Strengthening America's Infrastructure in Cyber and Energy Security

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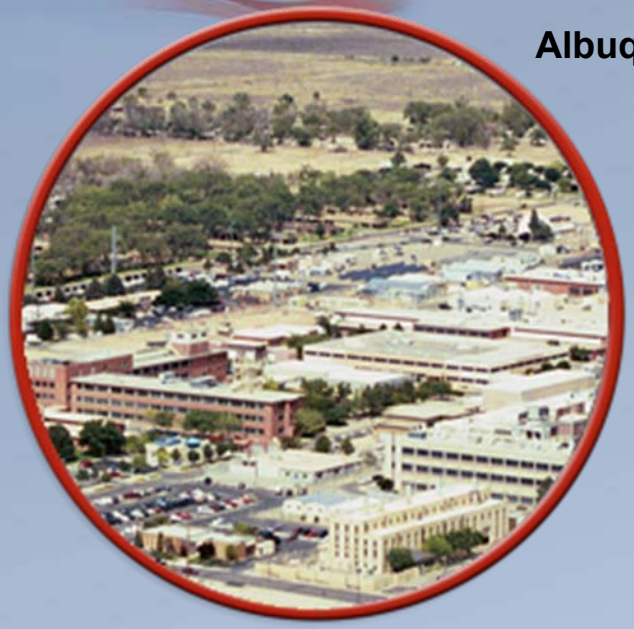
Washington DC

Sandia National Laboratories is a Multi-Program National Security Laboratory

Albuquerque, NM



Livermore, CA

THE WHITE HOUSE
WASHINGTON

May 13, 1949

Dear Mr. Wilson:

I am informed that the Atomic Energy Commission intends to ask that the Bell Telephone Laboratories accept under contract the direction of the Sandia Laboratory at Albuquerque, New Mexico.

This operation, which is a vital segment of the atomic weapons program, is of extreme importance and urgency in the national defense, and should have the best possible technical direction.

I hope that after you have heard more in detail from the Atomic Energy Commission, your organization will find it possible to undertake this task. In my opinion you have here an opportunity to render an exceptional service in the national interest.

I am writing a similar note direct to Dr. O. E. Buckley.

Very sincerely yours,

Harry Truman

Mr. Leroy A. Wilson,
President,
American Telephone and Telegraph Company,
195 Broadway,
New York 7, N. Y.

AMERICAN TELEPHONE & TELEGRAPH CO.
BELL SYSTEM
AND ASSOCIATED COMPANIES

LDRD
LABORATORY DIRECTED RESEARCH & DEVELOPMENT

Sandia National Laboratories

Six Strategic Management Units are Aligned with National Security Missions

Integrated Technologies and Systems
Three Management Units

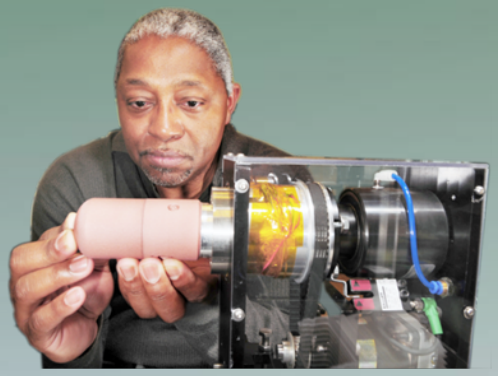
Energy, Resources, & Nonproliferation

Homeland Security & Defense

Defense Systems & Assessments

Nuclear Weapons
One Management Unit

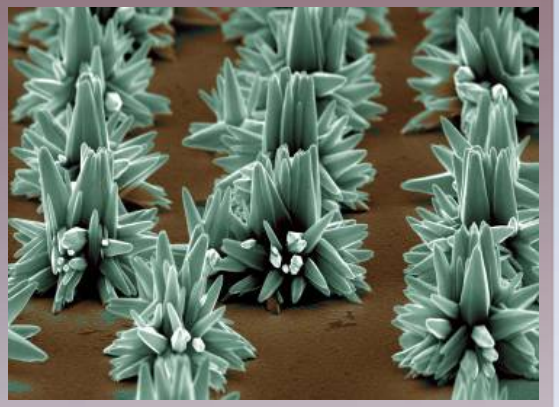
Nuclear Weapons



Laboratory Transformation
Two Management Units

Science, Technology, and Engineering

Integrated Enabling Services



LDRD Objectives (DOE Order 413.2b)

- *Enhance the laboratories' ability to address future DOE/NNSA missions*
- *Serve as a proving ground for new concepts in research and development*
- *Support high-risk, potentially high-value research and development.*

LDRD Cyber and Energy Security Portfolio

Informatics
Security
Computer science
Systems analysis

Batteries
Alternate energy storage
Renewable fuels
Nuclear and renewable sources

A Resilient, Trusted and Secure Cyber System is Central to America's Security and Economic Vitality

" … our digital infrastructure — the networks and computers we depend on every day — will be treated as they should be: as a strategic national asset. Protecting this infrastructure will be a national security priority. We will ensure that these networks are secure, trustworthy and resilient. " President Obama (5/29/09)

Cyber system threats affect private, commercial and government computer systems and databases:

- Virus
- Trojan Horse
- Phishing
- Spam
- Spyware

U.S. eyes N. Korea for 'massive' cyber attacks
(MSNBC News, 7/9/09)

Millions of machines in US are infected by botnets and other malware.
(Kaspersky Security Network, 9/08)

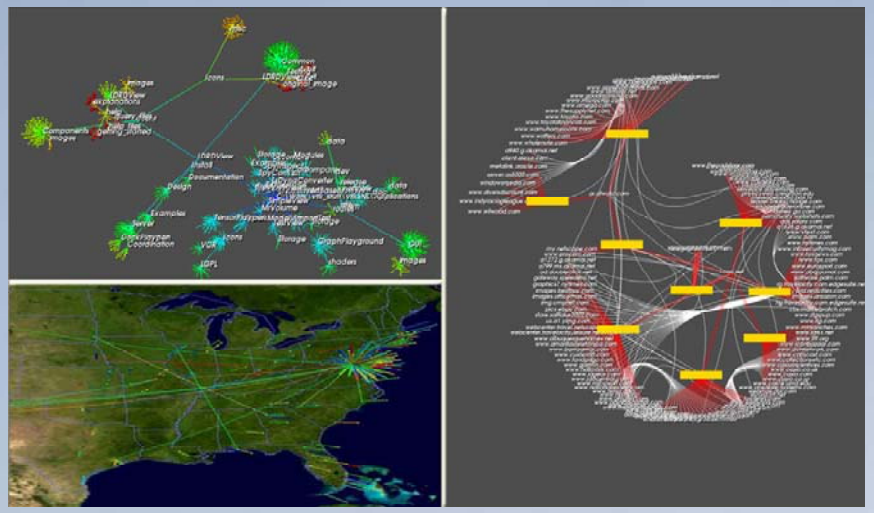
Advancing Informatics for Attack Network Monitoring and Data Extraction

Approach

- Interactive informatics on massive data sets
- Scalable simulation of botnet attacks
- Trusted hardware and software design

Accomplishments

- Analyst-focused, interactive graph analysis
- Internet network emulation at 10^7 node scale
- Tested resilience of Exascale architectures



Real-time monitoring of network traffic via new streaming algorithms

Significance

- Advanced computational and analyst tools for threat awareness and protection
- Fundamental changes in system resilience, reliability and productivity

Building the Foundation for Quantum Computing With Si Quantum Dots

Challenges

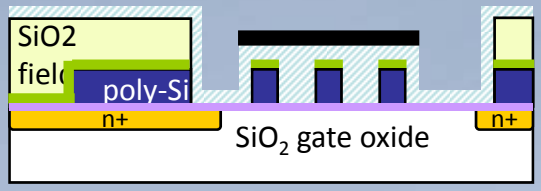
- Quamtum dot and circuit fabrication for logical Qbit
- Low temperature Electronics
- Theory
- Modeling & error correction algorithms

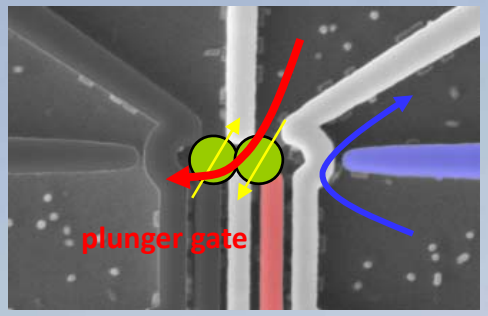
Accomplishments

- Achieved first disorder free Si quantum dot
- Tested cryogenic circuit elements at 4K
- Developed initial designs for logical qubit

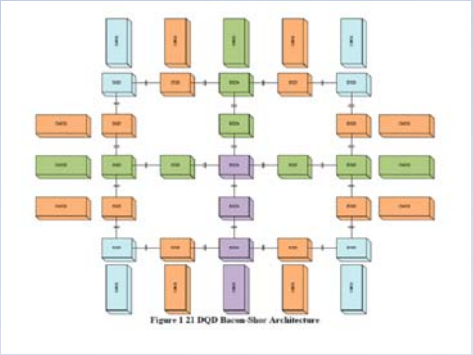
Significance

- Leading the way to High-Performance Quantum Computing through Si nanoelectronics & modeling



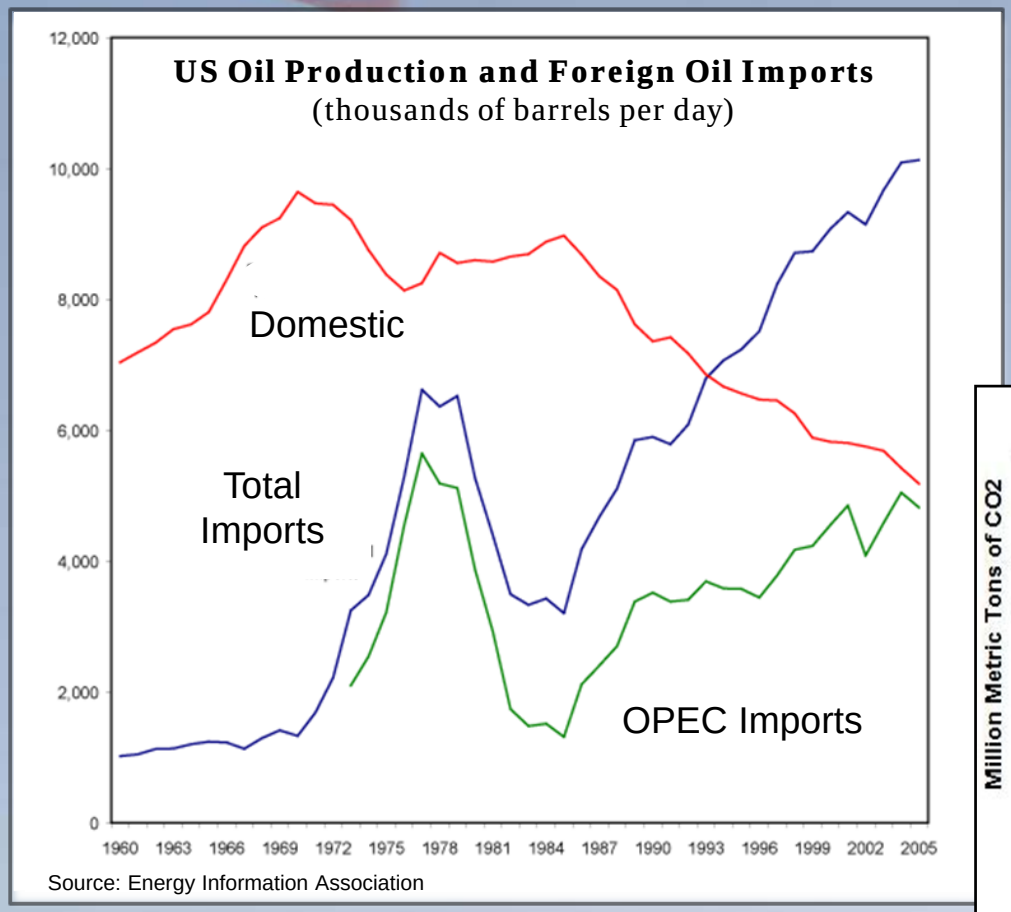


Physical Qubit & Native Gate Set



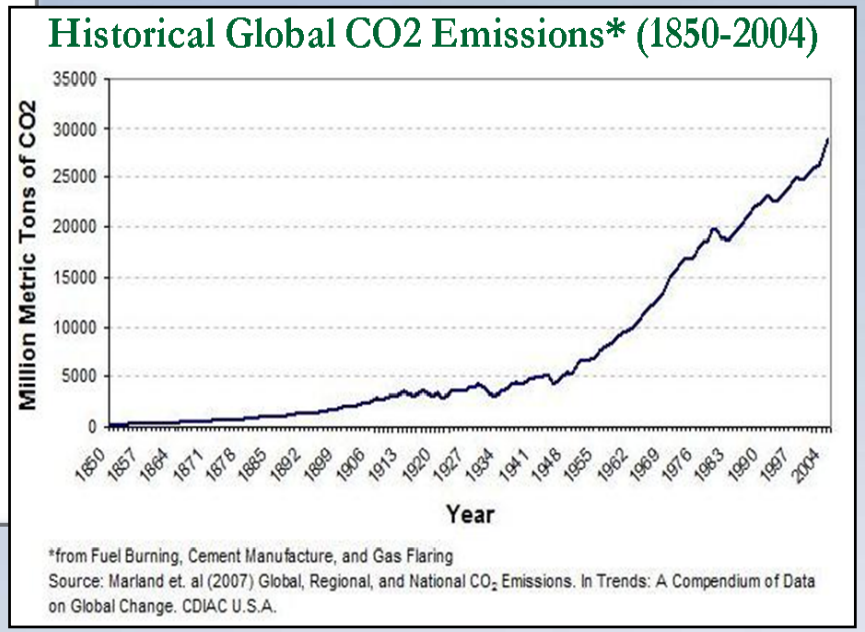
Logical Qubit Architecture

America's Energy Challenges



Energy Supply

Greenhouse Gas Emissions



Advancing Battery Technologies for Energy Storage and Transportation

Approach

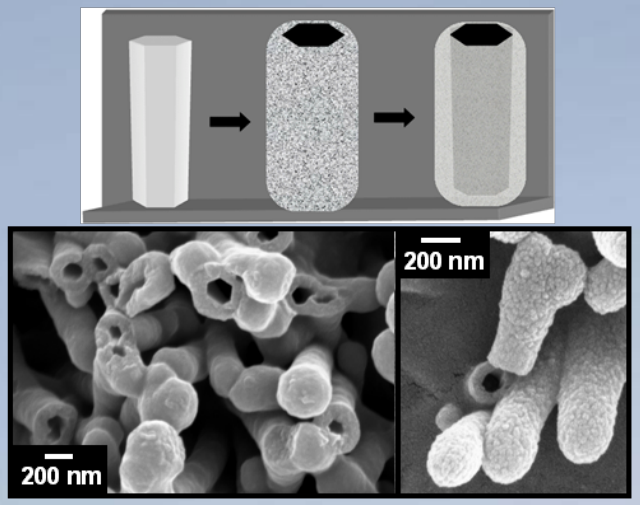
- Nanoscience and kinetics of battery materials
- Solution synthesis on nanoscale templates
- Direct printing of anode and cathode materials
- Flame retardant Li-salts and polymer separators

Accomplishments

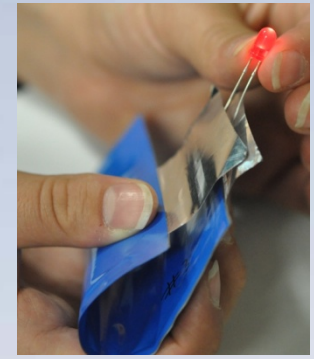
- Templating produces up to 3X capacitance improvement
- Printed battery shows good voltage performance
- Synthesis of alternate, non-precious electrode assemblies

Significance

- Enhanced materials for ultracapacitor, battery, and fuel cells
- Direct printing allows for flexible foldable battery architecture
- Safer, cost-effective batteries for Hybrids and Plug-in Hybrids



RuO_2 on Inorganic Templates

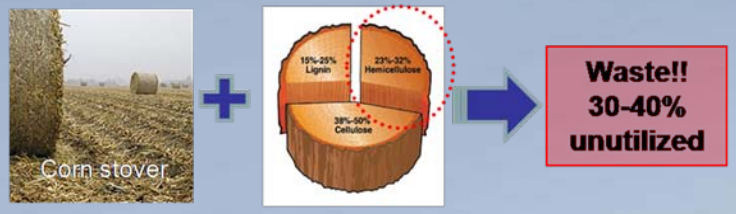


Flexible, foldable battery architecture

Developing New Technologies for Plant Biomass Conversion to Biofuel

Challenges

- Inefficiency and cost of bioethanol production
- Convert of lignocellulose into fermentable sugars
- Convert both hexose and pentose sugars into ethanol

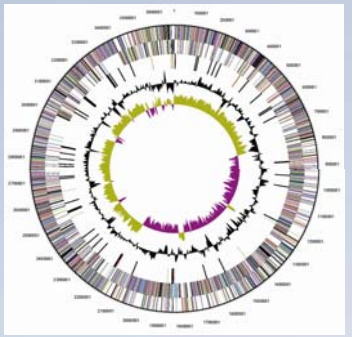


Approach

- Integration of genome biology, chemical engineering and traditional biochemistry and microbiology to engineer biologic systems/process
- Engineer thermophilic bacteria to optimize ethanol production at 60°C
- Metabolic and kinetic modeling to optimize ethanol production

Accomplishments

- G. *thermoglucosidasius M10EXG* chromosomal map to engineer synthetic butanol production pathway



G. thermoglucosidasius M10EXG Chromosomal Map

Significance

- Leading effort in thermophilic biology for biofuels R&D
- Unique approach for biofuels production (butanol)

Advancing Technologies for Solar Energy Utilization

Challenge

- Create a sustainable, carbon neutral fuel supply, and reduce CO_2 emissions

Approach

- Use solar power to convert CO_2 to synthetic fuels
- Develop PV cells with higher efficiencies than monolithic multi-junction cells

Accomplishments

- Novel Fe-Ce redox materials for thermochemical CO_2 splitting
- Integrated reactor systems engineering and cost analysis
- New InGaN material growth & processing capabilities

Significance

- Sustainably reenergizes thermodynamically-spent feed stocks
- New heterogeneous material integration methods for PV and other applications

$Sunlight + CO_2 + H_2O \rightarrow Fuel + O_2$

Summary

Laboratory Directed Research and Development (LDRD) enables us to conduct high-risk, potentially high value research in areas foundational to national security

LDRD has a long history of providing capabilities and technological solutions that address national security challenges

LDRD also plays an important role in preventing technological surprise