

Capabilities Supporting a Clean and Secure Energy Future

LLNL's Role in a Multi-Lab Strategy for the QER

Presented to: Secretary of Energy
Advisory Board (SEAB)

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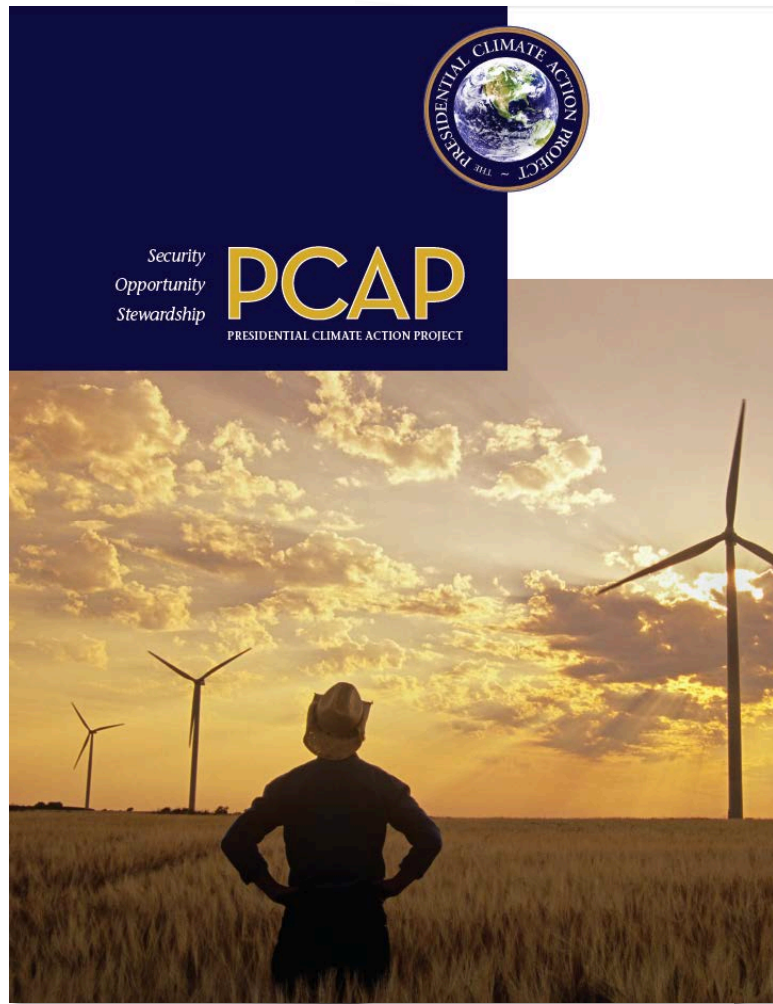
December 3, 2013

LLNL-PRES-767256

This work was performed under the auspices of the U.S. Department of Energy
by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344.
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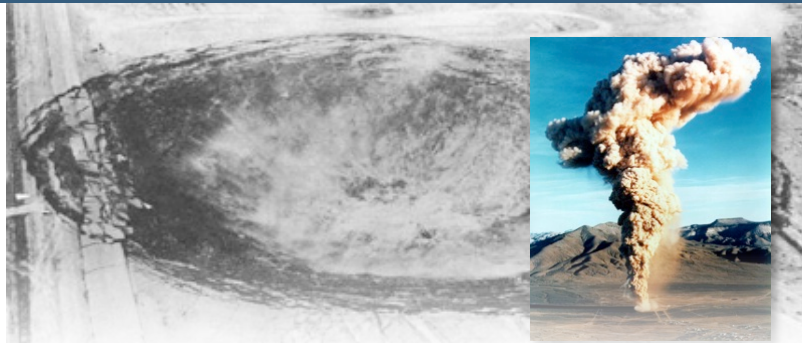
The President's Climate Action Plan calls for a multi-agency QER led by DOE



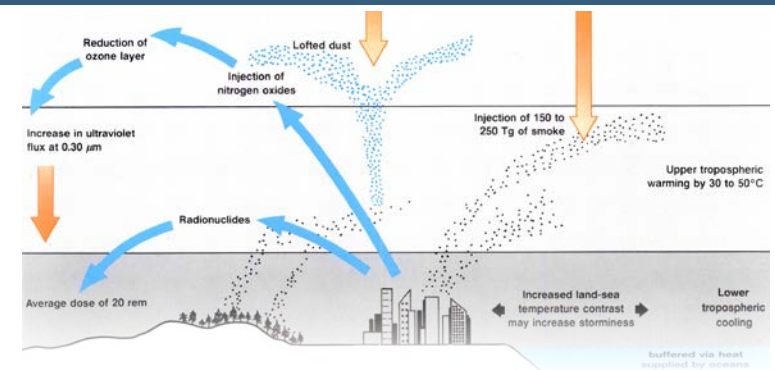
... Innovation and new sources of domestic energy supply are transforming the nation's energy marketplace, creating economic opportunities at the same time they raise environmental challenges. To ensure that federal energy policy meets our economic, environmental, and security goals in this changing landscape, the Administration will conduct a **Quadrennial Energy Review** which will be led by the White House Domestic Policy Council and Office of Science and Technology Policy, supported by a Secretariat established at the Department of Energy, and involving the robust engagement of federal agencies and outside stakeholders. This first-ever review will **focus on infrastructure challenges**, and will identify the threats, risks, and opportunities for U.S. energy and climate security, enabling the federal government to translate policy goals into a set of analytically based, clearly articulated, sequenced and integrated actions, and proposed investments over a four-year planning horizon.

Excellence in Earth sciences and systems engineering is fundamental to Livermore's weapons mission

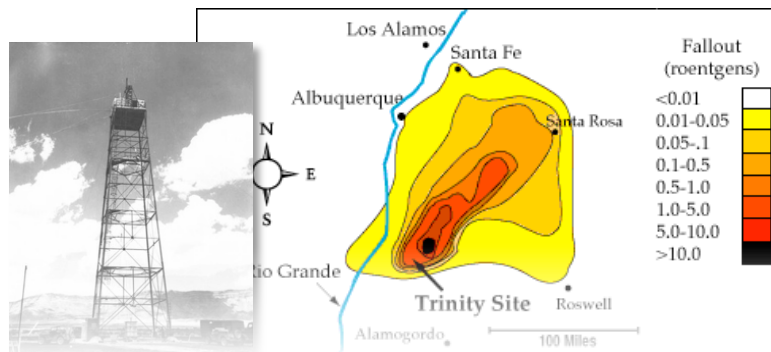
Containment: Geoscience



Nuclear Winter: Climate Science



Fallout : Atmospheric Science



Weapon Design: Systems Engineering

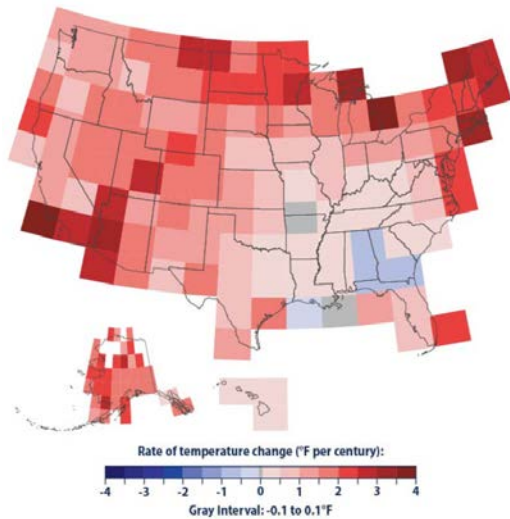


The Labs have are working together and providing substantive input to the QER Team

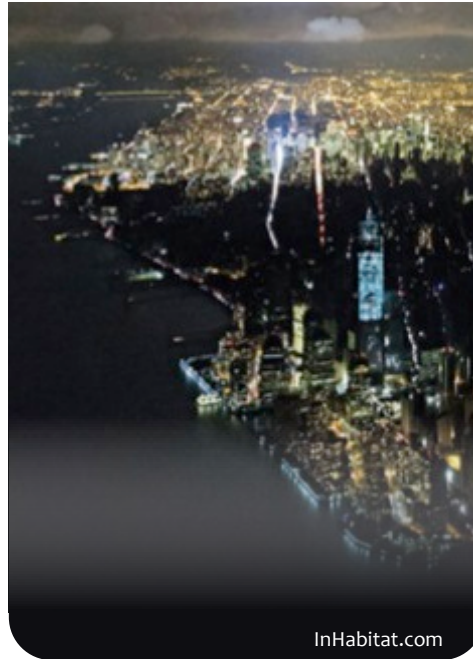


Climate variability will impact infrastructure on multiple spatial and temporal scales

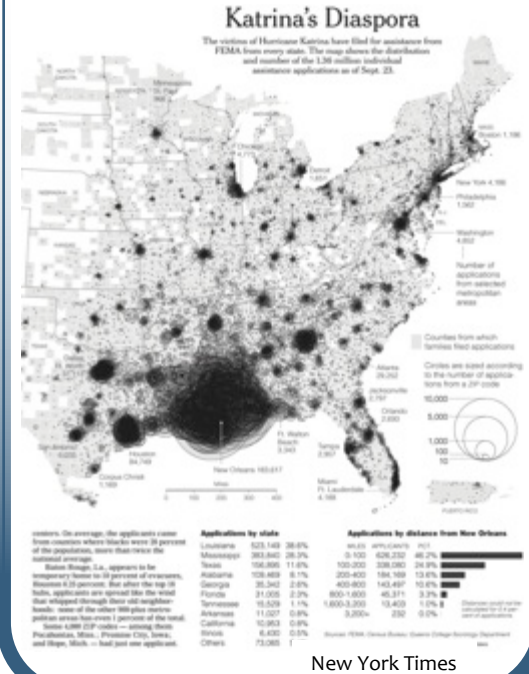
Long-Term Demand Changes



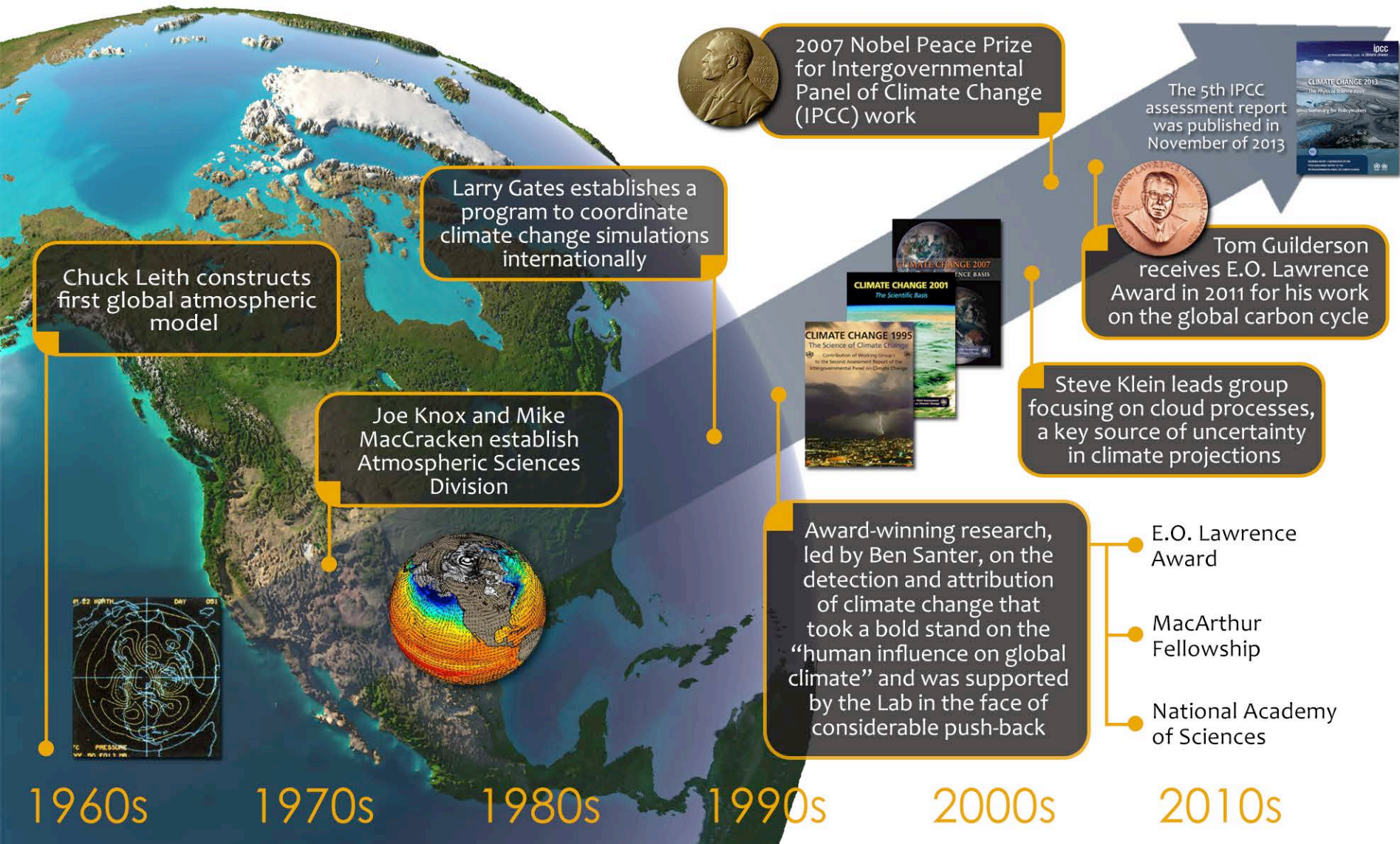
Severe Weather Impacts



Demographics Effects



LLNL was at the forefront of climate science from the beginning and remains a leader in the field



Program for Climate Model Intercomparison and Diagnosis (PCMDI) has transformed the science of climate analysis



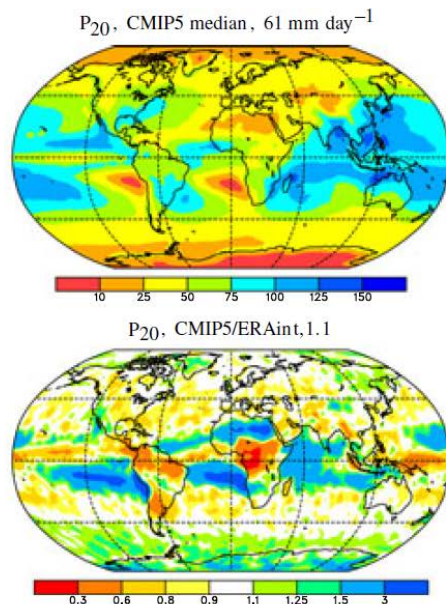
*Program for Climate Model
Diagnosis and Intercomparison*

- Special group award from the American Meteorological Society (AMS)
 - “for leadership in implementing, maintaining, and facilitating access to the CMIP-3 multi-model dataset archive, which led to a new era in climate system analysis and understanding.”
- AMS President Tom Karl stated in his congratulatory email “you have really changed the way we do business in climate science.”

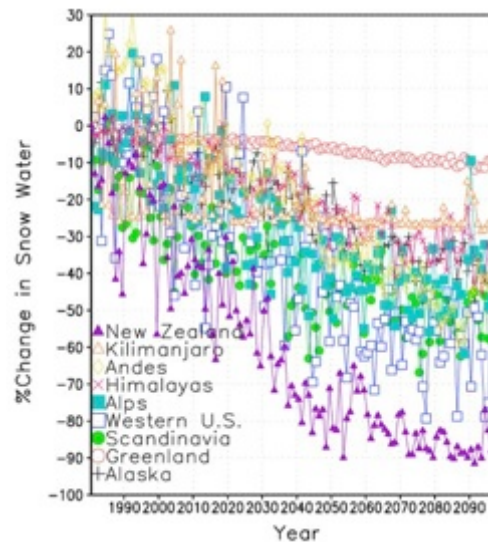


PCMDI is a key component of the capabilities that exist across the National Lab Complex

Climate Model Development, Analysis, and Diagnosis



Climate Model Regional Downscaling

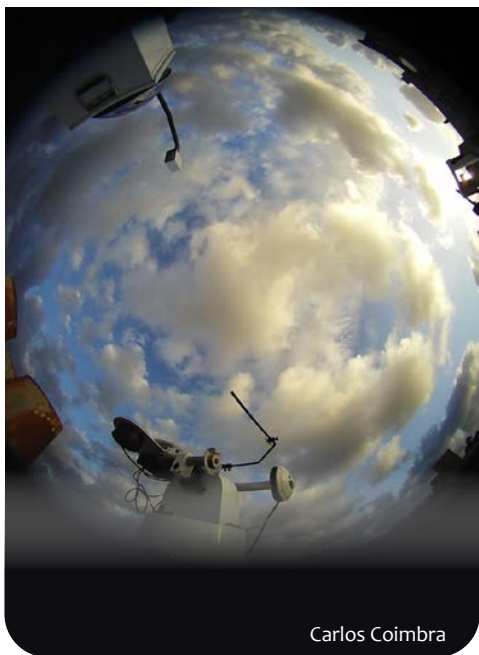


Infrastructure Inventories and Operational Modeling

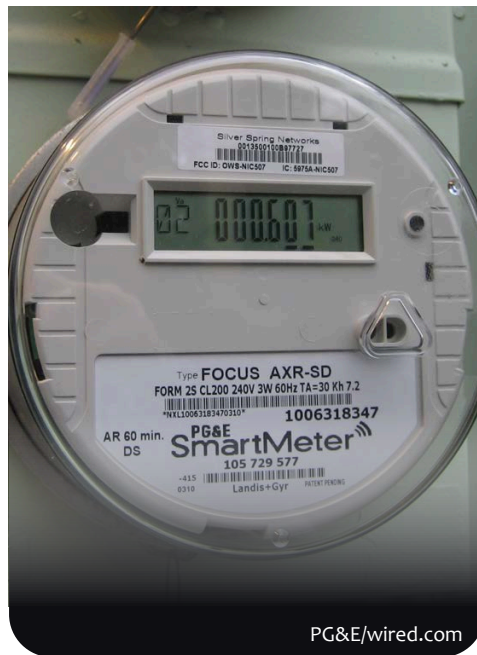


Extensive penetration by Distributed Energy Resources (DER) demands new infrastructure and markets

Variable Solar/PV



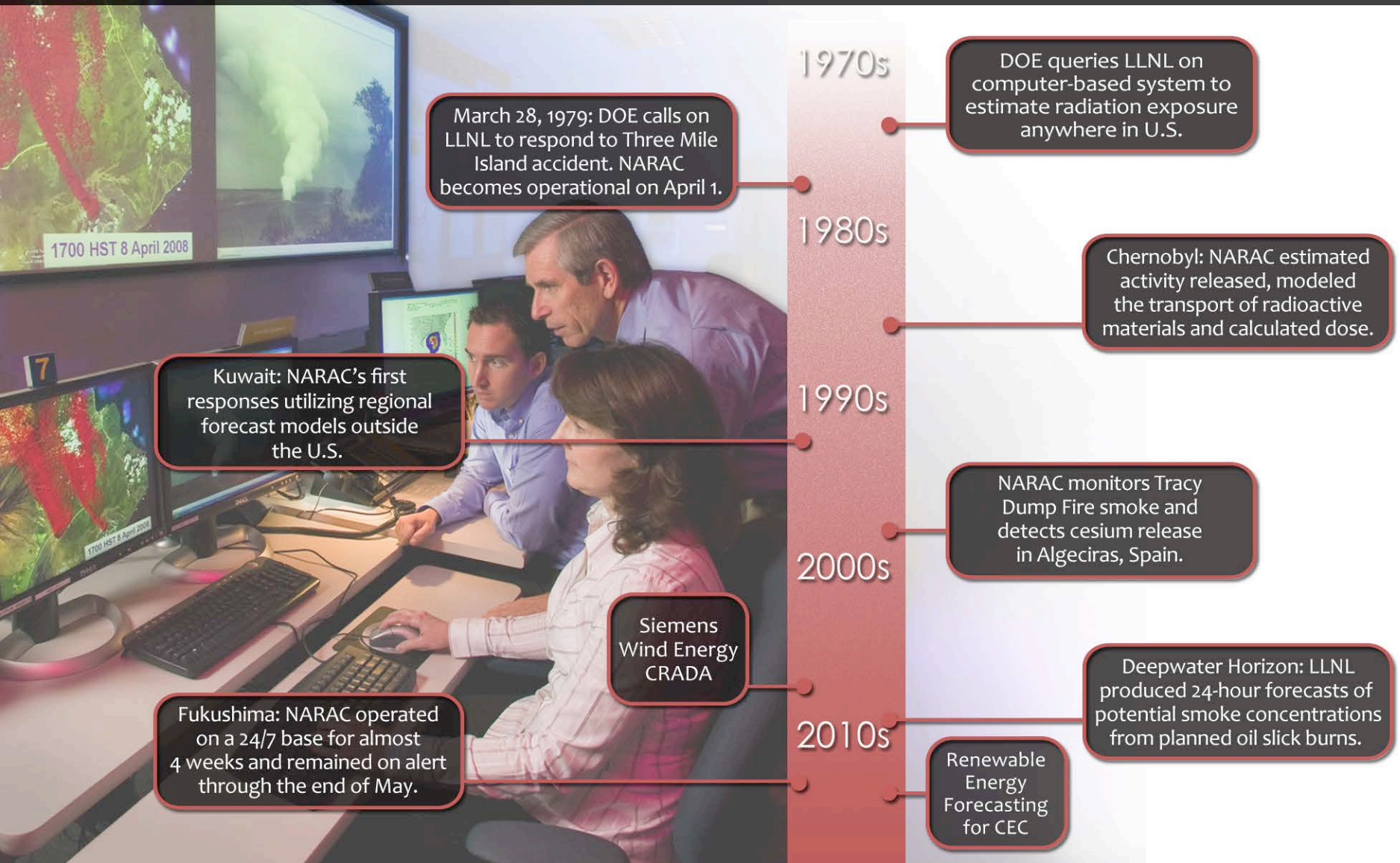
Demand Response



Energy Storage

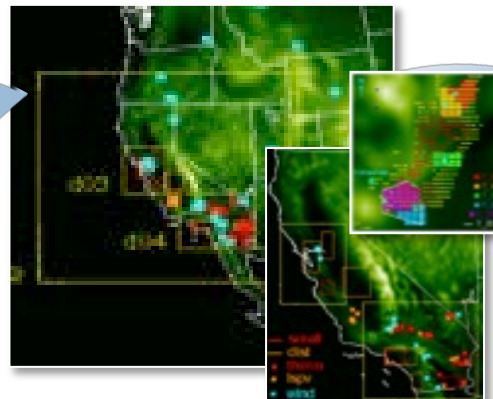
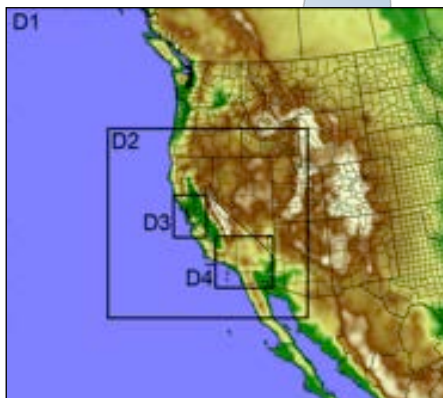


LLNL's security mission has led to innovation in atmospheric science and weather prediction

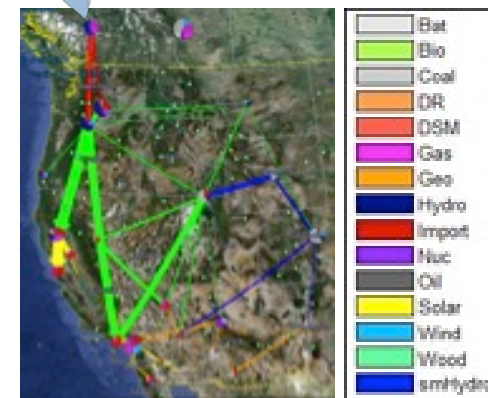


End-to-end analysis of DER resource-technology-value chain has been demonstrated at LLNL

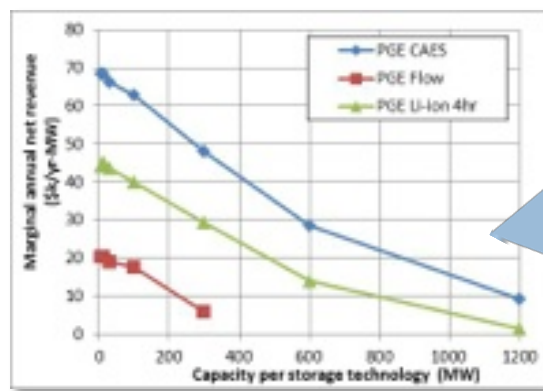
Nested weather simulations drive electricity demand and production



Production and demand simulations drive generation and transmission

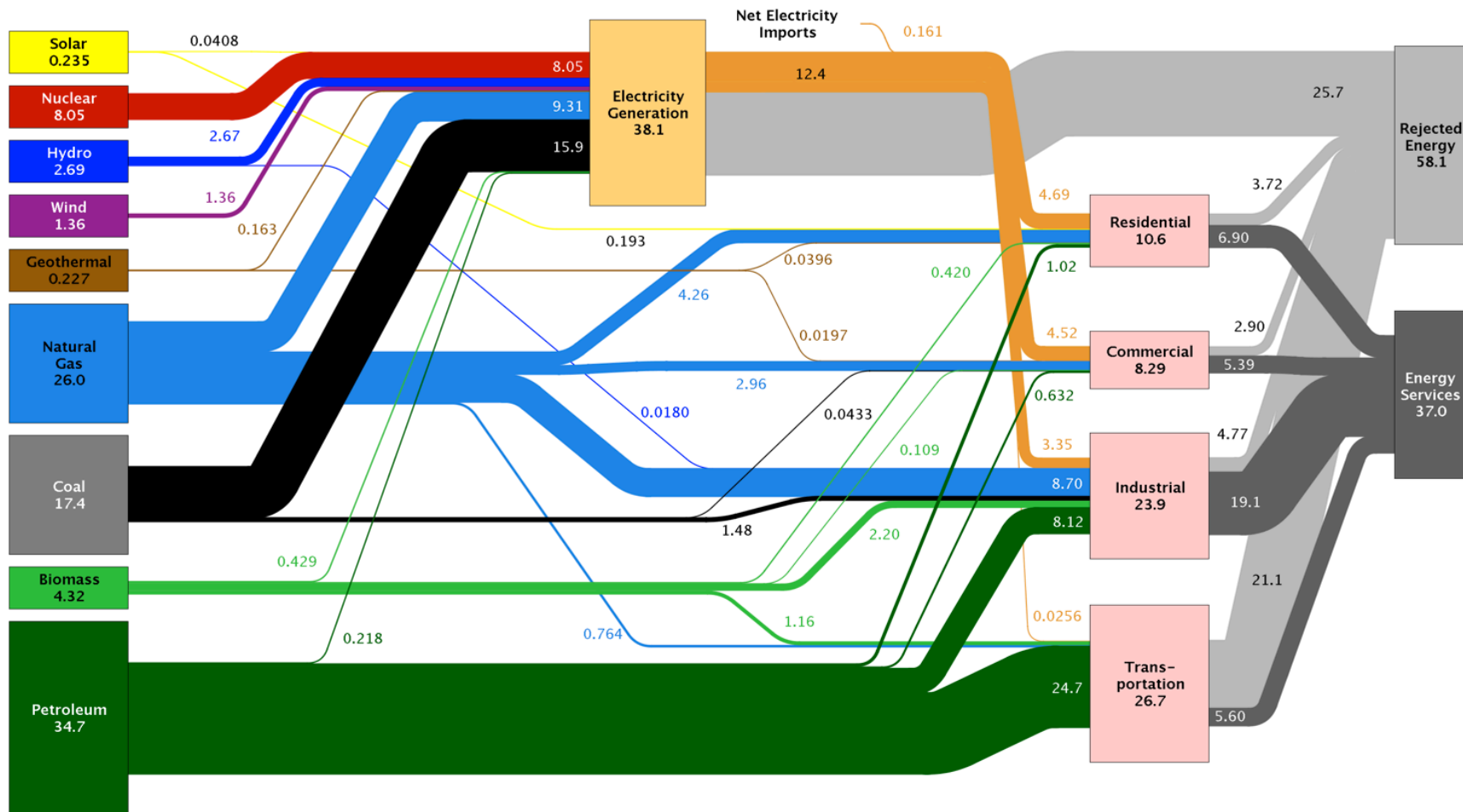


Time- and space-dependent market models drive technology valuation



Systems Thinking drives the QER process

Estimated U.S. Energy Use in 2012: ~95.1 Quads

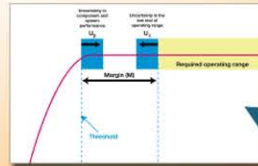


Source: LLNL 2013. Data is based on DOE/EIA-0035(2013-05), May, 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

Stockpile stewardship is the ultimate application of systems engineering

Mission Impact
Program Solution

Uncertainty
Quantification (UQ)



Design Code
Performance
Efficiency

*Algorithm/code
improvements*

21st Century
Surveillance

*Sensors, Design,
micro-fab, ...*

Integrated Program and ST&E Plan

*Sensors, Design,
micro-fab, ...*

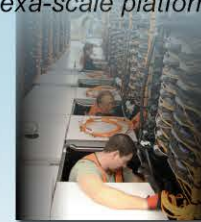
*High risk-high
payoff science*

*Diagnostics, Materials,
HED, Computing, ...*



*New Computational
Science*

*Efficient use of Peta- and
exa-scale platforms*

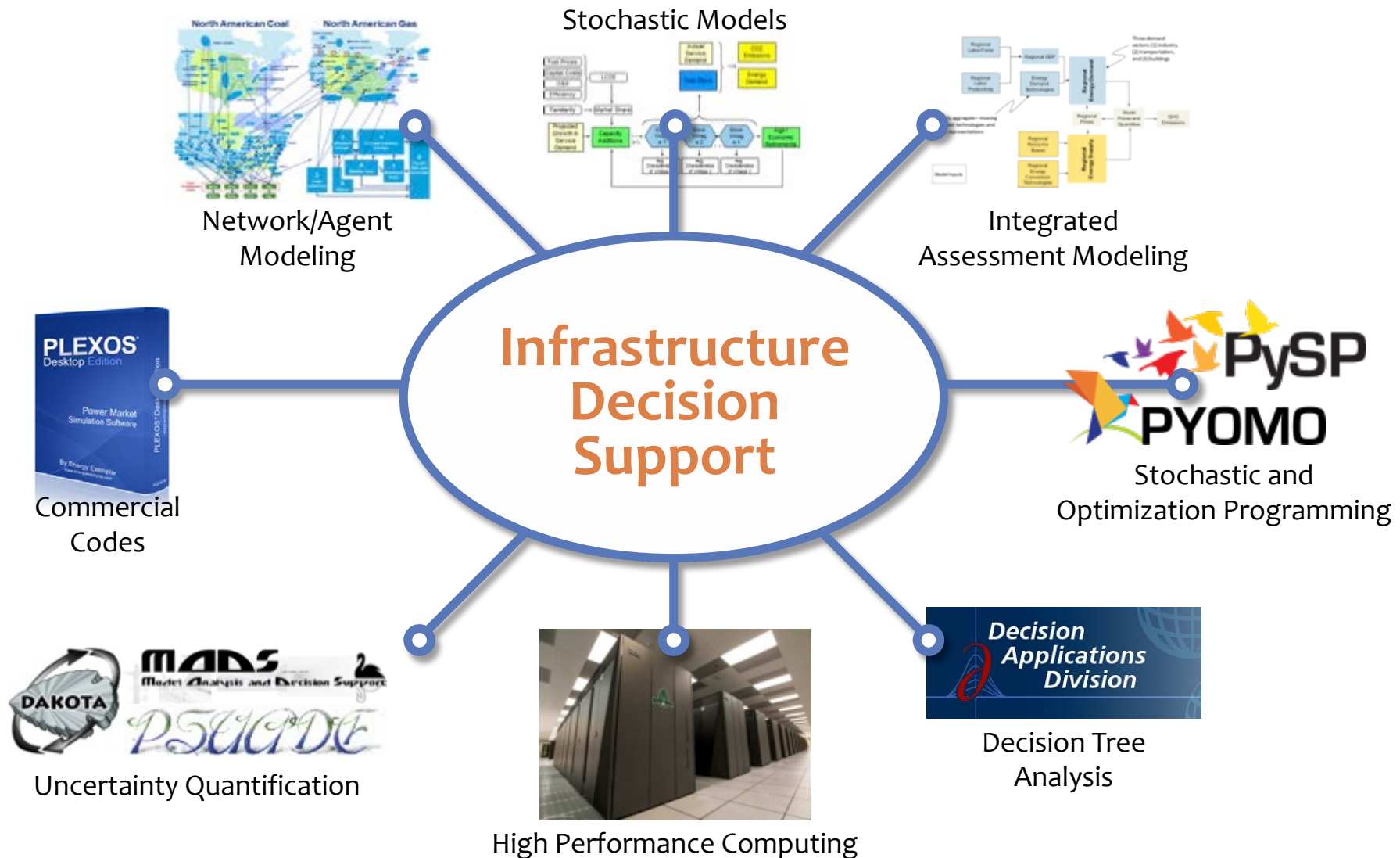


Nuclear
Stockpile
High
Confidence
Safe &
Secure

ST&E Discoveries
ST&E Discipline Health



The Labs can provide risk- and uncertainty-quantified decision support to Energy Policy & Systems Analysis



We have already identified and reached out to potential academic collaborators



Discussions with these and other institutions are ongoing



The Labs' capabilities are marshaled to support the QER's multi-agency strategy



