

Brookhaven National Laboratory: Overview

*East Coast Conference for Undergraduate
Women in Physics*

*Doon Gibbs
January 17, 2014*



DOE National Labs

SLAC National Accelerator Laboratory
Menlo Park, California

Pacific Northwest National Laboratory
Richland, Washington

Idaho National Laboratory
Idaho Falls, Idaho

National Renewable Energy Laboratory
Golden, Colorado

Ames Laboratory
Ames, Iowa

Argonne National Laboratory
Argonne, Illinois

Fermi National Accelerator Laboratory
Batavia, Illinois

National Energy Technology Laboratory
Morgantown, West Virginia
Pittsburgh, Pennsylvania

Brookhaven National Laboratory
Upton, New York

Sandia National Laboratories
Livermore, California
Albuquerque, New Mexico

Lawrence Livermore National Laboratory
Livermore, California

Lawrence Berkeley National Laboratory
Berkeley, California

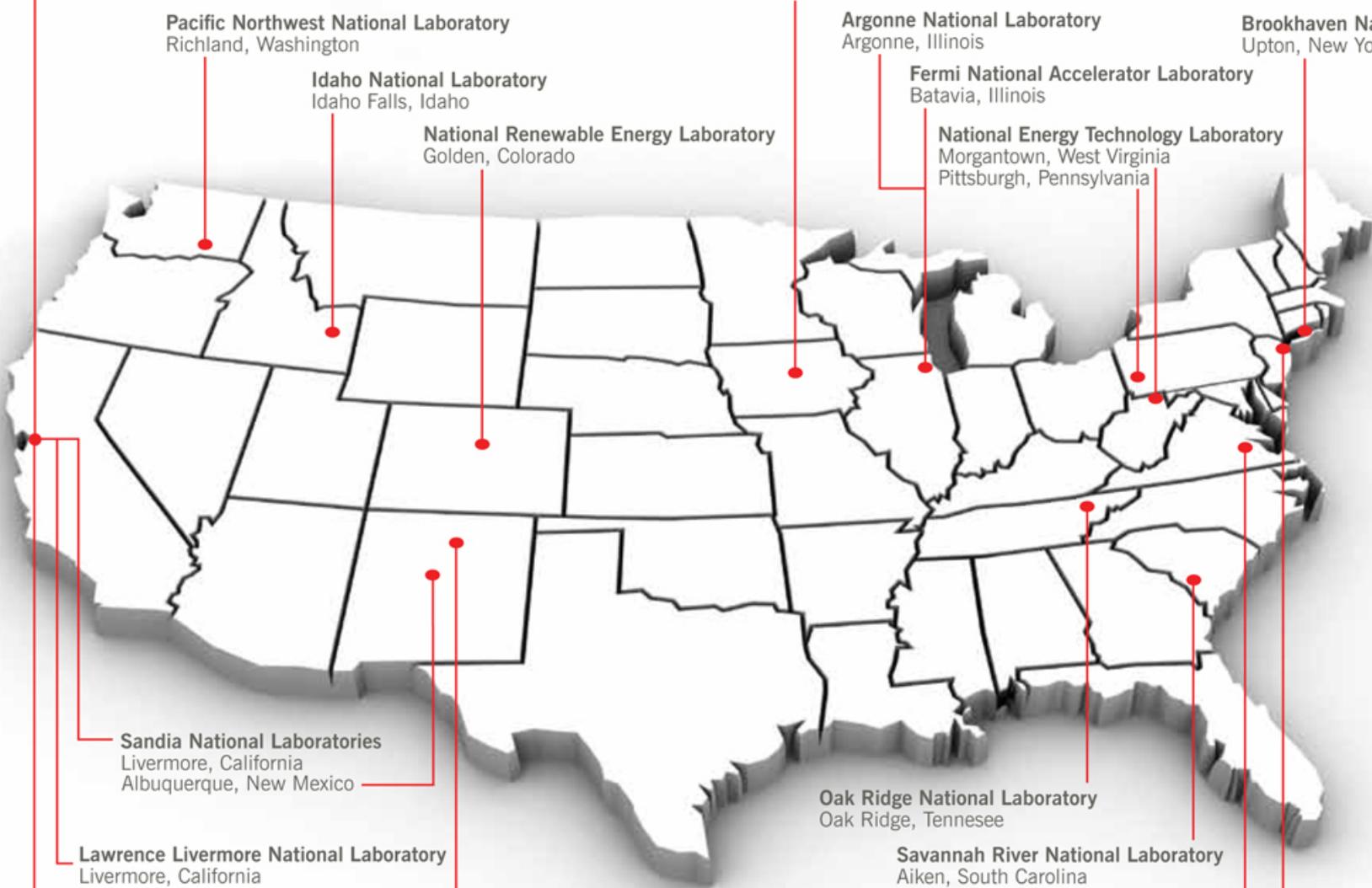
Los Alamos National Laboratory
Los Alamos, New Mexico

Oak Ridge National Laboratory
Oak Ridge, Tennessee

Savannah River National Laboratory
Aiken, South Carolina

Thomas Jefferson National Accelerator Facility
Newport News, Virginia

Princeton Plasma Physics Laboratory
Princeton, New Jersey



The Laboratory at a Glance...

- Est. 1947
- Managed by Brookhaven Science Associates founded by Stony Brook University and Battelle Memorial Institute under contract with the US DOE
 - One of six Office Science Labs—only one in NE
- Over 3,000 employees with 98% living on LI
 - Over \$700 M annual budget
 - 5,320 acres with 350 buildings
- Major user facility for university and industry researchers
 - Over 4,000 users per year
 - Stony Brook University is Lab's largest user
- Fundamental, basic research to innovation, development and commercialization of technologies: nuclear physics, energy S&T, life and nano-sciences, national security



U.S. DEPARTMENT OF
ENERGY

Office of
Science



Battelle

The Business of Innovation

Research Leadership



1957



1976



1980



1988



2002



2003



2009

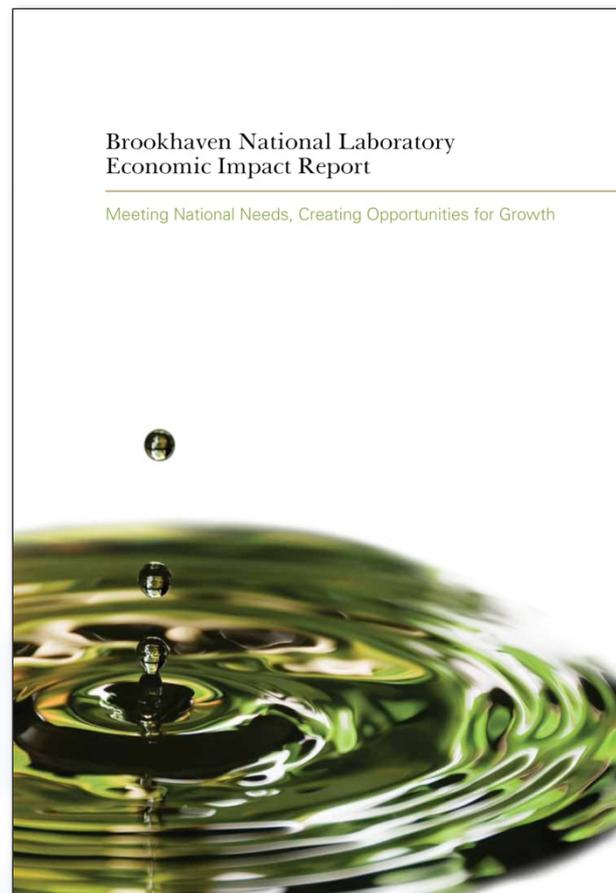


5 Nat' l Medal of Science winners
5 Fermi Awards
11 Lawrence Awards
2 Wolf Prizes
20 NAS/NAE members

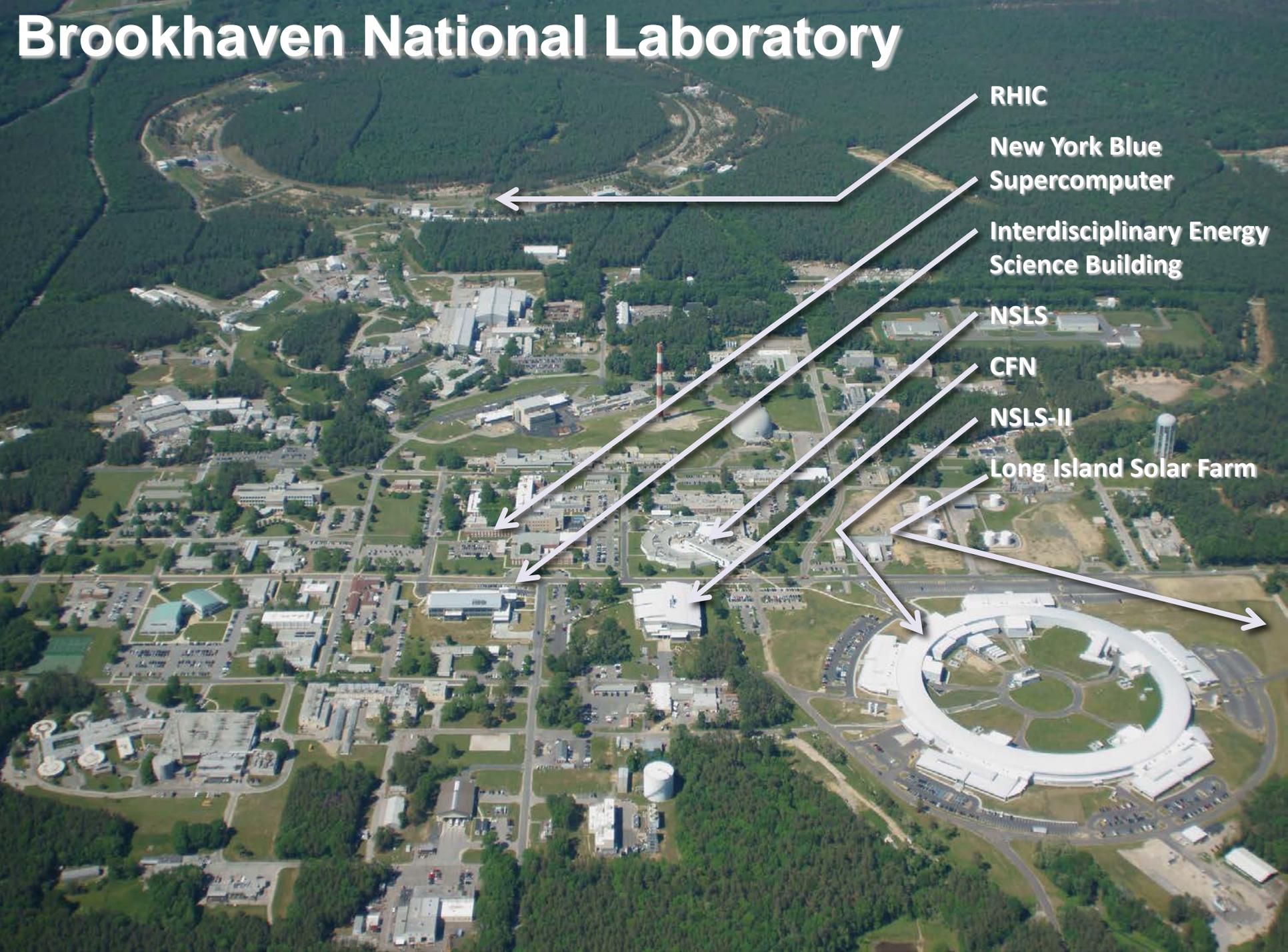
2009 National Medal of Science

BNL Economic Impact on New York State and Long Island

- Total 2009 economic output:
 - \$704M
 - 5,400 jobs
 - \$212M goods and services
 - \$74.7M in new construction and renovation
- Annual economic output 2010-2014
 - \$950M
 - 7,100 jobs



Brookhaven National Laboratory



- RHIC
- New York Blue Supercomputer
- Interdisciplinary Energy Science Building
- NSLS
- CFN
- NSLS-II
- Long Island Solar Farm

Major Research Facilities



National Synchrotron Light Source

National Synchrotron Light Source

- One of world's most powerful tools observing structure and behavior of matter
- Researching energy, Alzheimer's disease, breast cancer, HIV/AIDS, environmental cleanup technology and more



National Synchrotron Light Source II

National Synchrotron Light Source II

- Soon to be world's brightest X-ray light source
- \$960 million project - hundreds of local jobs
- **Scheduled for completion in 2014**
- Approx. 3,000 visiting researchers



Center for Functional Nanomaterials

Center for Functional Nanomaterials

- Exploring energy science at the nanoscale
- Building new materials atom-by-atom to achieve desired properties and functions

Major Research Facilities



Relativistic Heavy Ion Collider (RHIC)

RHIC

- 2.4 mile circumference
- Studying the origins of the universe through particle collisions revealing make up of matter
- Discovery of the ‘perfect liquid’



New York Blue Supercomputer

New York Center for Computational Science

- Partnership between BNL & Stony Brook University
- Two IBM supercomputers
- Supports broad range of research



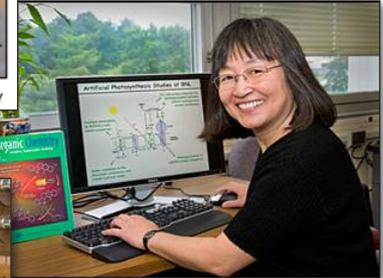
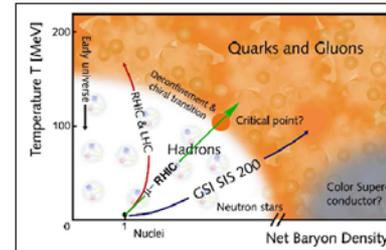
Long Island Solar Farm

Long Island Solar Farm

- Partnership between BNL, LIPA and BPSolar
- 32MW Peak to power 4500 L.I. homes
- Unique opportunity to study renewables in the Northeast and test new Grid technologies

Lab Core Capabilities

- Particle Physics
- Nuclear Physics
- Applied Nuclear S&T
- Condensed Matter Physics & Materials Science
- Chemical & Molecular Science
- Applied Materials Science & Eng.
- Chemical Engineering
- Climate Change Science
- Biological Systems Science
- Accelerator Science
- Large Scale User Facilities/Advanced Instrumentation
- Systems Engineering and Integration



Relativistic Heavy Ion Collider (RHIC)

The world's highest energy machine for fundamental nuclear physics and the only particle collider in the U.S.

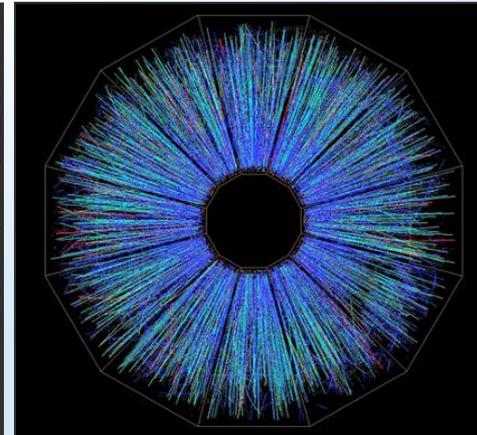
- World-wide collaboration of more than 1000 scientists, engineers and students

Unique, most powerful microscope to explore the mysterious world of the Strong Force inside the proton and 0.00001 sec after the birth of the universe

- 4,000,000,000,000K
- It is a Quark-Gluon Plasma and a “Perfect Liquid”!

Future upgrades - eRHIC

- Collide electrons with ions
- Learn what's at the heart of all visible matter



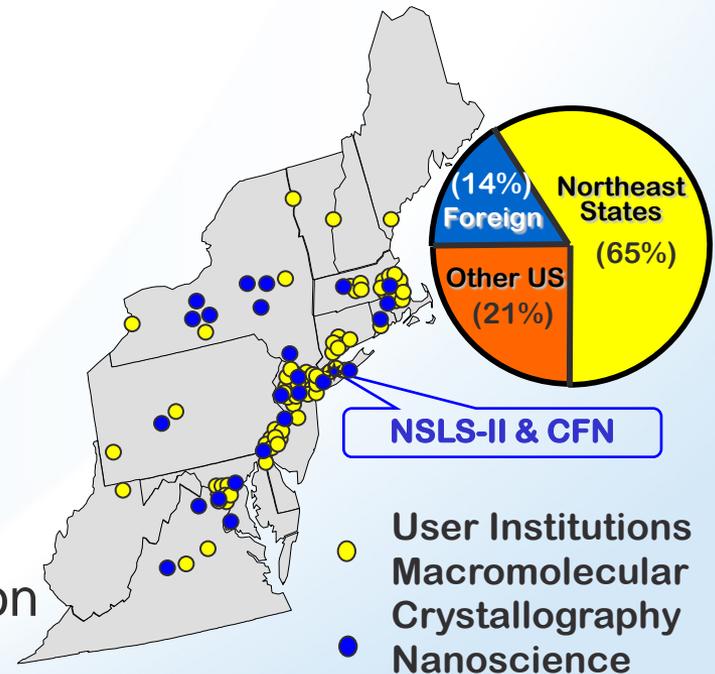
National Synchrotron Light Source (NSLS)

Crucial resource for the Northeast

- ~2000 Users annually
- 400 institutions
 - academic, industrial, government
- About 1000 publications/yr
- 25% in premier journals

Amazing diversity of research:

- Chemistry, Physics, Nanoscience, Energy Science, Structural Biology, Environment and other BNL facilities
- 2 most recent Nobel Prizes
- Used by industry to develop next generation computer chips and advanced batteries



NSLS-II: Enable the Nanoscience Revolution

World-leading performance

- 10,000 brighter than NSLS
- Spatial resolution at atomic/molecular scale
- Energy resolution capable of studying processes like catalysis
- Synergy with the Center for Functional Nanomaterials
 - Real-time characterization of new materials, reactions, processes

Ground breaking June, 2009

- Status as of last week
 - 91% Complete
- Completed in 2014
- Project Cost almost \$1 Billion



Center for Functional Nanomaterials (CFN)

Mission: To develop and share materials and processes at the nano-scale to address the nation's critical **energy** needs

- Offers materials preparation, characterization, theory and develop new techniques

Science Themes

- Electronic Nanomaterials
- Soft/Bio Nanomaterials
- Nano-catalysis/Interfaces

Facts

- Full operations: May `08
- 50-60 Staff
- Hundreds of Users each year



Brookhaven Energy R&D: A Collaborative Approach

Basic Research, Applied Research, and Industry Working Together

BNL Resources

CFN/Nanoscience



NSLS/NSLS-II



ISB-I



LISF



New York Blue

BNL
Research



NY State Consortia/Resources

ENERGY CHALLENGES: New York and Beyond

- Electric Systems
- Sustainable Fuels

DOE ALIGNMENT/LEVERAGE

- DOE Priority Research Directions
- 4 Energy Frontier Research Centers

Collaborators/Joint Appointments



Rensselaer



R·I·T



SYRACUSE



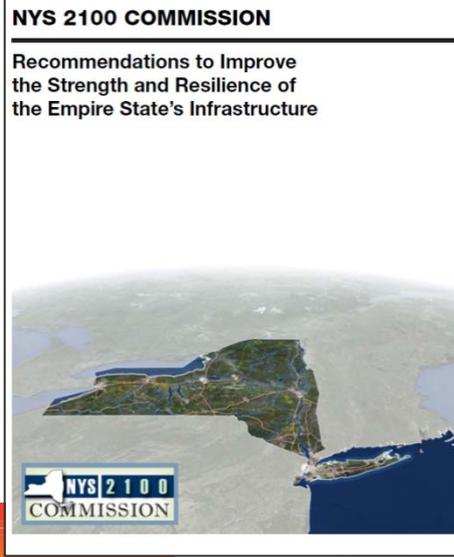
IBM



BROOKHAVEN
NATIONAL LABORATORY

SGRID3 → An LIREDC transformational project (BNL/SBU)

- Selected in 2011 –
 - Design and pilot projects moving forward
 - Partnerships with utilities strong and growing – LIPA, ORU, NYS Smart Grid Consortium
- Vulnerabilities Exposed by Sandy highlighted the need
 - Improved Reliability, Resilience, Recovery (3R)
- NYS 2100 Commission Reports highlight grid needs
 - SBU and BNL personnel served as “Experts”
- Strategy
 - Seeking Federal support of a electric grid distribution laboratory
 - Seeking state support of specific projects
 - Long Island dynamic Micro-grid Proposal – a 3R solution for LI and the region



The Urgent Challenge: New York's Vulnerable Electric Grid

Historic impacts from three major storms in less than two years have highlighted fundamental vulnerabilities and limitations of the state's electric grid. In addition to interruptions and severe damage from storms, the grid is exposed to potential devastation from cyber-attacks and grid disturbances originating from outside the state. The delivery of reliable, reasonably priced, high quality power is needed to drive New York's economic growth agenda and maintain competitiveness. New York must address its major vulnerability issues on an aggressive timescale to protect its residents and their economic future.

Strategy: Move immediately to support the Governor's initiatives to address the electric grid vulnerabilities by bringing together the best minds and resources to analyze, plan and recommend solutions and to accelerate grid modernization.

Action Plan:
Phase I: Rebuild Smarter - Now through June 2013

- Act as an "honest broker" to host and facilitate workshops to identify lessons learned and best practices in storm planning, response and recovery
- Convene panels of experts identify "ready now" smart grid technologies to improve storm preparation, planning, system resilience and recovery actions that are deployable in time for the next storm season
- Identify successful operating and planning approaches and relevant technologies in other states that can be applied in NY
- Through these interactions identify technology needs/gaps and initiate research to produce solutions
- Identify energy policy barriers and develop needed revisions
- Conduct accelerated validation and pre-deployment testing of new disaster planning/avoidance, response and recovery technologies

The Vision: An efficient, resilient, reliable New York electric grid that rapidly recovers from disasters. Smart devices that provide real-time information on the state of the electric grid can inform system operators and consumers. Control systems and operational tools that enable utilization of this information and grid components utilizing advanced materials are rapidly evolving. Benefits are clear: grid efficiency, reliability and resilience, enhanced recovery, and a more informed and empowered public. New York has a competitive advantage through our leadership in science and technology and a head start through state investments that recognize the economic development opportunity associated with smart grid technology acceleration. The post-Sandy need to immediately improve grid reliability, resilience, and security is driving a thorough review of energy policy, utility company and power authority structure and roles, storm planning and recovery management. Exploiting the knowledge gained to modernize the grid presents a unique opportunity for New York.

The Process: Engage NYS Energy Stakeholders to work together for effective grid modernization
 The scale and scope of modernizing the New York state electric grid are formidable. The New York State Smart Grid Consortium membership brings diverse and powerful resources together to address common non-competitive challenges in technologies, systems, operations, and policies. The Consortium will facilitate communication and inter-actor policy-makers. Building SGRID, proving existing technologies, and for improving technologies, and for improving technologies, and for improving technologies.

Realizing the Vision: Util support planning, implement of the New York "Smarter" challenge. The New York addressing needed modernization efficiently move power across provides national leadership in



ADVANCED ENERGY RESEARCH AND TECHNOLOGY CENTER

