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Title: | Energy Security Los Alamos National Laboratory

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April 18, 2011

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The attached slide presentation, entitled "Energy Security Los Alamos National Laboratory" is a general, unclassified presentation for the upcoming Global New Energy Summit (GNES) in Boulder, Colorado, from April 17-19, 2010. It provides an overview of LANL's Energy Security capabilities, divided into three main focus areas: Impacts of Energy Demand Growth, Sustainable Nuclear Energy, and Concepts and Materials for Clean Energy.

Energy Security

Los Alamos National Laboratory

Steven J. Buelow

**Energy Security Center Leader
Los Alamos National Laboratory**

**Global New Energy Summit
Colorado Springs, Colorado
April 18, 2010**

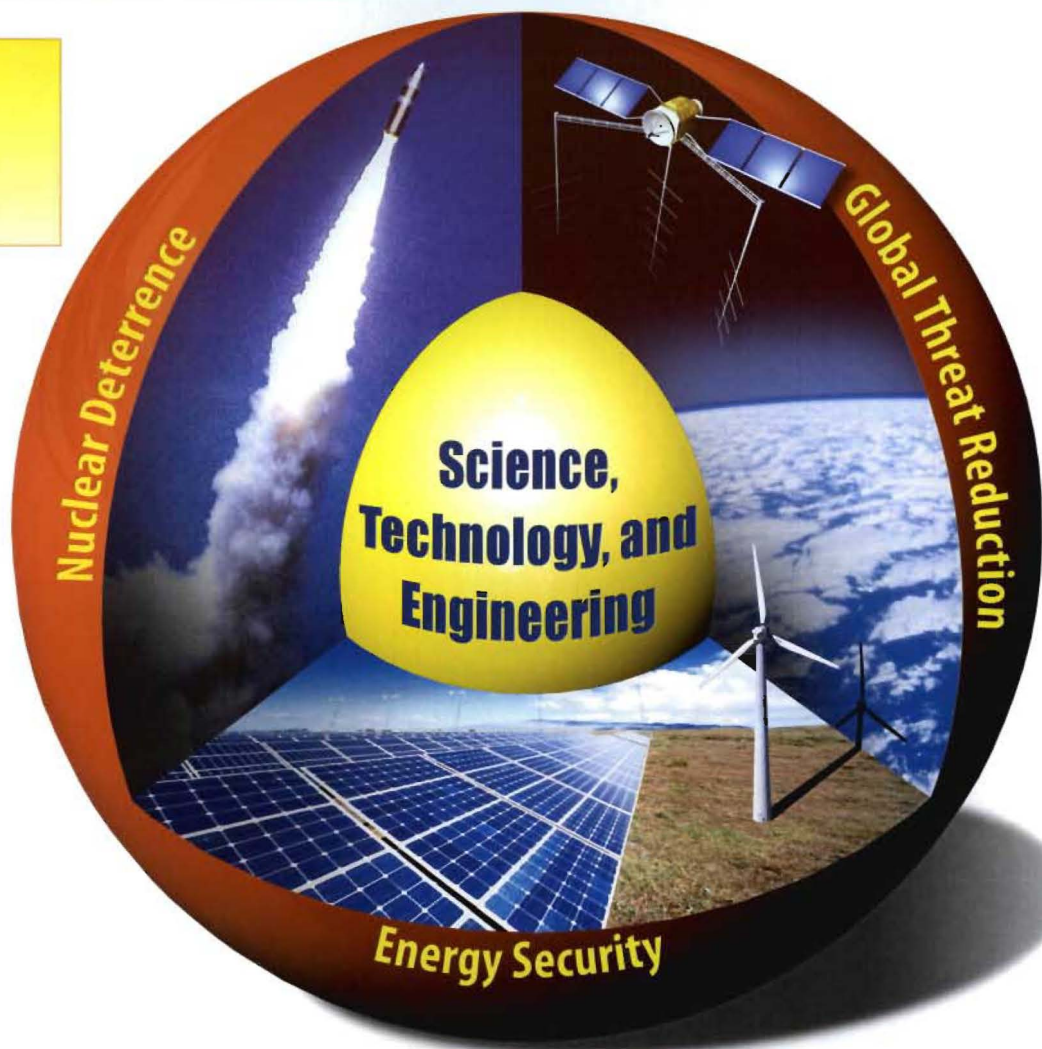# Energy Security – Important LANL Mission

LANL Capabilities Serve All Three Missions

Information Science & Technology enabling Integrative and Predictive Science

Experimental Science focused on Materials for the Future

Fundamental Measurement and Detection Science

Nuclear Deterrence

Global Threat Reduction

Science, Technology, and Engineering

Energy Security

Los Alamos Energy Security Focus Areas
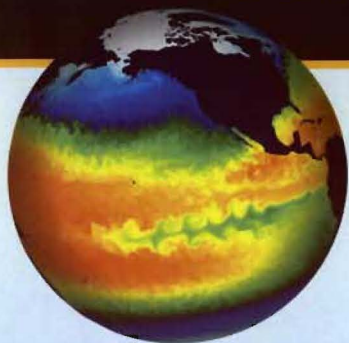
Impacts of Energy Demand Growth

- Coupled predictive models for climate, infrastructure impact analysis
- Prediction of abrupt change at multiple scales (regional to global)
- Global security and policy implications
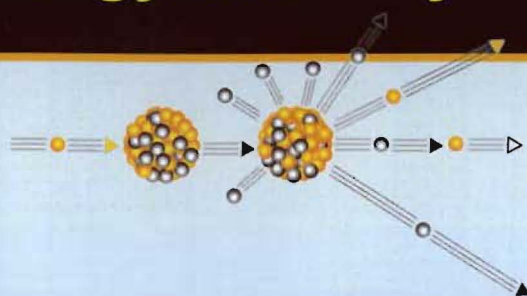
Sustainable Nuclear Energy

- Efficient extraction of energy content from fuel
- Nonproliferation & safeguards
- Effective waste management
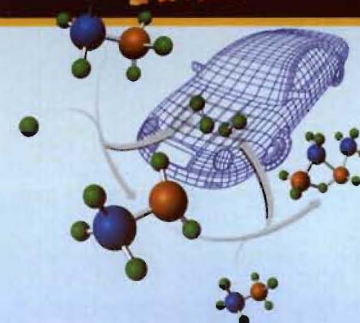
Concepts and Materials for Clean Energy

- Energy storage, generation, and transmission
- Revolutionary alternatives to petroleum
- Clean fossil energy

Slide 3

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Materials and Concepts for Clean Energy

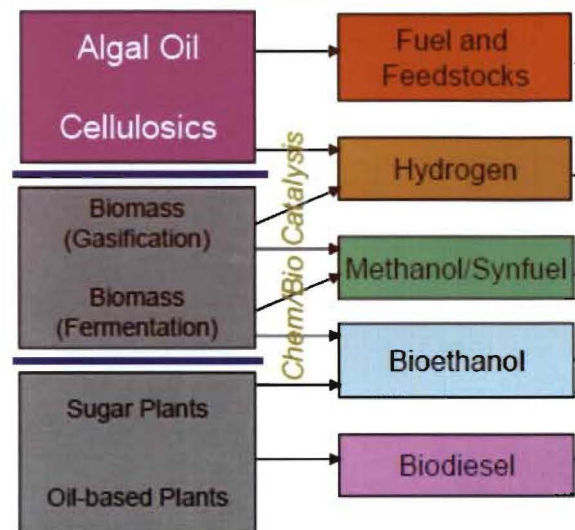## • Biofuels : Production and Conversion

- Grow faster – greater light harvesting, increase metabolism
- Less fertilizer and water – alter metabolic signaling pathways
- Maximize fuel yields – better conversion and separation technologies

• Solar Energy

- Photovoltaics – materials discovery to device fabrication
- Solar thermal – improved thermal transfer and storage

Bifunctional materials

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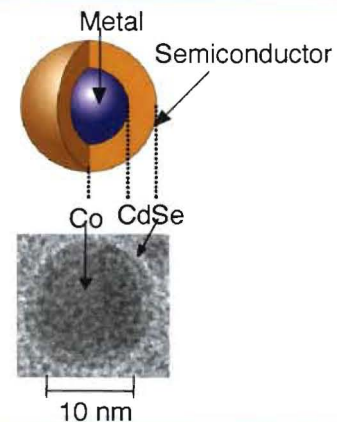
Infrastructure Analysis and Modeling

- ## National Infrastructure & Simulation Center
  - 19 critical infrastructure components
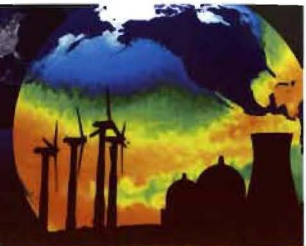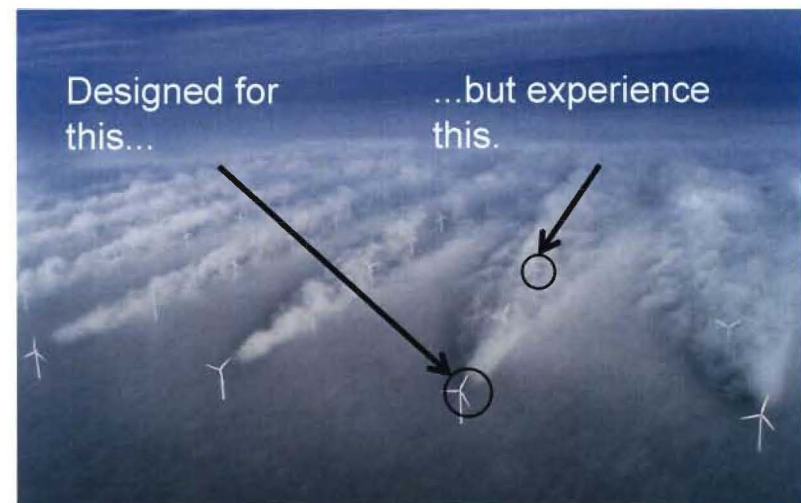 - Inter-connected models
  - National to local scales
  - Used for emergency preparedness & recovery

- ## Grid Analysis & Modeling
  - Same techniques can be used for modeling the insertion of renewable resources on the national grid
  - Models based on actual grid operation, not nominal capacities

- ## Wind Field Analysis & Modeling
 - Computational fluid dynamics of specific terrain and turbine deployment improves energy extraction

Designed for this...

...but experience this.

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Sustainable Nuclear Energy

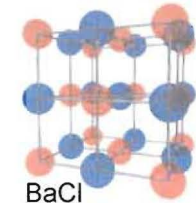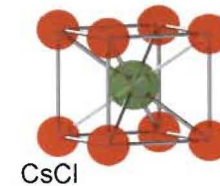## Better Materials – Better Modeling – Better Simulation

Fuels and Clad Materials

Innovative Fuel Development & Predictive Understanding of Clad/Structural Material Behavior Under Irradiation
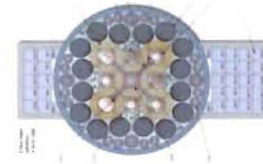
Separation and Waste

Design of Exceptionally Robust Waste Forms and Predictive Separation Tools

CsCl   BaCl

Reactor Design & Safety

Innovative Reactor Concepts Using Next Generation Design and Safety Tools for Existing and Alternative Fuel Cycles
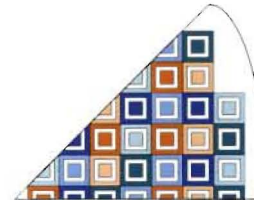
Evaluation of new fuel cycles for existing LWR core

Transport & Nuclear Data

Advanced Methods for Next Generation Reactor Design and Safety Tools and Predictive Tools for Fission Cross Section and Its Uncertainty

New computing capabilities allow a stronger physics foundation for models and simulations

Roadrunner

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Sustainable Nulcear – Tolerant Materials via Atomic Scale Design of Interfaces

Center leader: M. Nastasi (MPA-CINT)

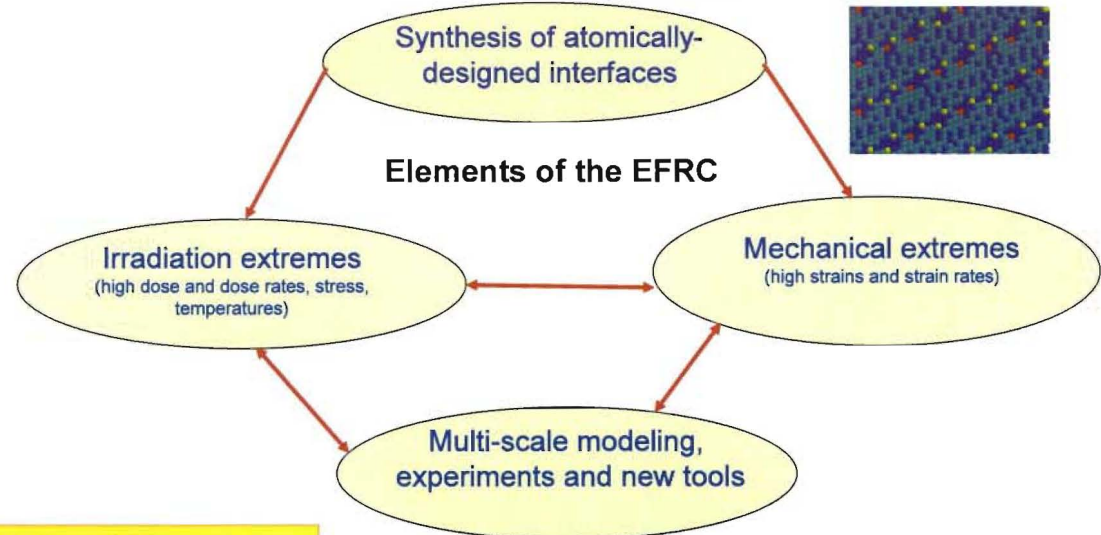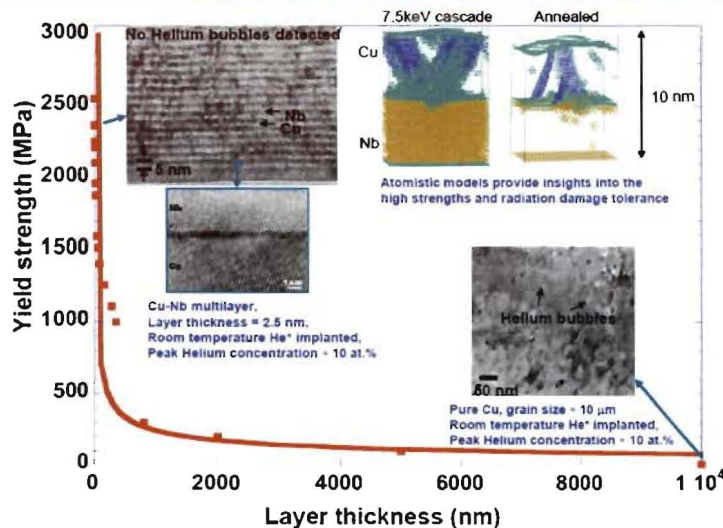*Co-PI's: A. Misra (CINT), Rusty Gray, S.A. Maloy, B.P. Uberuaga, C. Stanek, Y.Q. Wang, E. Cerreta, R.G. Hoagland (MST-8), N.A. Mara (MST-6), T. Germann, I.J. Beyerlein, A.F. Voter (T), S. Luo (P); A. Caro (LLNL), M.J. Demkowicz (MIT), R. Averback, P. Bellon (Illinois)*

Elements of the EFRC

- Synthesis of atomically-designed interfaces
- Irradiation extremes (high dose and dose rates, stress, temperatures)
- Mechanical extremes (high strains and strain rates)
- Multi-scale modeling, experiments and new tools

Interfaces act as obstacles to slip and sinks for radiation induced defects. Nanolayered composites provide orders of magnitude increase in strength _and_ enhanced radiation damage tolerance compared to bulk materials. Such composites have potential as structural materials and coatings in nuclear power reactors.

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Impacts of Energy Demand Growth: Climate, Measurement, and Modeling

Oceans
3d state-of-the-art ocean model

Sea Ice Model
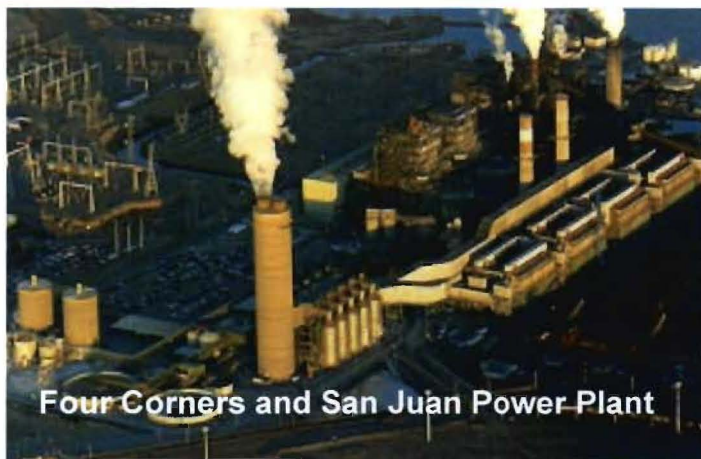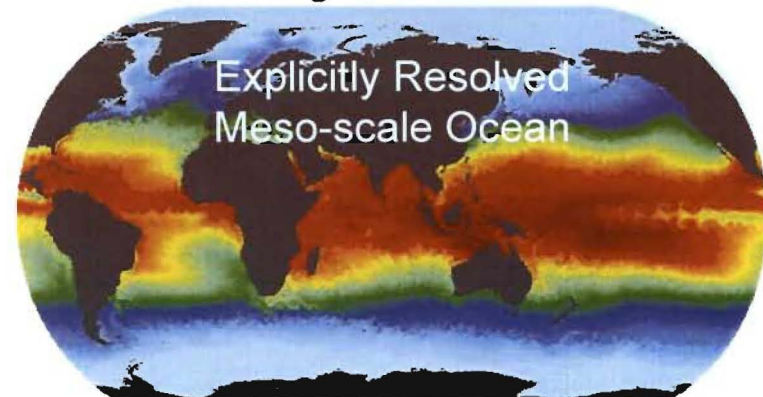Advanced model of sea ice

Land Ice Sheet Model
New dynamic model for Greenland, Antarctic

Community Climate System Model (CCSM) – DOE/ NSF model
Atmos-ocean-ice-land coupled climate model
POP, CICE, CISM form ocean ice components

Four Corners and San Juan Power Plant

Temperature at 15m depth from global eddy-resolving ocean simulation

Explicitly Resolved Meso-scale Ocean

■ **Next Generation** Arctic Terrestrial System Model

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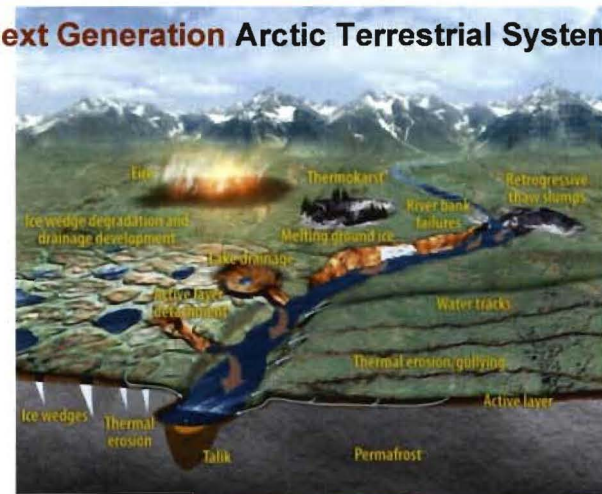
Regional Prediction of Climate, Vegetation Response, and Feedbacks

Global, climate-associated mortality is rising. Coupled hydraulic-carbon theory explains why. Experimental tests of piñon and juniper support theory.
This theory appears globally applicable.

SC-BER Precipitation Experiments

Piñon and Juniper Transpiration at BER Site

Soil Community Metagenomics of DOE's FAC &OTC Sites

Using metagenomic sequencing approaches, contribute to a field-scale understanding of the responses of soil microbial communities to long-term (10yr) elevated CO_2, and compare the responses across terrestrial ecosystems represented by DOE's FACE (Free-Air CO_2 Enrichment) and OTC (Open-Top Chamber) sites.

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Outlook for Energy Security

Energy Demand – Growing

Energy Supply – Uncertain

Energy Impacts – Important

Science Matters

National Laboratories are an indispensable resource to shape our energy future