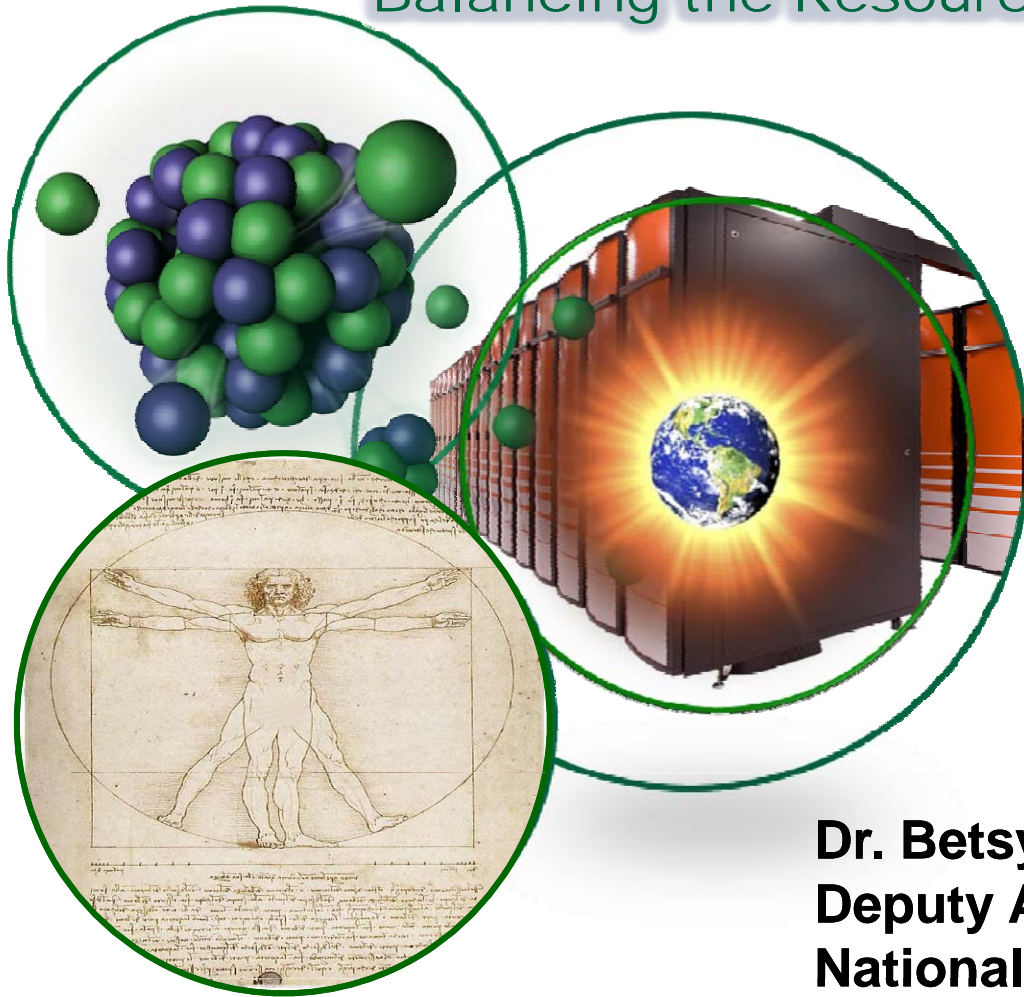


Resource Assurance

Balancing the Resource Equation



Presented to

**EUCOM/AFRICOM
S&T Conference**

**Dr. Betsy Cantwell
Deputy Associate Laboratory Director
National Security Directorate
Oak Ridge National Laboratory
June 2009**

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for the Department of Energy

**OAK
RIDGE**
National Laboratory

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Today, ORNL is DOE's largest science and energy laboratory

\$1.5B budget

4,550 employees

**3,900 research
guests annually**

**\$350 million invested
in modernization**

- **World's most powerful
open scientific
computing facility**

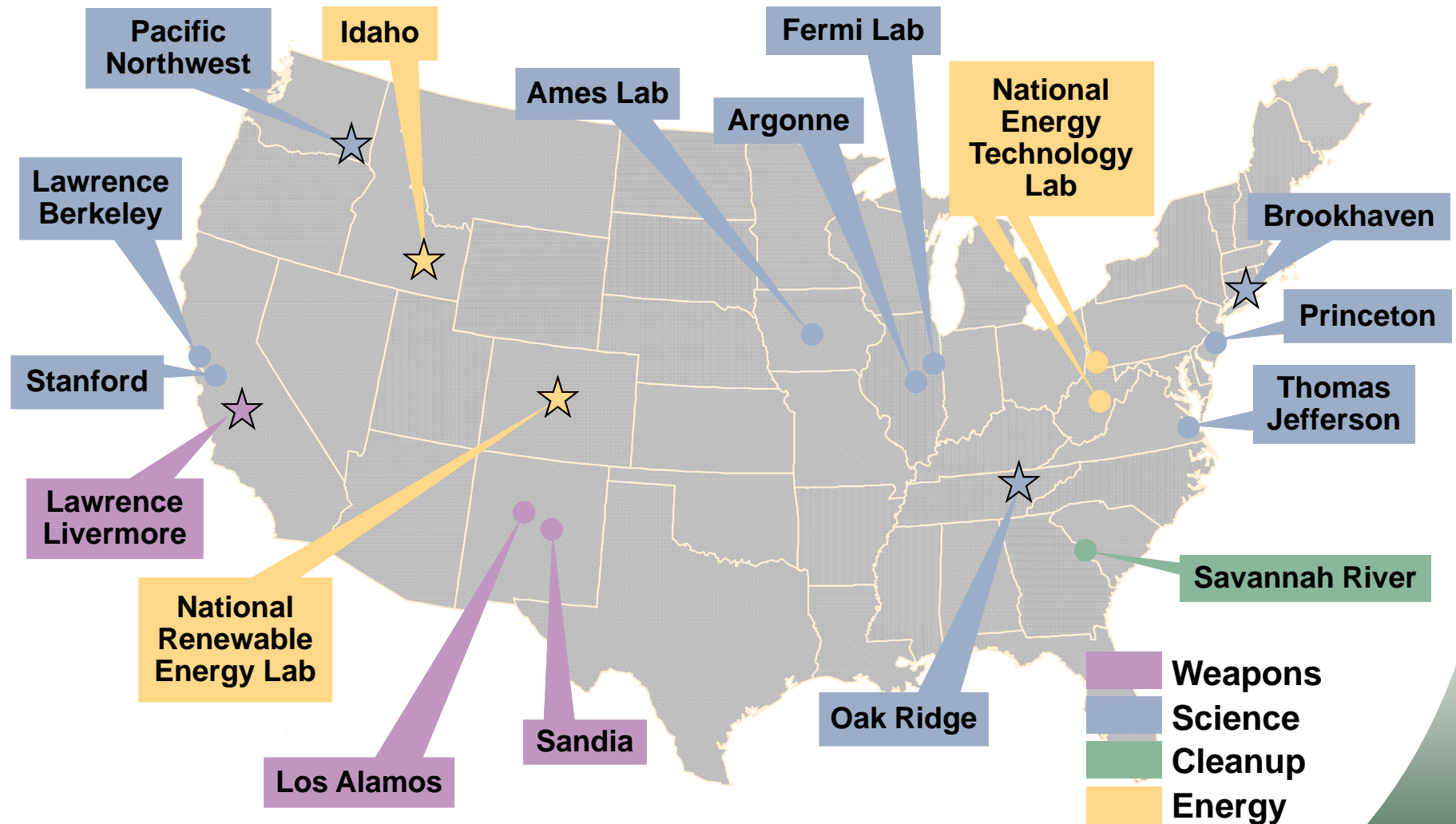
**Nation's largest
concentration
of open source
materials research**

**Nation's most diverse
energy portfolio**

**Operating the world's
most intense pulsed
neutron source**

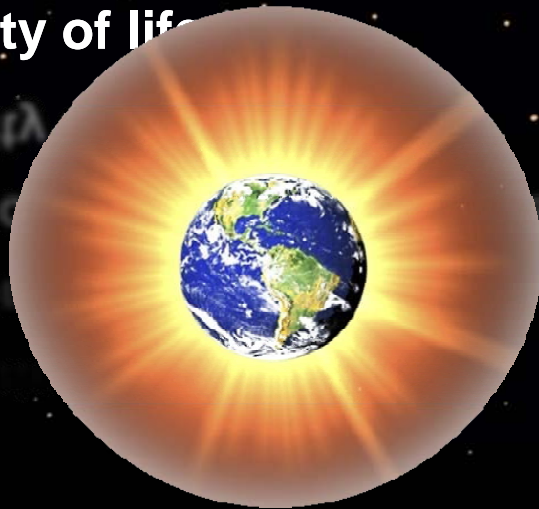
**Managing the billion-
dollar U.S. ITER project**

The Department of Energy's national laboratories: A comprehensive research system



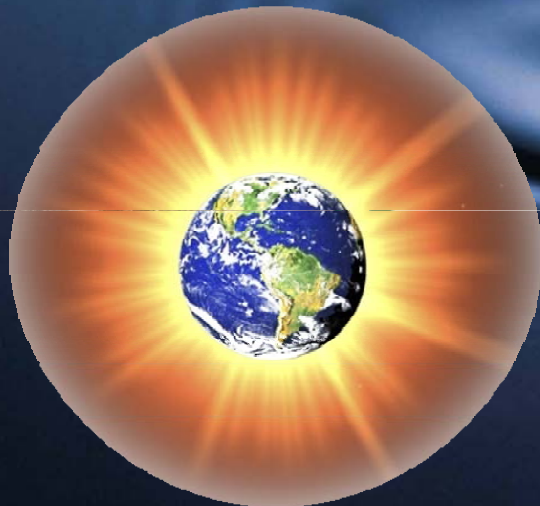
Energy

- The world's largest industry
- The number one challenge facing humanity
- A key element of the resource challenge
- A principal driver for global stability
 - Climate change
 - National security
 - Economic competitiveness
 - Quality of life
- Compels nation-state behavior
- Creates Environmental concerns
- Stresses Trade Relationships
- There will be an “Energy Trip-wire”



Water

- Essential for human life
- Essential for agriculture
- Essential for energy production
- Historical ingredient of political stability
 - Availability
 - Security
 - Economic competitiveness
 - Quality of life

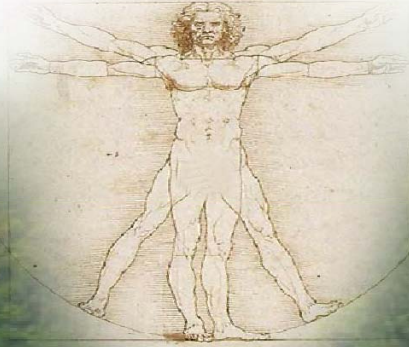


- “Water wars and confrontations”
- Waste is an environmental concern

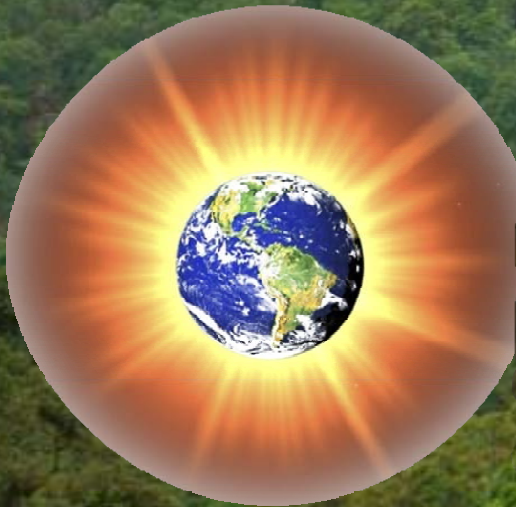
Resource Assurance

Balancing the Resource Equation

Energy + Water + Waste + Land-Use



How mankind manages the resources challenge will determine the quality and sustainability of the human - habitat interface.



Interface interrelationships must be understood in detail, in particular the impacts and trade-offs of Energy vs Water vs Waste vs Land-Use.

The Resource Assurance Approach

Tools for scenario-based “Systems-of-systems” analyses to understand the complex linkages, challenges, and temporal interdependencies of:

The Resource Assurance Approach

Tools for scenario-based “Systems-of-systems” analyses to understand the complex linkages, challenges, and temporal interdependencies of:

- **Present and Future Energy Needs**
- **Water Availability**
- **Waste, Land-Use & Human Footprints on the Environment**
- **Climate Change Impacts**
- **Demographic Factors**
- **Natural Disasters**

The Resource Assurance Approach

Tools for scenario-based “Systems-of-systems” analyses to understand the complex linkages, challenges, and temporal interdependencies of:

- Present and Future Energy Needs
 - Water Availability
 - Waste, Land-Use & Human Footprints on the Environment
 - Climate Change Impacts
 - Demographic Factors
 - Natural Disasters
- *Resources*
 - *Environment*
 - *Economic development*
 - *Security concerns*
 - *Policy & regulation*
 - *Technology*

The Resource Assurance Approach

- The energy crisis is also a opportunity
- Energy is a significant component of the resource challenge:
 - Energy + Water + Waste + Land-Use
- Gaps in understanding can result in poor decisions
- Decisions effect infrastructure - expensive to correct
- Modern computers, methods, and advancing science now enable evaluation of multiple conflicting scenarios through modeling & simulation, knowledge extraction and data assimilation

The Resource Assurance Construct

Good Decisions

- **Avoid or mitigate resource instigated conflicts**



The Resource Assurance Construct

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- **Build future prosperity with business models that yield a healthy environment and new business sectors that support its maintenance**

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- **Avoids or mitigates resource instigated conflicts**
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- **Underpinning future prosperity with a healthy environment and new businesses for its maintenance**
- **Solutions from test cases can be applied worldwide**

The Resource Assurance Construct

Good Decisions

- Avoids or mitigates resource instigated conflicts
- Uses capital productively and efficiently
- Underpinning future prosperity with a healthy environment and new businesses for its maintenance
- Solutions from test cases are reproducible worldwide
- Derive from multiple functional partnerships to capture, combine and deliver capabilities

Producing Resource Assurance Analyses

- DOE-scale Modeling and Simulation
 - High Performance Computing



Producing Resource Assurance Analyses

- **DOE-scale Modeling and Simulation**
 - High Performance Computing
- **Energy, environment, and biosciences technologies, capabilities and expertise**
 - **Examples include**
 - Climate change analyses
 - Bioenergy centers
 - Human population distribution changes due to climate changes or new energy technologies

Producing Resource Assurance Analyses



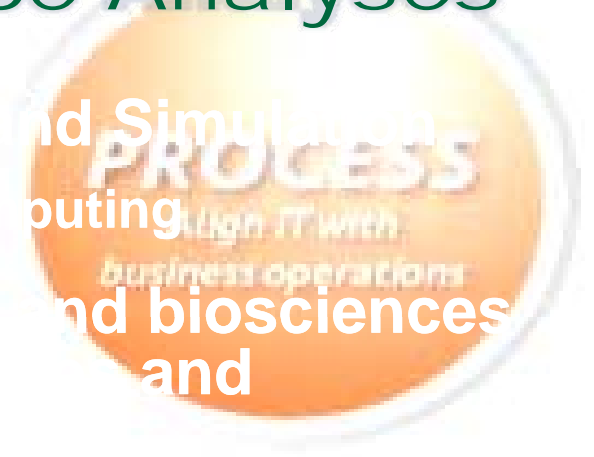
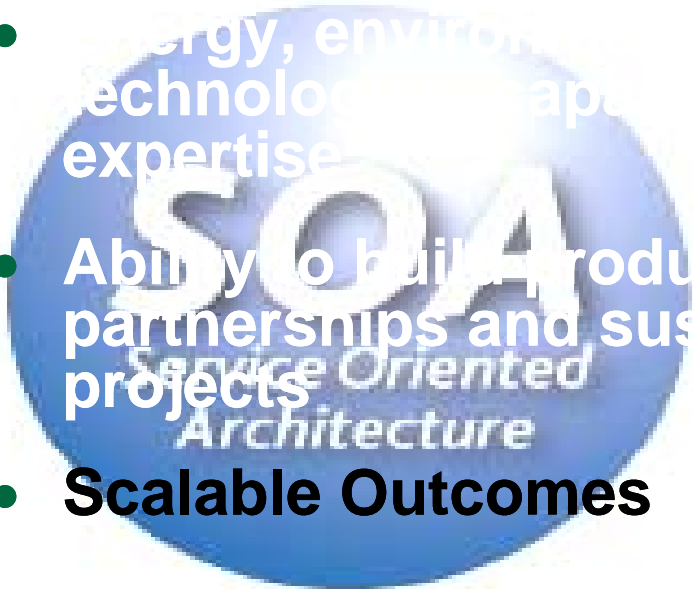
- Environment, and bioscience, technology, capabilities, and expertise
- **Ability to build productive partnerships and sustain collaborative projects**



Producing Resource Assurance Analyses



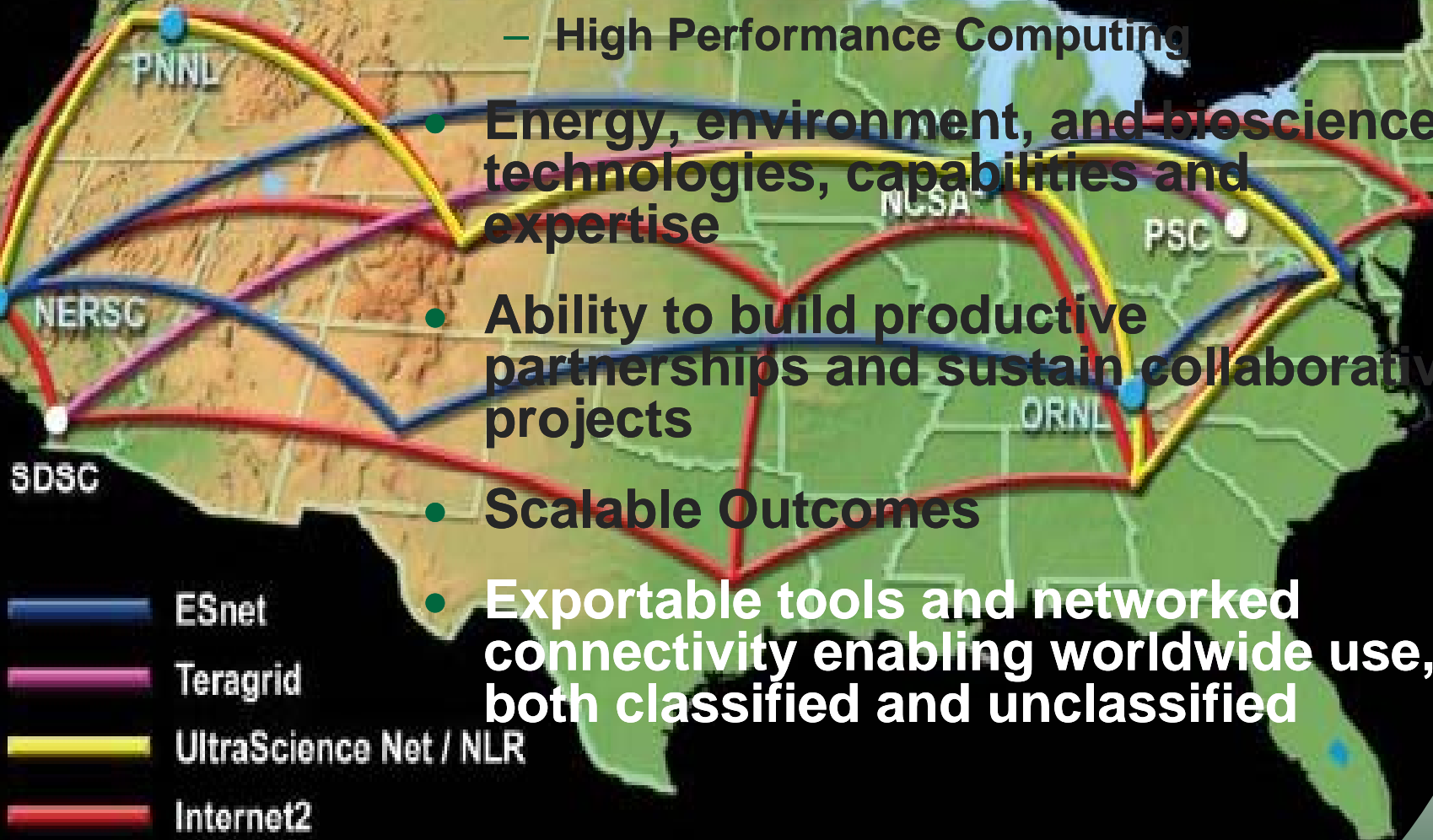
- **Scalable Outcomes**
- Ability to build product partnerships and sustain projects
- Energy, environmental and technology capabilities and expertise



Outcomes must be scalable, and our approach is the development of a SOA

Producing Resource Assurance Analyses

- DOE-scale Modeling and Simulation
 - High Performance Computing
- Energy, environment, and biosciences technologies, capabilities and expertise
- Ability to build productive partnerships and sustain collaborative projects
- Scalable Outcomes
- Exportable tools and networked connectivity enabling worldwide use, both classified and unclassified



- ESnet
- Teragrid
- UltraScience Net / NLR
- Internet2

The Resource Assurance Construct

- A long view - ten to fifty years global view— with near-term deliverables

The Resource Assurance Construct

- A long view - ten to fifty years global view— with near-term deliverables
- **Technology – Policy assessment**

The Resource Assurance Construct

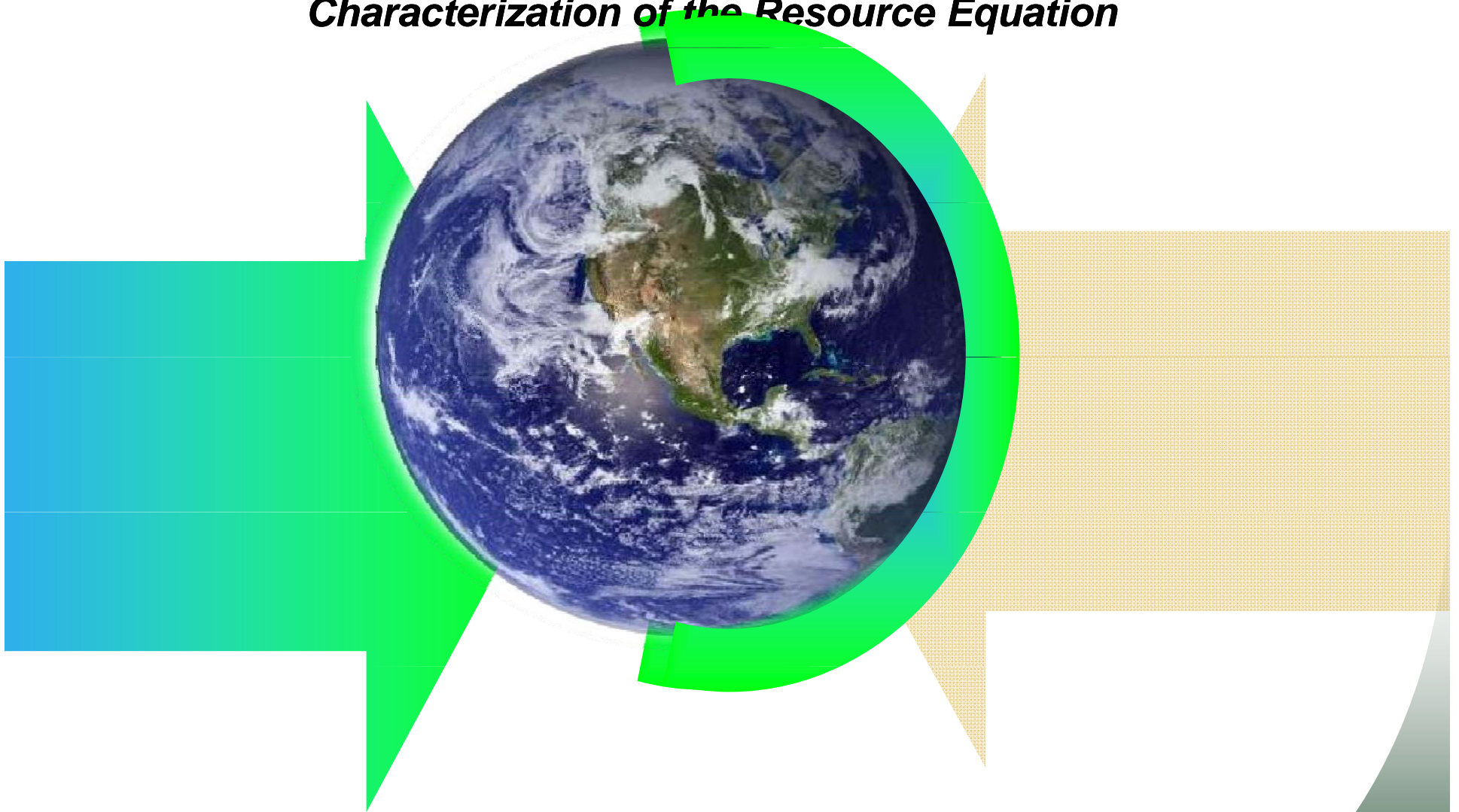
- A long view - ten to fifty years global view— with near-term deliverables
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- **Systems thinking and interaction**

The Resource Assurance Construct

- A long view - ten to fifty years global view– with near-term deliverables
- Technology – Policy assessment
- Systems thinking and interaction
- Capitalize on many technology futures
 - Renewable energy
(hydro, solar, wind, bio, land-use)
 - Resources efficiency
(zero energy homes, electric transportation, low-water-use technologies, waste-to-energy, remanufacturing)
 - Energy Base Load (Fossil fuels + nuclear)
 - Efficient, reliable distribution (Grid)

Resource Assurance Construct

Characterization of the Resource Equation



Resource Assurance Construct

Characterization of the Resource Equation



Creates and sustains Geospatially Enabled Unclassified and Classified “Resource Globes”

- *Allows development of accurate region specific assessments*
- *Evaluation of the dynamics of energy-water-waste cycles*
- *Supports course of action analysis and decision making*

Resource Assurance Construct

Characterization of the Resource Equation

Collaborative team builds the foundation models...

- **Energy Systems**
- **Water**
- **Pollution**
- **Climate Change**
- **Population**
- **Natural Disasters**



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- DOD-COCOMS
- DOE
- DHS
- CDC
- NSF
- Universities

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- Commercial Interface Models
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- Environment
- Economics
- Security
- Policy
- Technology

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Resource Assurance Value to the COCOMs

- **Develops and establishes standards, technology assessments and linkage tools on an open architecture**

NORTHCOM

AFRICOM

CENTCOM

PACOM

SOUTHCOM

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- Outlines a "resource framework", to provide a standard process for technology and policy assessment**
- Provides system network architectures that define data-storage-mining-processing and visualization science techniques**
- Provides a modeling and simulations backbone to examine alternative policy and technology strategies**

Resource Assurance will Help Guide Technology Selection and Strategy

- **The power of Resource Assurance is the ability to see the synergistic impact of multiple technology combinations and development decisions.**



Resource Assurance will Help Guide Technology Selection and Strategy

- **Identify a broad number of resource capabilities that will drive technology selection with the power to see the synergic impact of multiple technology combinations and development decisions.**
- **Expand the ability of communities and organizations to determine the technology alternatives that can best satisfy resource needs within a dynamic updated framework.**

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- **Select the best technology from multiple alternatives.**

Resource Assurance will Help Guide Technology Selection and Strategy

- **Identify a broad number of resource capabilities that will drive technology selection with the power to see the synergic impact of multiple technology combinations and development decisions.**
- **Expand the ability of communities/regions to determine the optimal combination of technology alternatives that can best satisfy resource needs within a dynamically updated framework.**
- **Select the best technology options from multiple alternatives.**
- **Generate, implement and keep updated plans to develop and deploy appropriate resource technology alternatives.**

Contacts for Resource Assurance Information-

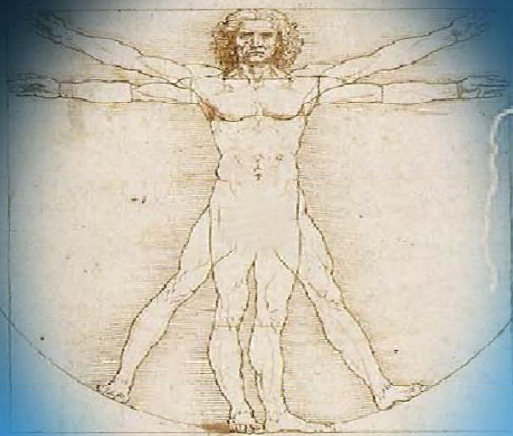


Jeremy Cohen
Resource Assurance Program Manager
Oak Ridge National Laboratory
Oak Ridge, TN 37831
Email: cohenjd@ornl.gov
Phone: (865) 576-3445



Kristy Herron
Resource Assurance Program Coordinator
Oak Ridge National Laboratory
Oak Ridge, TN 37831
Email: herronkc@ornl.gov
Phone: (865) 241-9242

Resource Assurance...



...Balancing the Resource Equation

Resource Assurance Status

Year Integrated Project Plan

Unclassified and Classified Components

Focused to COCOM needs

PACOM- Resource challenges identified

Theater Support Plan interface

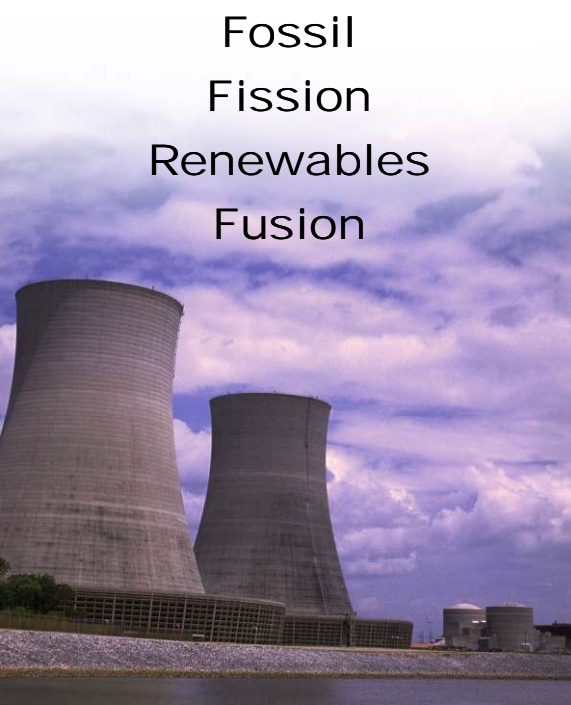
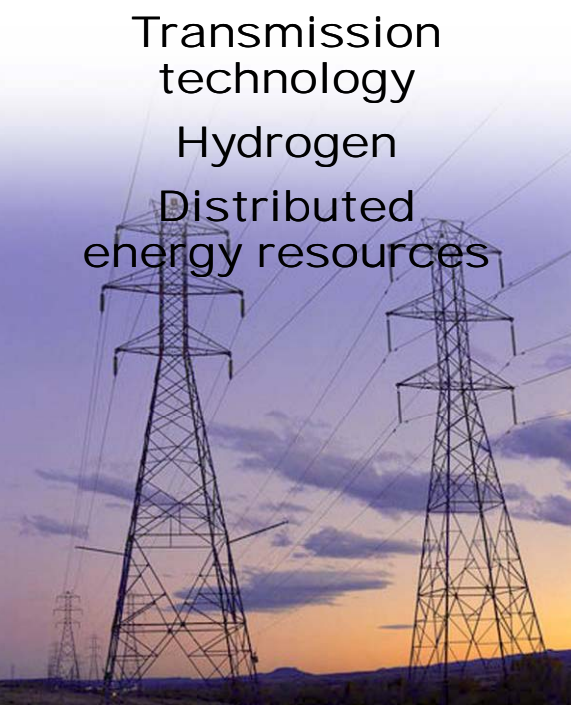
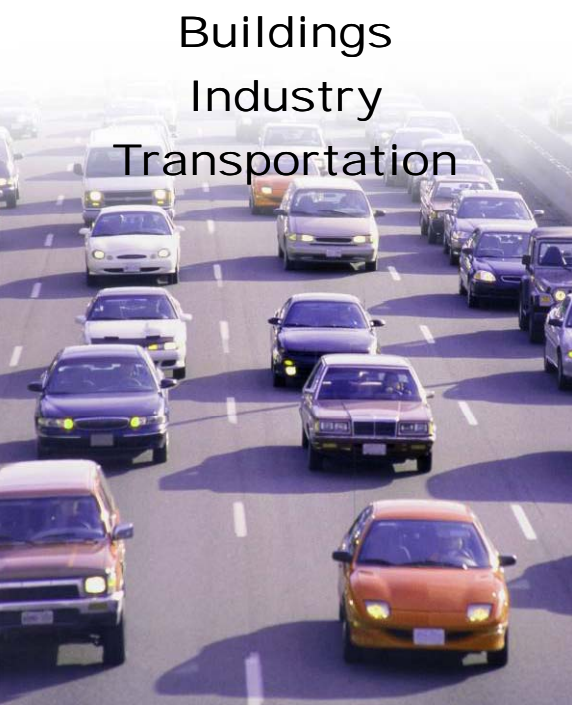
**National Laboratory and University Team
identified & working**

April 2009 Roles and Missions Session

May- June 2009 Operational Needs Statement

July 2009 Team meeting complete project plan

Translating science and technology into energy solutions

Generation	Distribution	Consumption
<p>Fossil Fission Renewables Fusion</p> 	<p>Transmission technology Hydrogen Distributed energy resources</p> 	<p>Buildings Industry Transportation</p> 

Supporting national goals for energy security and independence

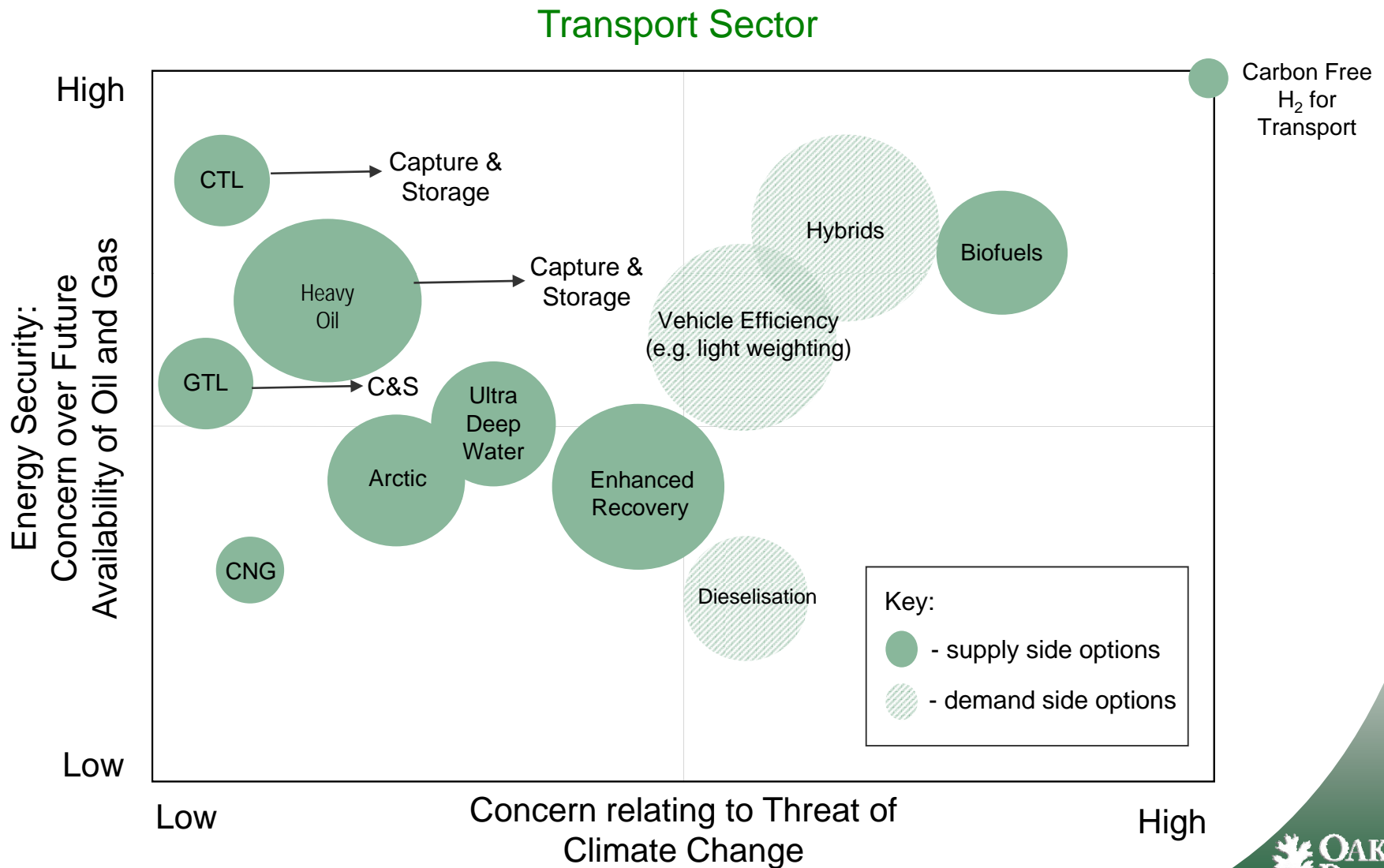
The Energy-Carbon-Water Nexus

Sustainable production and use of interrelated resources on a constrained and changing Earth

Energy	Carbon	Water
<ul style="list-style-type: none">• Production, distribution, and use• Economic drivers• Environmental drivers	<ul style="list-style-type: none">• Biofuel, food, fiber• Ecosystem health (e.g., biodiversity)• Managing carbon for mitigation of climate change	<ul style="list-style-type: none">• Energy requires water; Water requires energy• Many critical climate change impacts are water related

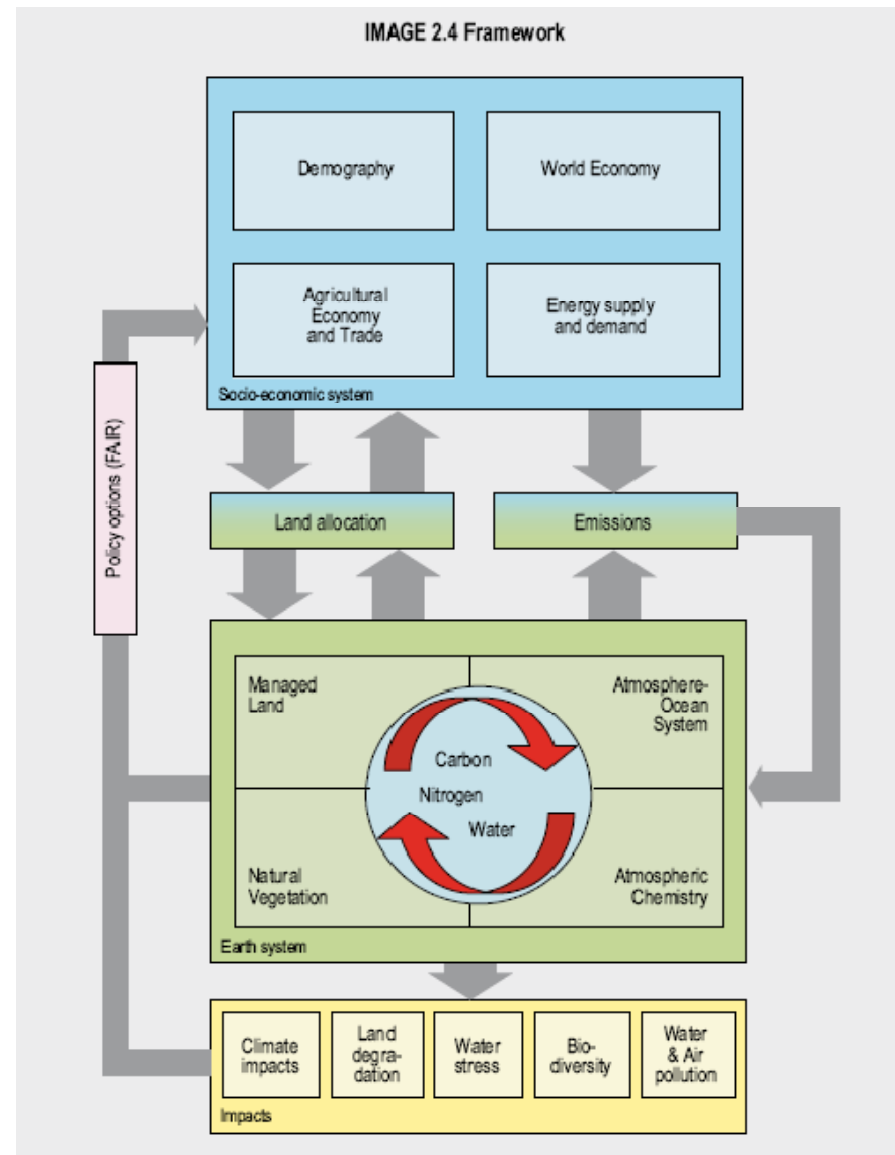


Technology Options for Transportation (Source: Koonin, BP)



Sustainability Science: Integrating energy, economics, and environment

- Regional to global scales
 - Even molecular indicators
- Level of detail driven by needs
- Data and computing limitations are disappearing



Regional Simulation Model (RSim)

- Spatially explicit
- Forecast outcomes of management options

(Fort Benning shown here)

Scenarios influence RSim

