process
CURRENT PROCESS
Develop biomass
that is easier to
break down
into sugars
Energy Efficiency an
Renewable Energy


Bioenergy Resource &. Engineer
Resource Analysis Objectives
• What feedstocks are available?
• How much is available and at what cost?
• Where are the feedstocks?
• What are the sustainability co
• What are the supply options?
Billion-ton resource analysis
Land resources are capable of producing a sustainable supply of biomass sufficient to displace more than 30% of the country's present gasoline consumption
Resources
Forest (368)
Agricultural (998)
Total potential (1366)
0
400
800
1200
Million dry tons per year
Corn stover is the single largest biomass resource that is currently available:
• Availability dependent on yield increase
• Efficiency of collection equipment
• Use of no-till cultivation
• Sustainability requirements accounted for


OAK RIDGE
Annual Hybrid Vehicle Showcase
SUSTAINABLE CAMPUS INITIATIVE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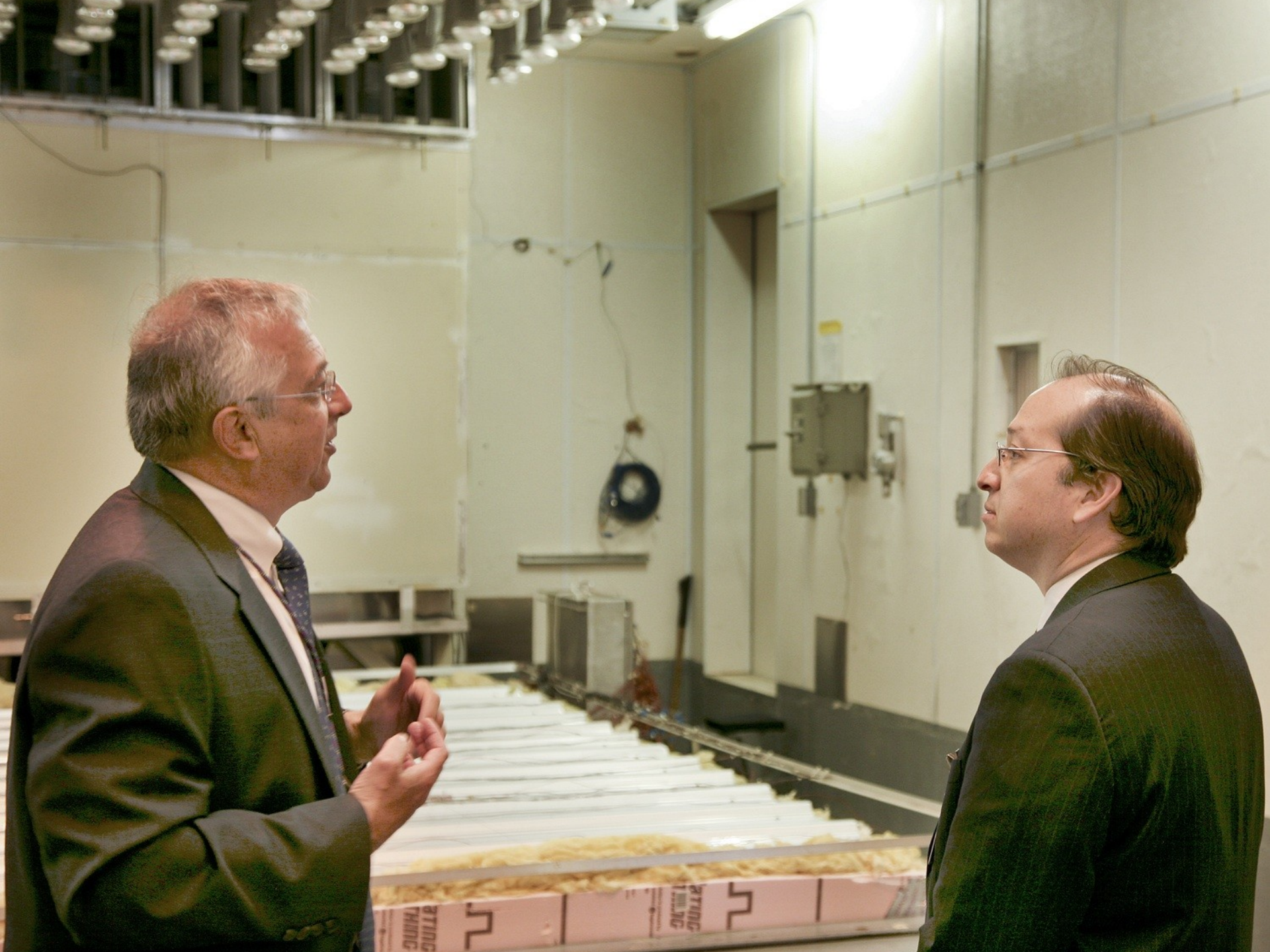
Single-Axis Tracking
Photovoltaic System
ENERGY MANAGEMENT




Industry:
l Energy Picture
Industr
largest
using s
37% of
natural
gas dem
29% of U
electricity
demand
30% of U.S.
greenhouse g
emissions
Industrial Technologies Program
Oak R
Indust
ITP D
ogy Solutions
Science


Industrial Technologies Program
Rapid Infrared Heating Technology offers a Low-cost, Energy Efficient Heating Methodology with Significant Enhancement in Material Properties
Science


R&D 100
2006
Award Winner
TMA® 6301 and TMA® 4701
Heat-Resistant Alloys
Metals & Ceramics


R&D 100
2006 Award Winner
TMA® 6301 and TMA® 4701
Heat-Resistant Alloys


HTML's New RSUC Laboratory
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129-A


Development of Materials Analysis Tools for Studying NO_x Adsorber Catalysts
A cooperative research and development agreement with Cummins Engine Company
Roger England, Bill Epling, Howard Fang and Tom Yonushonis
Cummins Engine Company
Introduction
Objective
Results: X-ray Diffraction
Microscopy
Results: Spectroscopy
Summary
bulletin


Oxidized PAN Fiber
PAN Precursor


Booz | Allen | Hamilton


Composites for Transportation


POWER ELECTRONICS AND ELECTRIC MACHINES
Wide Bandgap Materials
Objectives:
Technology Importance:
POWER ELECTRONICS AND ELECTRIC MACHINES
Integrated Traction Motor and HVAC Compressor Drives
Objectives:
Technology Importance:
Target Applications:
POWER ELECTRONICS AND ELECTRIC MACHINES
Bi-directional Triple-Voltage DC-DC Converter
Objectives:
Technology Importance:
Target Applications:
POWER ELECTRONICS AND ELECTRIC MACHINES
Cascade Multilevel Inverter for Fuel Cell Based HEV
Objectives:
Technology Importance:
ORNL PHEV Integrated Charger


EXIT


ergy Efficiency, Renewable Energy, & Electricity Delivery
Pursuing Ener
Disc
Dev
Del


NICS
ORNL IS A LEADER IN SUSTAINABILITY
A SUSTAINABLE CAMPUS
High-level metric:
Ratio of total data center power to IT equipment power
STATUS OF ORNL TEAM INITIAT


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