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
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# Resource Assurance Balancing the Resource Equation

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**Abstract:**

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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 an opportunity
- Energy is a significant component of the resource challenge:
  - Energy + Water + Waste + Land-Use
- Gaps in understanding can result in poor decisions
- Decisions affect 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

Good Decisions

• Avoid or mitigate resource instigated conflicts
• Uses capital productively and efficiently
The Resource Assurance Construct

Good Decisions

• **Avoids or mitigates resource instigated conflicts**
• **Uses capital productively and efficiently**
• **Build future prosperity with business models that yield a healthy environment and new business sectors that support its maintenance**
The Resource Assurance Construct

- 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 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

- Energy, environment, and biosciences technologies, capabilities, and expertise

- Ability to build productive partnerships and sustain collaborative projects
Producing Resource Assurance Analyses

- High Performance Computing
- Energy, environment, and biosciences technologies, capabilities, and expertise
- Ability to build productive partnerships and sustain projects
- Scalable Outcomes

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
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
- Technology – Policy assessment
- 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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Resource Assurance Construct

Characterization of the Resource Equation

Collaborative team builds the foundation models... for the customer set striving to understand the resource equation

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

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Resource Assurance Construct

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Resource Assurance Value to the COCOMs

- Develops and establishes standards, technology assessments and linkage tools on an open architecture
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- Outlines a "resource framework", to provide a standard process for technology and policy assessment
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- Provides system network architectures that define data-storage-mining-processing and visualization science techniques
Resource Assurance Value to the COCOMs

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

- 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.
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.

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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

Five Year Integrated Project Plan

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

<table>
<thead>
<tr>
<th>Generation</th>
<th>Distribution</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Fission</td>
<td>Transmission technology Hydrogen</td>
<td>Buildings Industry Transportation</td>
</tr>
<tr>
<td>Renewables Fusion</td>
<td>Distributed energy resources</td>
<td></td>
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</tbody>
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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

<table>
<thead>
<tr>
<th>Energy</th>
<th>Carbon</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production, distribution, and use</td>
<td>• Biofuel, food, fiber</td>
<td>• Energy requires water; Water requires energy</td>
</tr>
<tr>
<td>Economic drivers</td>
<td>• Ecosystem health (e.g., biodiversity)</td>
<td>• Many critical climate change impacts are water related</td>
</tr>
<tr>
<td>Environmental drivers</td>
<td>• Managing carbon for mitigation of climate change</td>
<td></td>
</tr>
</tbody>
</table>
Technology Options for Transportation
(Source: Koonin, BP)

Transport Sector

Energy Security: Concern over Future Availability of Oil and Gas

Low

High

Capture & Storage

CTL

GTL

CNG

Heavy Oil

Ultra Deep Water

Arctic

Capture & Storage

Enhanced Recovery

Dieselisation

Carbon Free H₂ for Transport

Low

Concern relating to Threat of Climate Change

High

Hybrids

Biofuels

Vehicle Efficiency (e.g. light weighting)

Key:
- supply side options
- demand side options

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for the Department of Energy
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)