SAND2012-5572C

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Sandia National Laboratories

Energy, Climate, and Infrastructure Security

Energy Security Overview

2012

U.S. DEPARTMENT OF ENERGY

NNSA

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Energy Security

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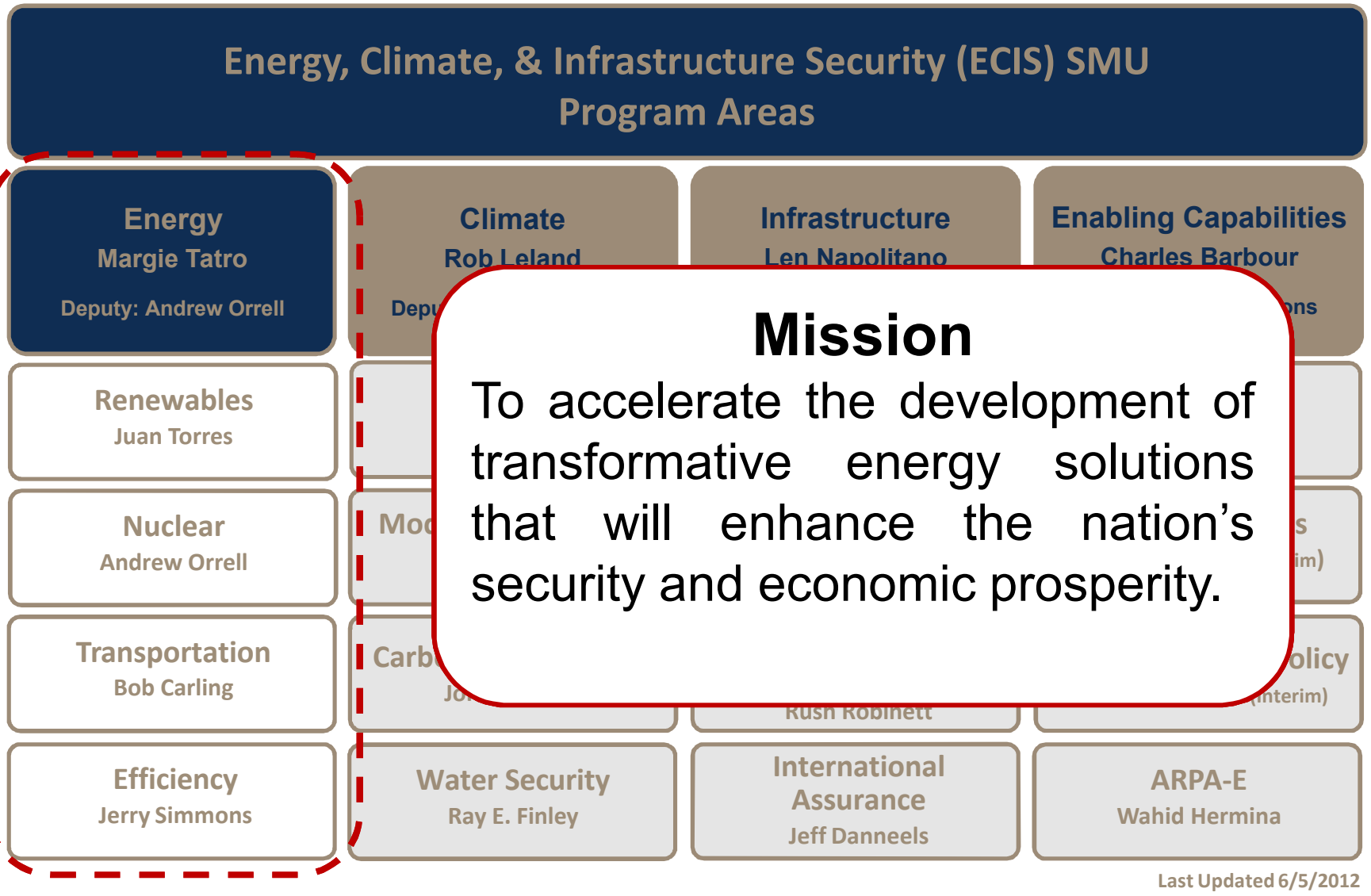
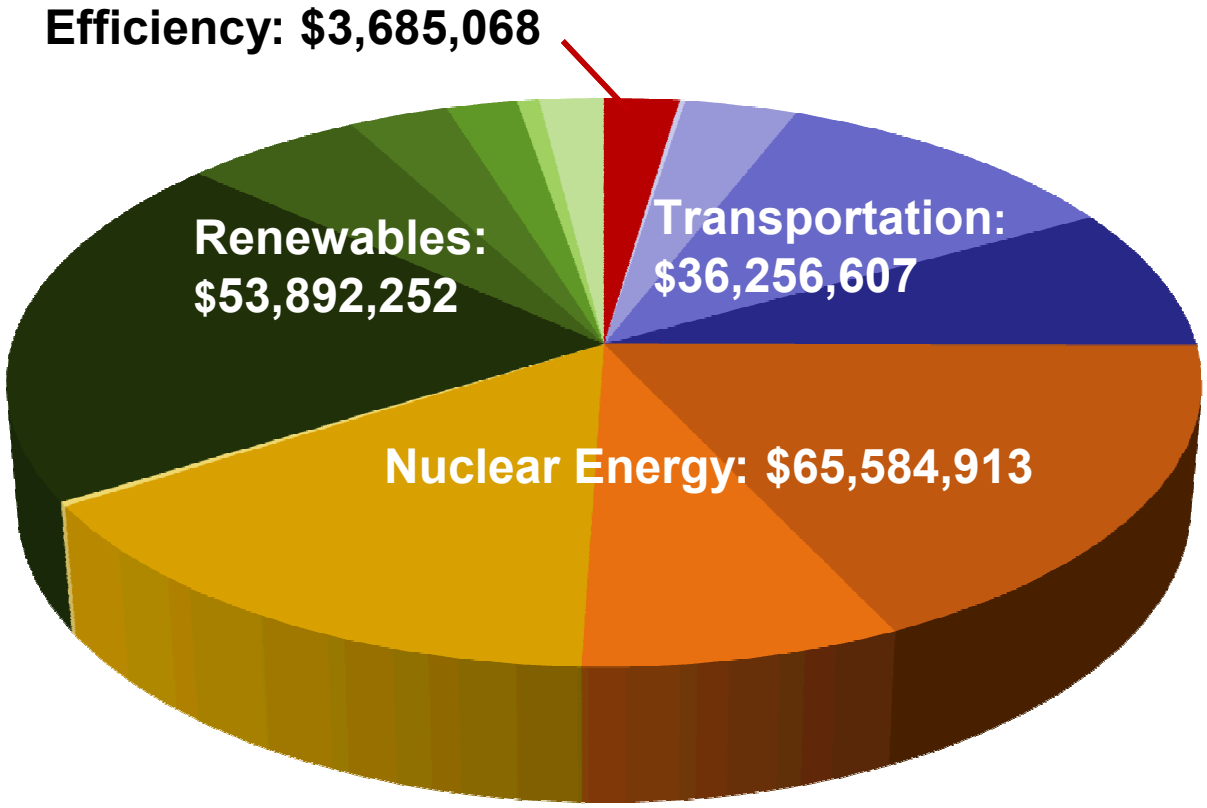


Energy Security Subprogram Budget

Sandia National Laboratories

FY11 Funding: $159,418,840

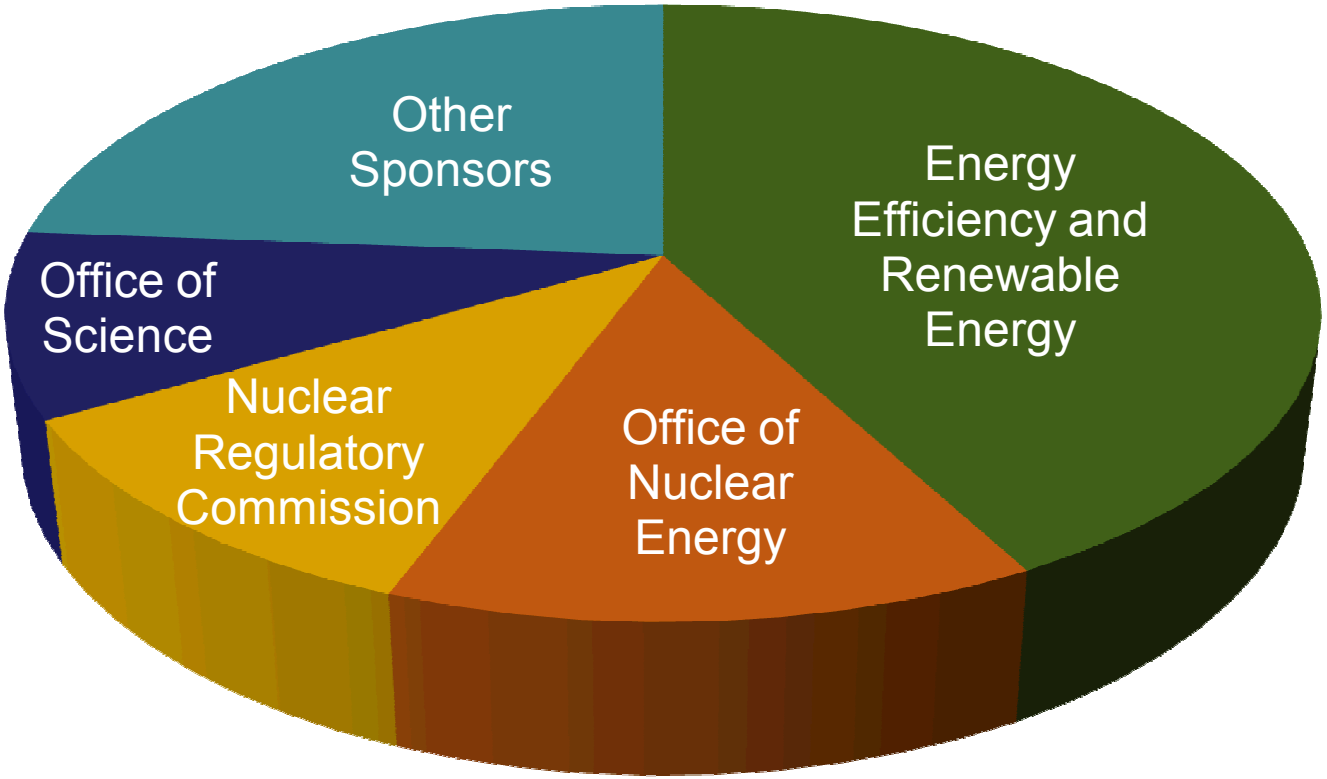


- Solid State Lighting
- Biomass
- Hydrogen Initiative
- Chem Sciences and JBEI
- Vehicle Technologies
- Advanced NE
- Repository Systems and Waste Management
- Safety and Security
- NE Other
- Solar
- Wind
- Water
- Geothermal
- Buildings
- RE Other

Funding by Sponsor

Sandia National Laboratories

FY11 Funding: $159,418,840



Energy Security Program Focus

Energy
Margie Tatro
Deputy: Andrew Orrell

Renewables
Juan Torres

Nuclear
Andrew Orrell

Transportation
Bob Carling

Efficiency
Jerry Simmons

Energy Security Key Challenges

1. Reducing dependence on foreign oil
2. Increasing the use of low-carbon power generation.

Additional Goals Supported by the Energy Program

- Increase resilience of US critical infrastructure system by providing increased understanding of interdependencies and risk.
- Design and demonstrate 30% Renewable Energy Penetration into an energy surety microgrid.
- Nurture discovery science for fundamental breakthroughs and deepen our competencies in key strategic areas that enable ECIS mission objectives and goals.

Energy Security Program Area Goals

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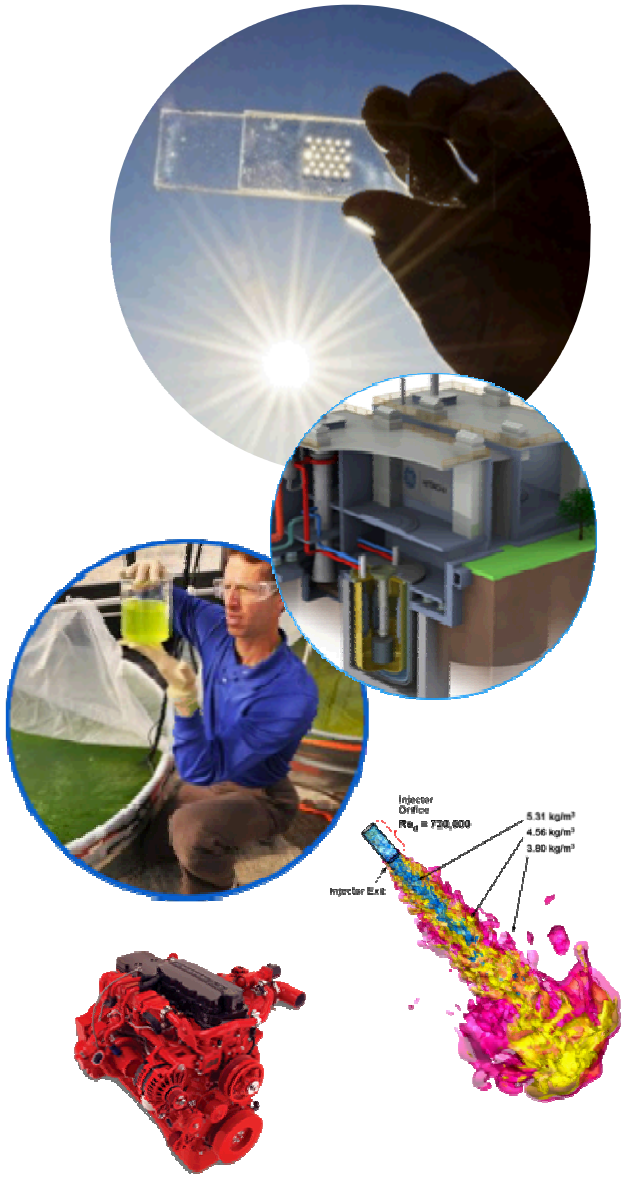
- Demonstrate 12.5% sunlight to syngas as a critical step towards the longer-term goal of > 10% lifecycle sunlight to fuel. Demonstrate an ionic liquid base approach to sugar production from biomass with 90% C5 and C6 sugar yields at 1/10th the enzyme loading required by dilute acid.
- Develop advanced solar technologies to allow a domestic solar industry to deliver at less than 10 cents per KW/hr.
- Develop nuclear reactor designs for the deployment of Small Modular Reactors at DoD installations by 2021.
- Provide policy, programmatic and technical leadership in repository systems, with a key demonstration of deep borehole disposal concepts, to respond to the recommendations of the Blue Ribbon Commission and anticipated congressional action.
- Provide new design tools necessary for industry to reduce CO2 and petroleum footprint of the transportation sector by 25%.



Renewable Fuels

Energy Goal: Demonstrate 12.5% sunlight to syngas and demonstrate an ionic liquid base approach to sugar production from biomass.

Solutions

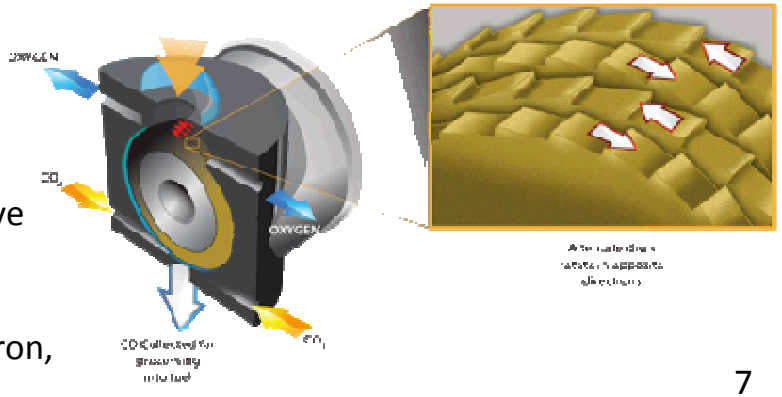
- Reliable, reproducible on-sun CR5 S2P reactor operations
- Gen 2 S2P reactor has moved from concept and design to construction and bench top testing
- Highest thermodynamic and kinetic reduction chemistry achieved to date for quaternary Fe, Ce, Y, and Zr
- Developed an ionic liquid process that can efficiently process a wide range of biomass feedstocks
- Achieved 97% glucose yields and 92% xylose yields
- Dropped enzyme loads to 10% of comparable technologies ($0.70-1.20/gal reduction in price of biofuel produced)

Policy Impact

- Briefed ARPA-E Director Dr. Majumdar, Assistant Secretary Dr. Danielson, and other DOE and DoD officials
- Former Senator Dorgan agreed to write WSJ op ed on S2P
- JBEI recommended renewal funding, $125M, FY13-17

Engagement

- Negotiating phase 2 interactions with BP to begin a comprehensive reactor and materials program
- Biofuels engagement with a variety of industry and government partners including DOE-Sc, BASF, Lockheed Martin, GE, GM, Chevron, and BP



Solar Electricity Program

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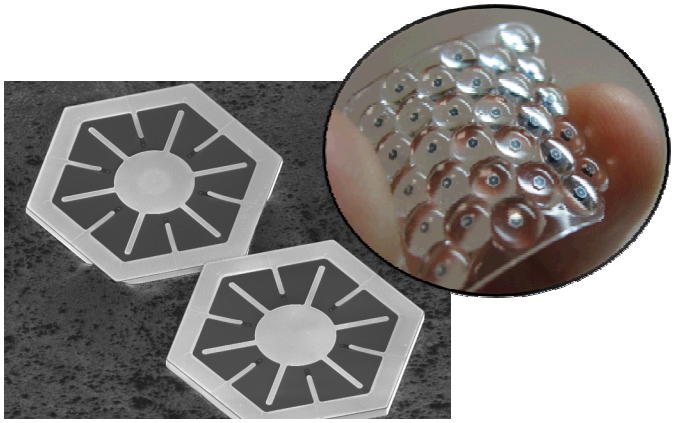
Energy Goal: Develop advanced solar technologies to allow a domestic solar industry to deliver at less than 10 cents per KW/hr.



Solutions

- First-of-a-kind, Brayton-cycle turbomachinery for S-CO2
- Achieved 11% efficiency from a flexible MEPV module that used 20 micron thick MEPV c-Si cells
- Standardized operations and maintenance data collection tool (PVROM) and systems model (PV-RPM) for optimizing PV system operations and maintenance
- Successfully concluded SEGIS, an over $20 million commercialization program

Policy Impact

- New methods to assess high penetration impacts on the electric grid
- Numerous workshops for state regulatory commissions (Hawaii, NM, Washington, NV, CA)
- SIRFN knowledge plan to share best practices

Engagement

- Technology development support with other federal agencies including DoD, FAA, BLM, GSA, and DOS
- CRADAs with EPRI, SunPower, and NV Energy

Small Modular Reactors (SMRs)

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Energy Goal: Develop nuclear reactor designs for the deployment of Small Modular Reactors at DoD installations by 2021.

Solutions

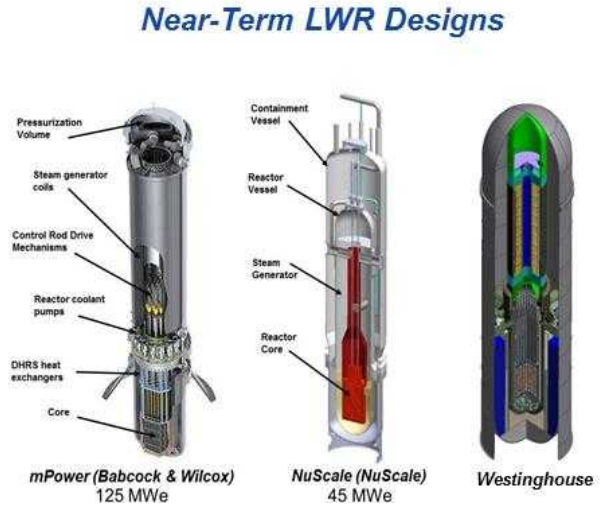
- Enabled advancements in licensing and certification of SMRs through support of NuScale's response to the "Cost-Shared Industry Partnership Program for Small Modular Reactors" Funding Opportunity Announcement issued by the DOE
- Began new work funded by the DOE SMR R&D Program to investigate physical protection and advanced energy conversion technology related to SMRs
- Developed white papers to support the siting of an SMR at White Sands Missile Range

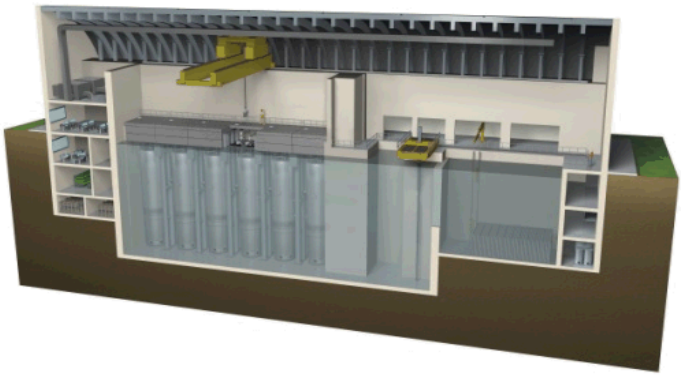
Policy Impact

- Support DOE NE engagement with the DoD as part of the DoD/DOE Memorandum of Understanding (MOU)
- Briefed Senators Alexander and Bingaman, and Senator Feinstein's staff on the value of SMRs

Engagement

- Informed the Air Force's decision to include SMRs in the Energy Horizons strategy
- MOUs with NuScale and Scitor Corporation





Nuclear Waste Management Policy and Deep Borehole Disposal

Energy Goal: Provide policy, programmatic and technical leadership in repository systems, with a key demonstration of deep borehole disposal concepts, to respond to the recommendations of the Blue Ribbon Commission and anticipated congressional action.

Solutions

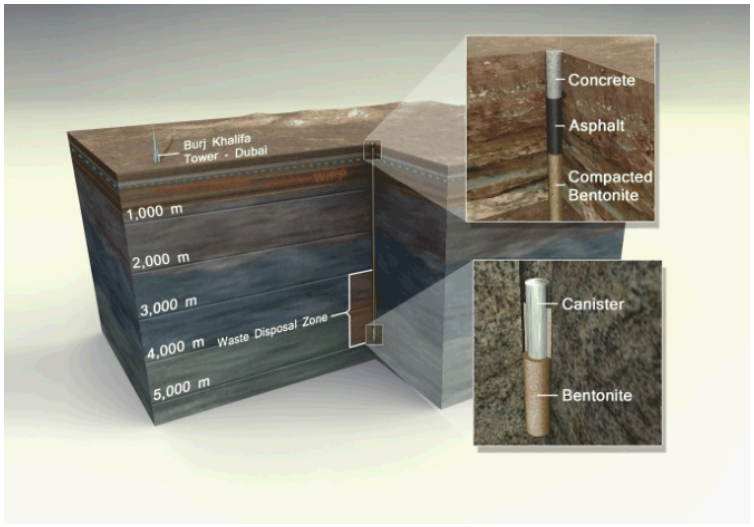
- Issued Deep Borehole Demonstration Reference Design, Site Characterization Report, and Performance Assessment
- Deep Borehole Demonstration RD&D Roadmap due to DOE on September 30, 2012

Policy Impact

- Provided substantial input and testimony to the Blue Ribbon Commission on America's Nuclear Future regarding NWM policy, repository development, and regulation
- Briefed the Nuclear Waste Technical Review Board 3 times on Deep Boreholes

Engagement

- Built Deep Borehole Consortium to develop deep borehole demonstration (w. MIT, Schlumberger, EPRI, Areva, NEI, CH2M, and others)

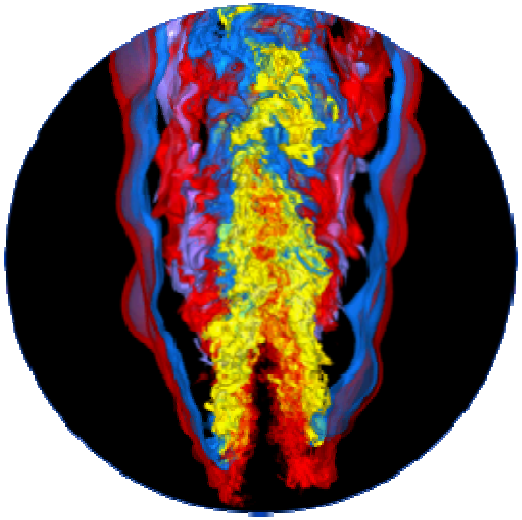


From The Economist, June 2, 2012

"America's Blue Ribbon Commission … called for research into an alternative form of underground burial, packing waste into holes drilled several kilometres deep. Research into borehole disposal, as it is known, is now taking off□, says Fergus Gibb, a geochemist at the University of Sheffi□eld in England. A workshop held last October at ***Sandia National Laboratories*** *in Albuquerque, New Mexico, concluded that borehole disposal would be cheaper, more fl□exible and faster to implement than repository disposal…"*

Transportation

Energy Goal: Provide new design tools necessary for industry to reduce CO2 and petroleum footprint of the transportation sector by 25%.



Solution

- Low Temperature Diesel combustion- The technology offers a path to cleaner more efficient compression ignition engines with lower cost after treatment. Publication pending.
- Developed, validated, and published risk-informed approaches to inform siting of H2 refueling stations for fuel cell electric vehicles.

Policy Impact

- PreSICE workshop coordinated for DOE led to new $10M program in Office of Science for advancement of next gen computing for predicative simulation.
- Provided testimony to CA State Senate at their AB32 Fuels of the Future hearing
- Provided technical guidance to US DOT for the development of the UN Global Technical Regulation for hydrogen vehicles.
- Bob Carling Op-Ed Washington Post Oct 2011, calls for renewed focus on combustion science to increase engine efficiency

Engagement

- Global cooperation in science discovery lead to reductions in GHG admissions
- Engine Combustion Network Proprietary work with GM, Caterpillar, Ford, Chevron, GE, Aramco, Lockheed
- China US Energy Research Center (CERC)
- Fuel cell electric vehicles: Broad industry and government engagement and partnerships including H2 producers, technology companies, standards developers (e.g. CARB, CEC, Air Products, Nuvera Fuel Cells, NFPA, etc)

Energy Security Program Challenges

- Focus vs Breadth (technologies, partners, sponsors)
  - What measures (evidence) of impact would the EAB suggest we focus on?
  - How do we leverage decades of repository expertise to secure a lead role for the future in spent fuel solutions?
- DOE leadership changes and priorities
  - What shifts do the EAB members anticipate?
  - Is our strategy robust to such changes, in the EAB's view?
- Building complementary DOE and DoD energy security efforts
  - Where does the EAB see opportunities and challenges?
  - Where can the EAB members help with introductions, critical reviews of strategy, etc.?