

JGCRI 2105 Integrated Assessment Workshop and GCAM Community Modeling Meeting

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December 1, 2015

College Park Marriott &
Conference Center



U.S. DEPARTMENT OF
ENERGY

Office of
Science

Office of Biological
and Environmental Research

Drivers of Change...and Evolution of Priorities

Impacts, Adaptations, Vulnerabilities (IAV)

- Systems and cascading system vulnerabilities, especially to rapid change and extreme events
- Influences and impacts across scales – time and space
- Implications of multiple stressors and evolving regional landscapes
- Tensions and tradeoffs in complex, dynamic systems
- Physical and economic consequences
- Implications and uncertainties of decision options

Mitigation – Adaptation Interface

Anthropogenic Influences on Climate

- Feedbacks that matter

Three Communities Evolving Individually and Collectively – Where are We Headed and Why?

1. What are the key information exchanges presently or potentially for these communities – **IA (IAM and IAV)** and ESMs, RGCMS...and demographics, hydrology, and other specialized domains.
2. Interest in building off of USGCRP and agency priorities at the intersection of Energy-Water-Land (or Food) systems.
3. Importance and focus on modeling and understanding cross-sectoral and system dynamics.
4. Particularly important to understand disruptive events...extremes, system shocks, vulnerabilities and adaptations.
5. Where and why might hard versus soft couplings be useful? Where do they need to be coupled? Two way exchanges?
6. Scale matches and mismatches?
7. Implications of adaptive grids and/or other “telescopic” capabilities?

Three Communities Evolving Individually and Collectively (contd.)

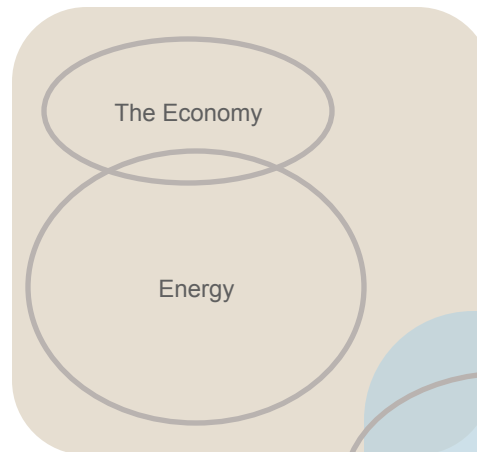
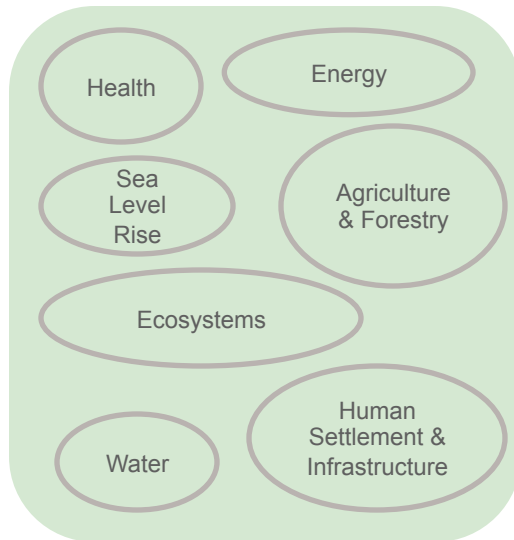
8. Typology of users. What makes sense given uncertainties and/or data limitations for key aspects?
9. Differences for one pass deep dives versus highly iterative analyses tied to uncertainties and options (e.g., human decisions)?
 1. More complexity does not always mean better predictability
 2. Use of emulators?
 3. How do we test and incorporate what really matters for key questions of interest...not all detail matters?
10. How do we transfer place-based learning to more generalized models and simulations?
11. Modeling and scenarios... in both directions?

EXAMPLES to Follow at the Energy-Water-Land Nexus and/or Urban Systems and Connected Infrastructure

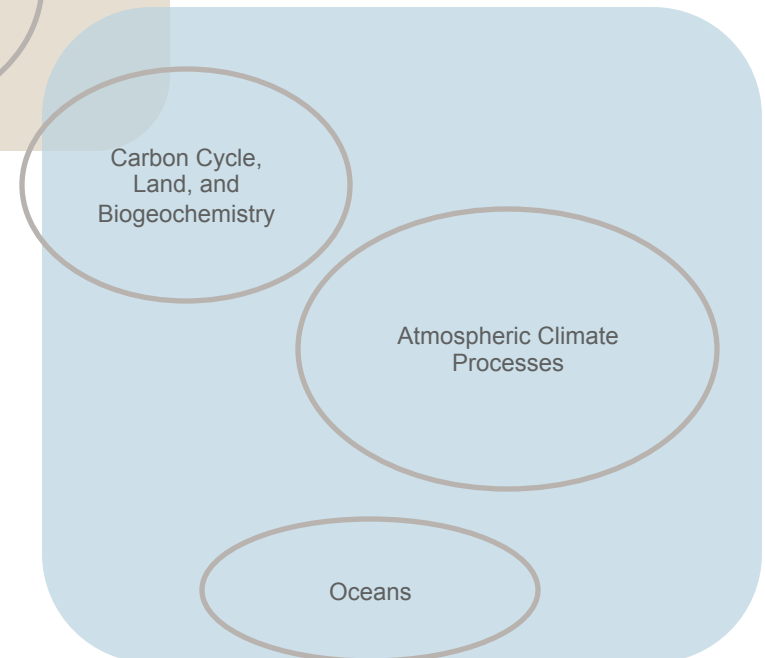
Modeling & Analysis – IA, IAV, and ESM/RGCM *Before*

Integrated Assessment Modeling

Impacts, Adaptation & Vulnerability Modeling



Climate Modeling

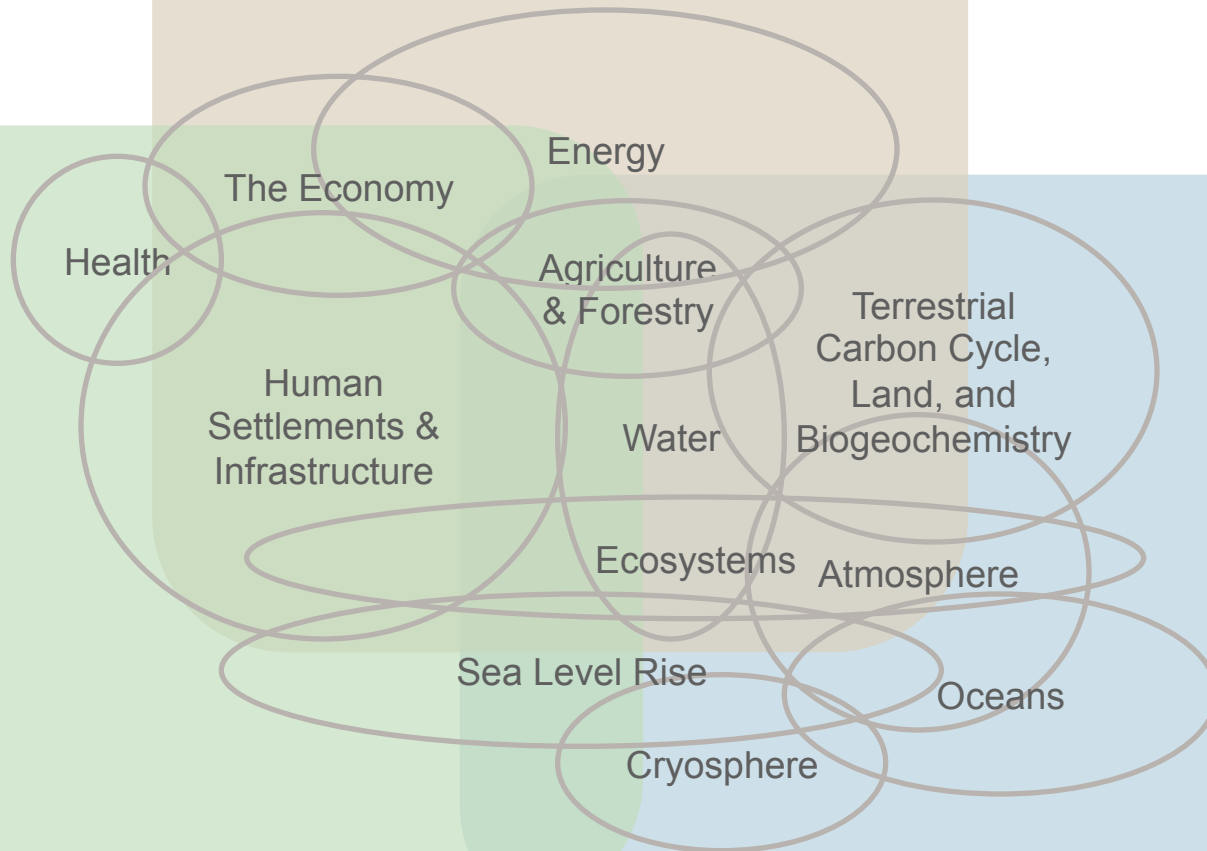


Modeling & Analysis - Regional and Global *Emerging*

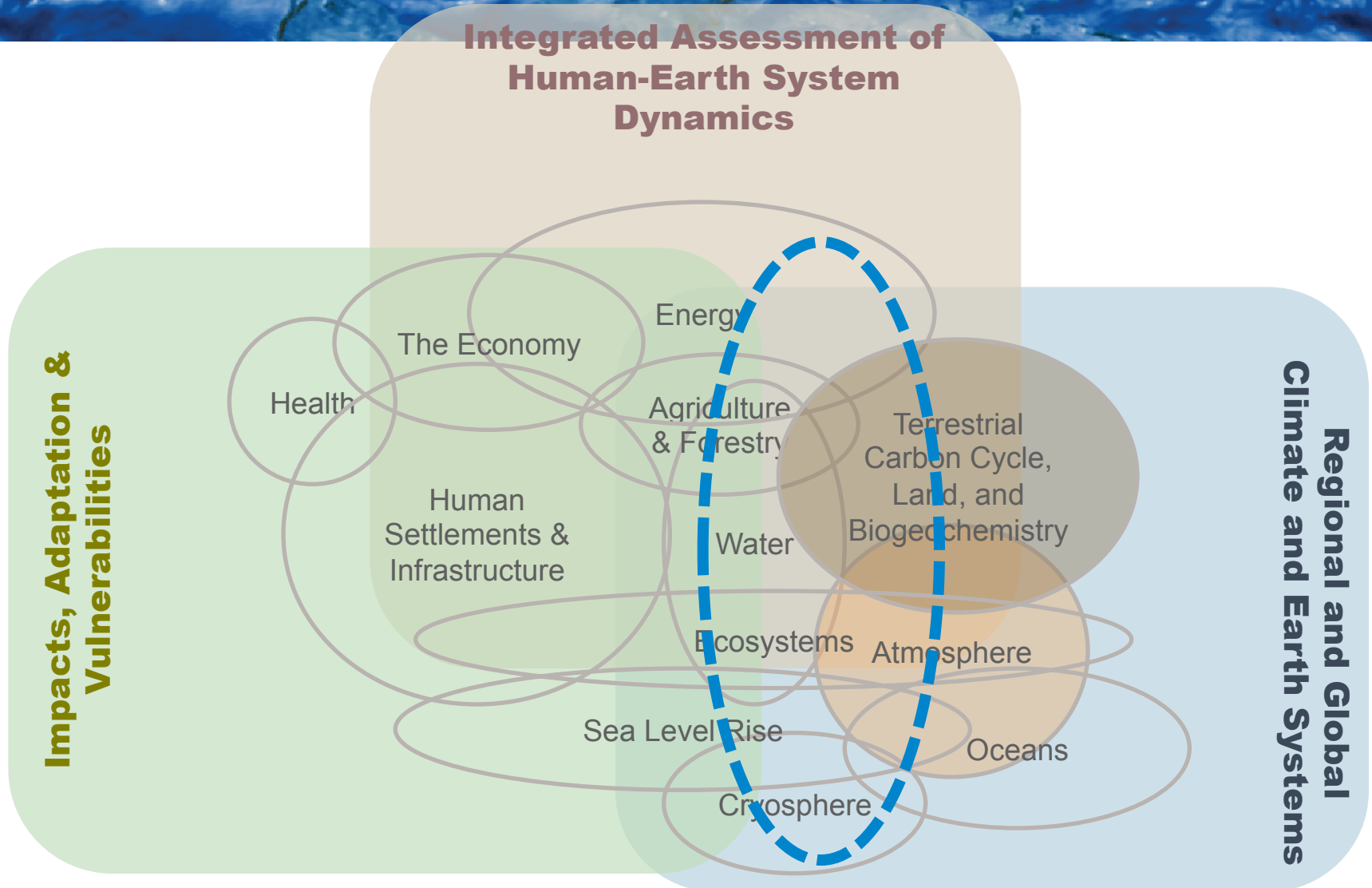
Integrated Assessment of Human-Earth System Dynamics

**Regional and Global
Climate and Earth Systems**

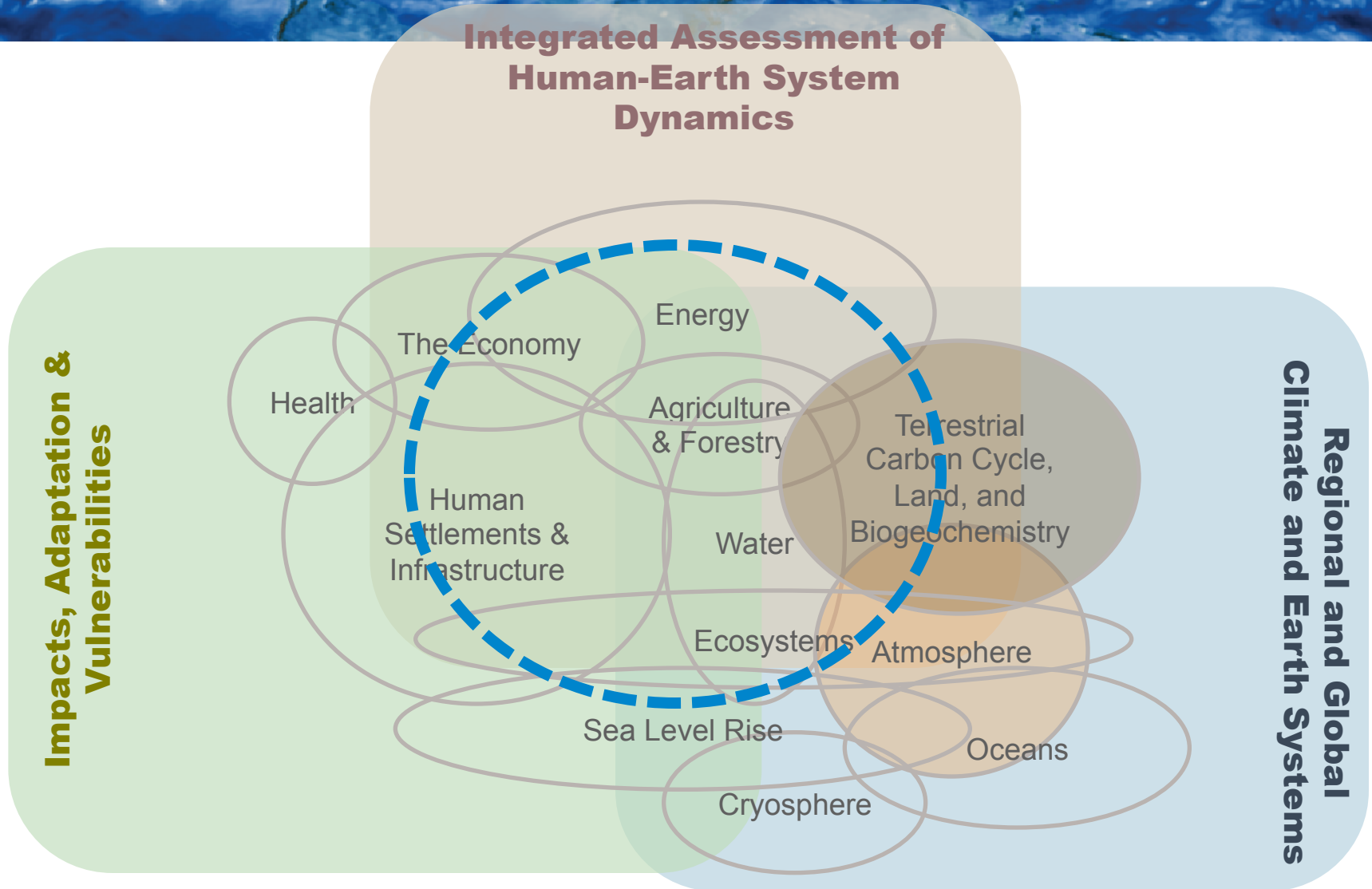
**Impacts, Adaptation &
Vulnerabilities**



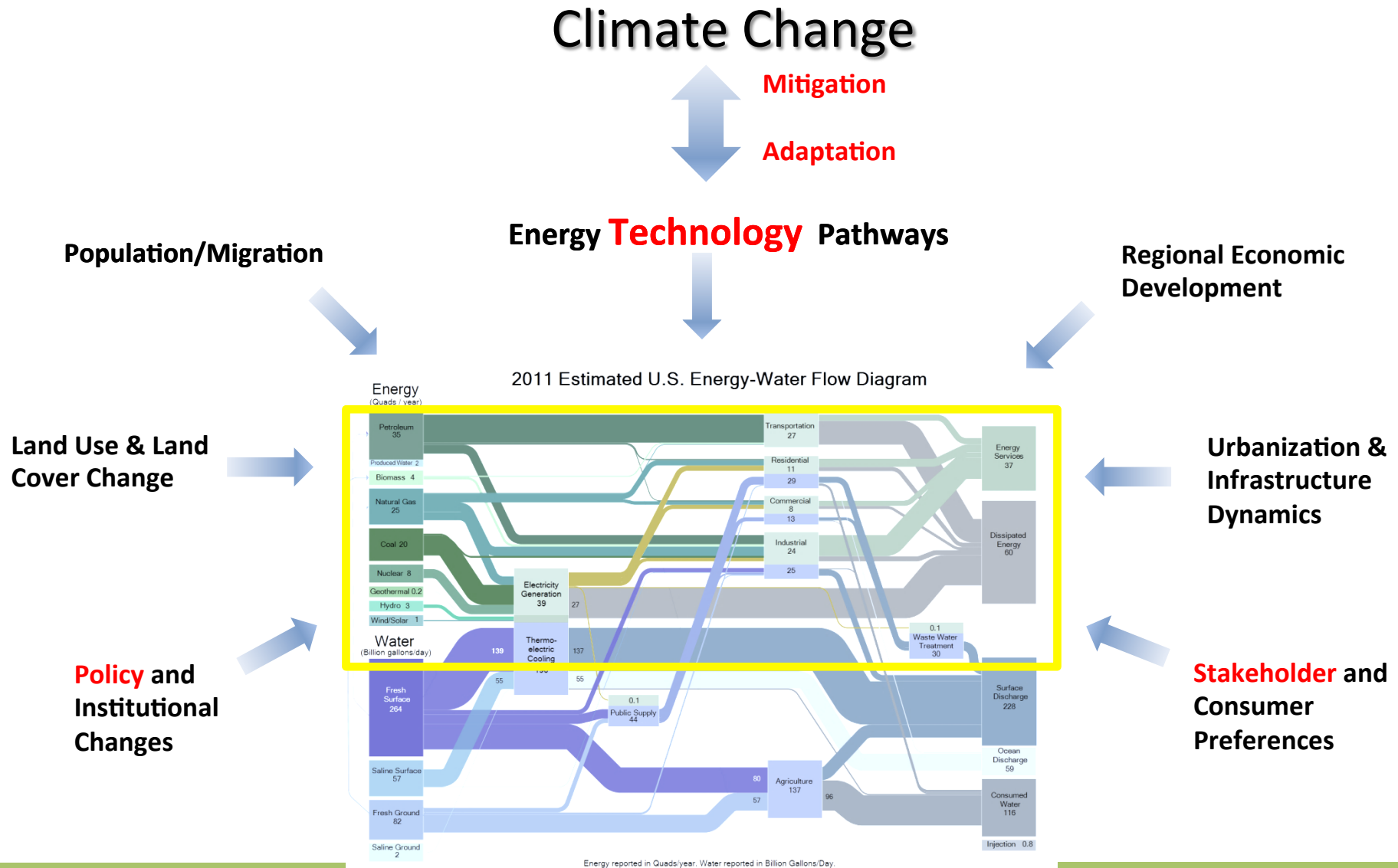
Intersections between IA and ESMs/RGCMs



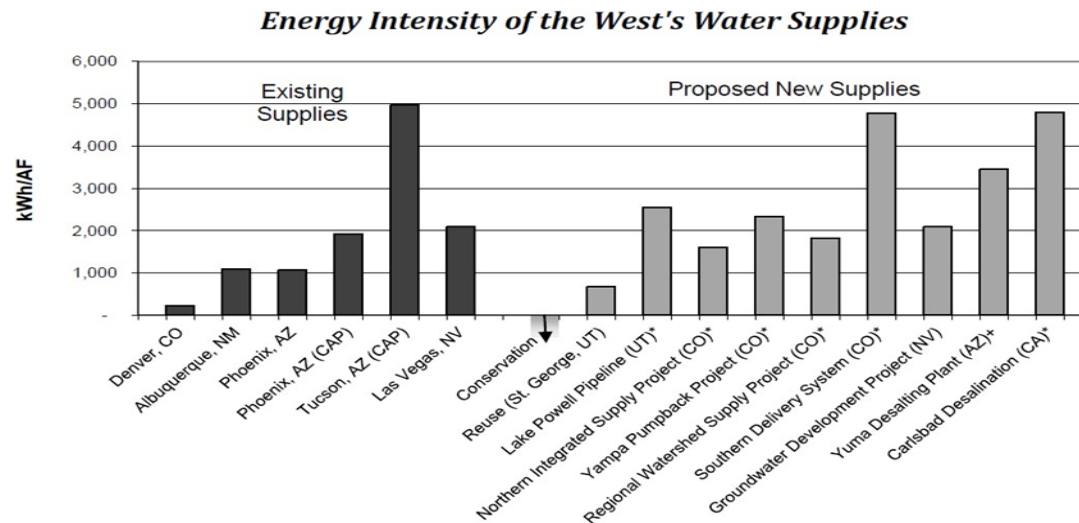
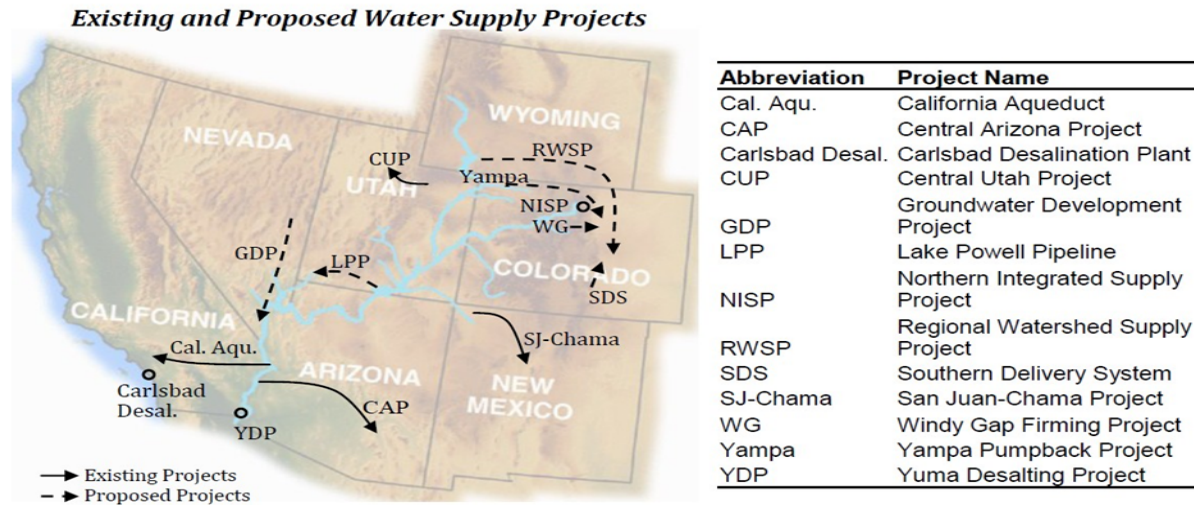
Example – Energy-Water-Land Nexus



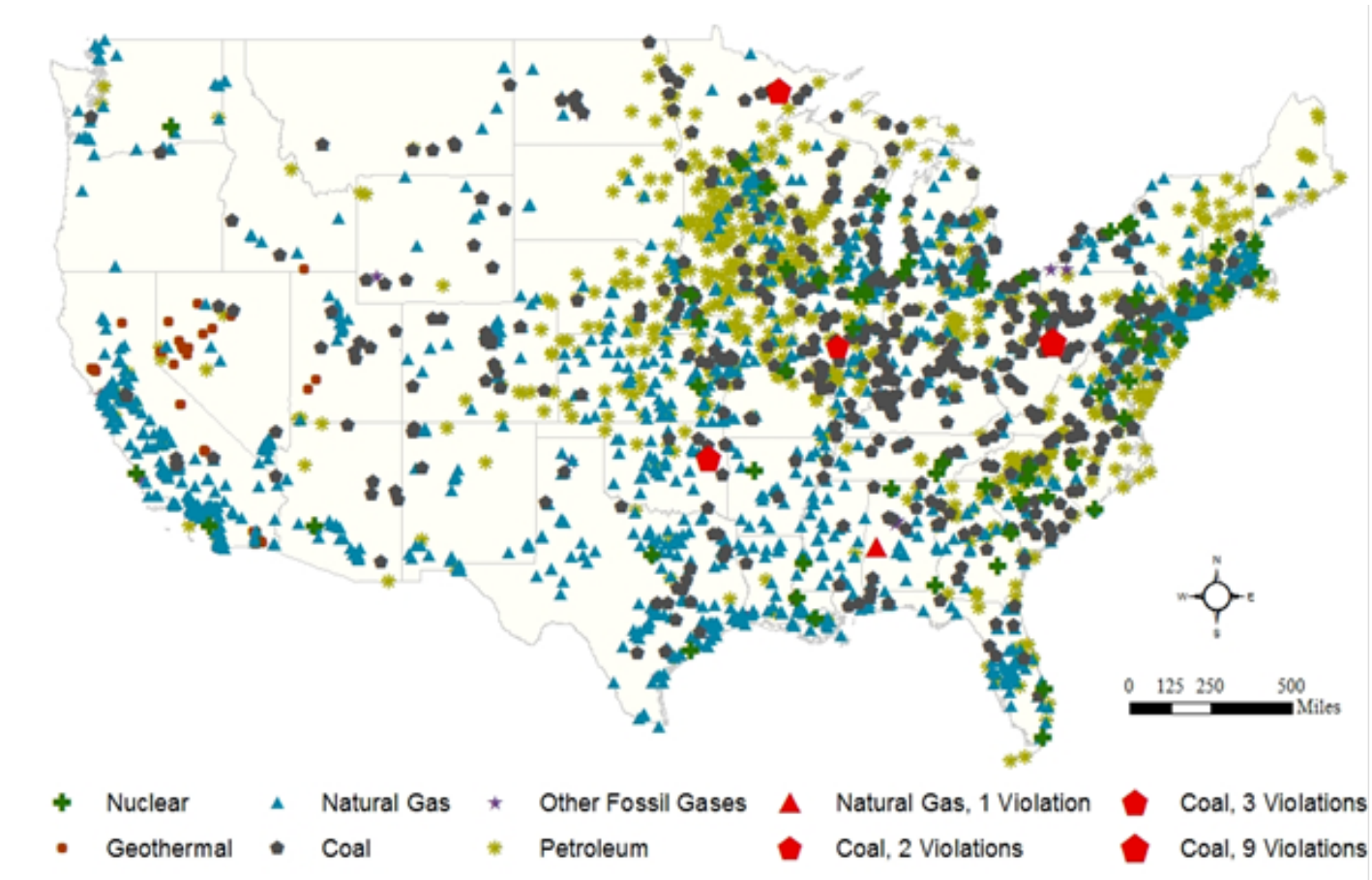
Example of Factors Influencing “Two-Sector” Dynamics



Example: Understanding Energy Intensity of the West's Water Supplies

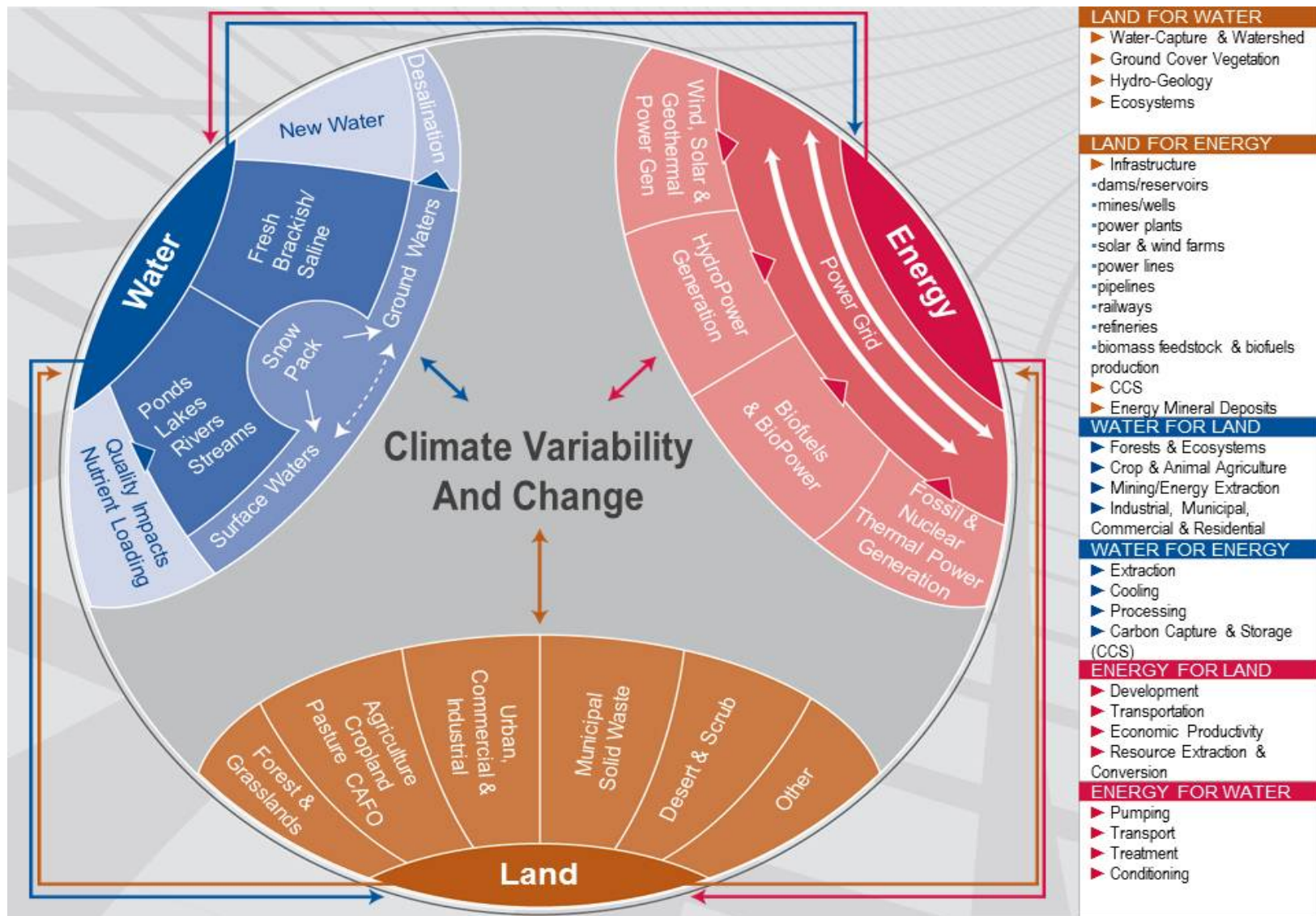


Example: Thermoelectric Vulnerabilities to Stream Flow and Temperatures

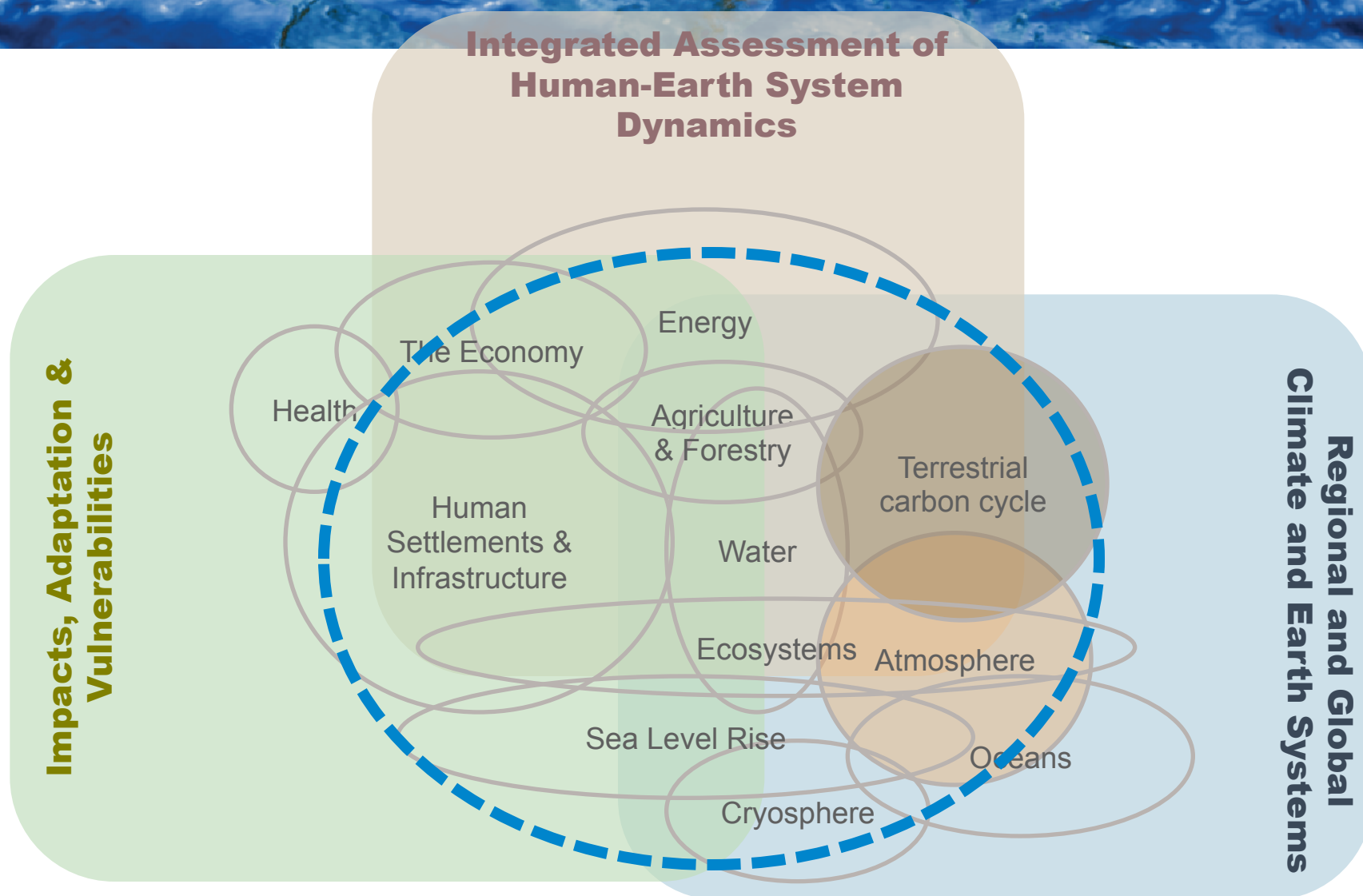


Thermoelectric power plants in the United States, indicating average monthly discharge temperature violations between January 2008 and December 2011. *Source: EPA 2013*

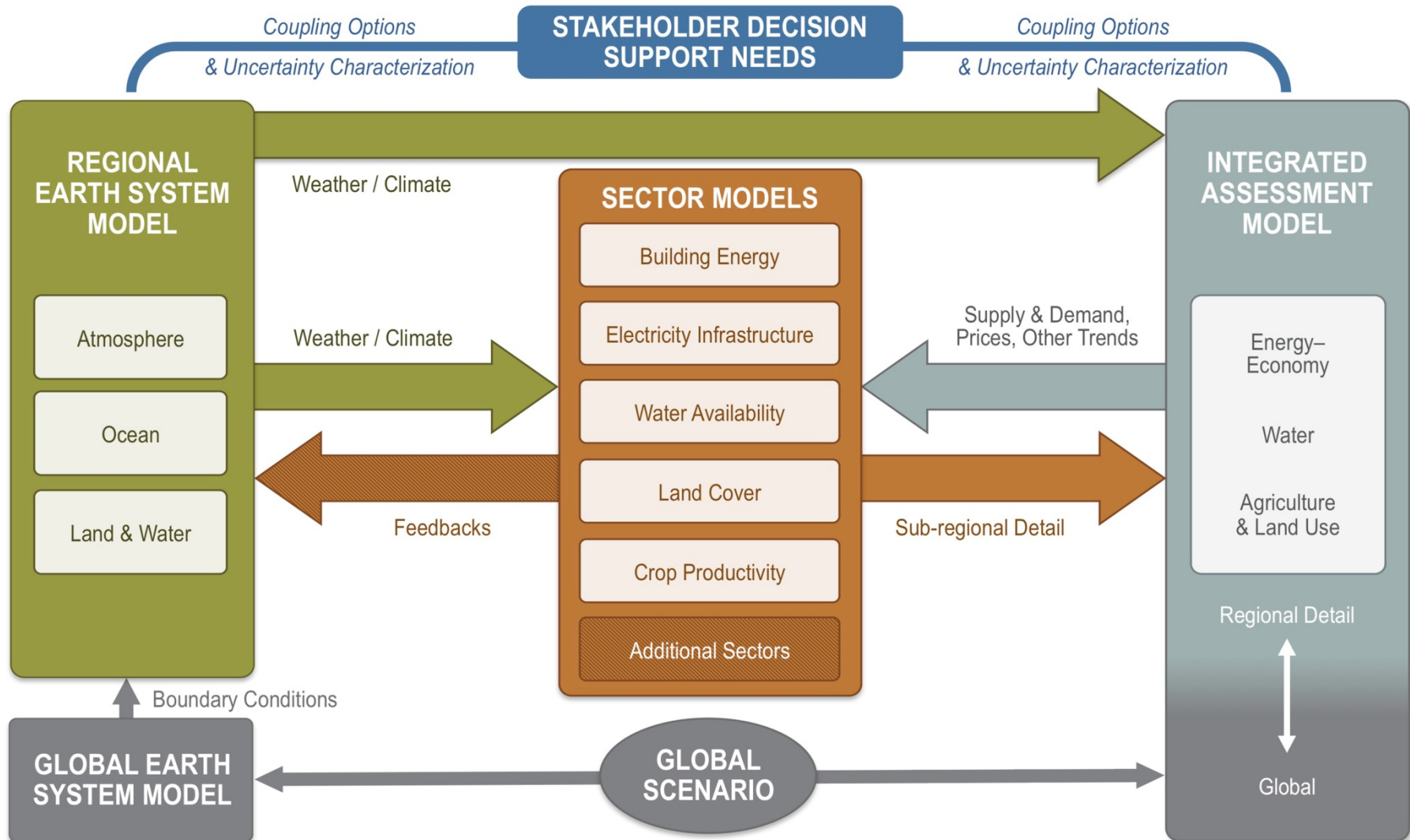
Three Sector Dynamics “Ups the Ante”



Convergence of All Three Model Domains in the Platform for Regional Integrated Modeling and Analysis



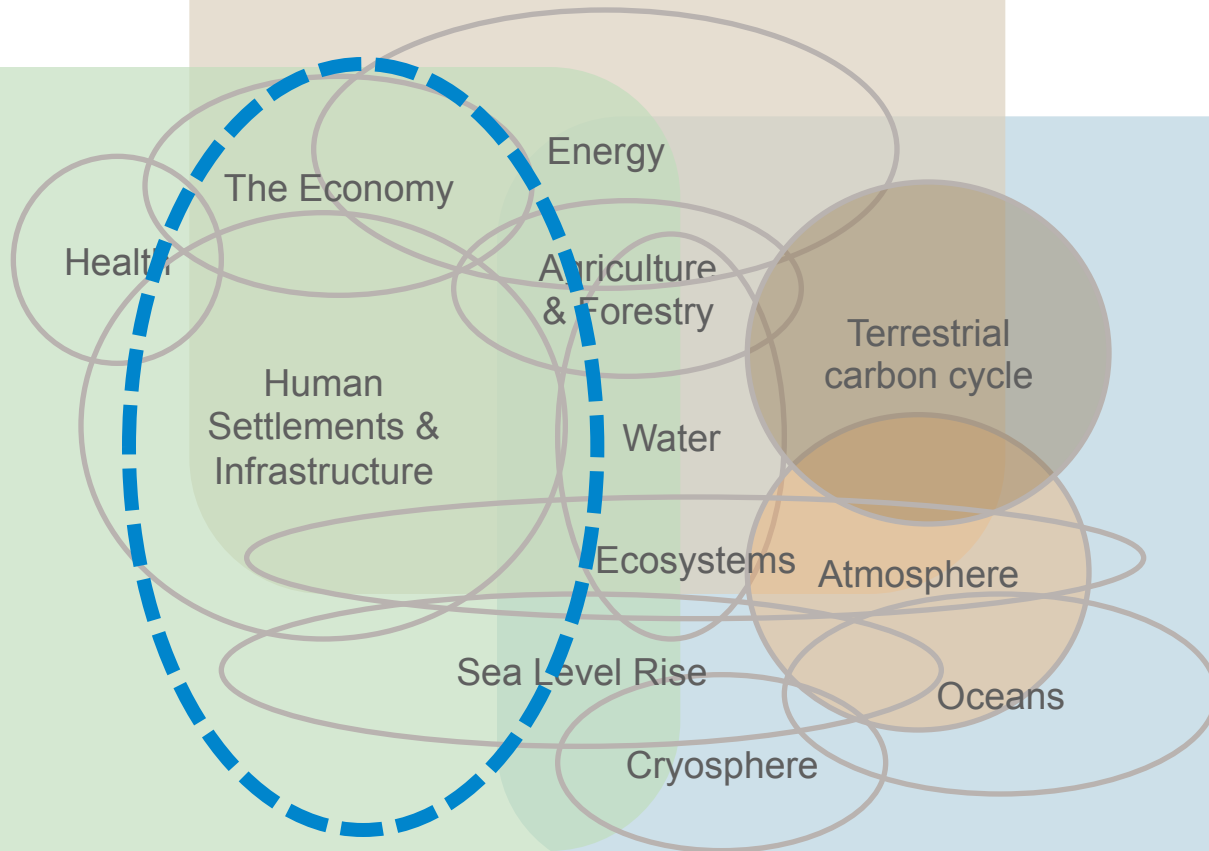
Multi-model Frameworks – E.g., Platform for Regional Integrated Modeling and Analysis



Example –Urban Systems

Integrated Assessment of Human-Earth System Dynamics

**Impacts, Adaptation &
Vulnerabilities**



**Regional and Global
Climate and Earth Systems**

Present Night Lights and 2030 Projection of Urban Expansion – Local Impacts and Feedbacks



Percentage urban and urban agglomerations by size class

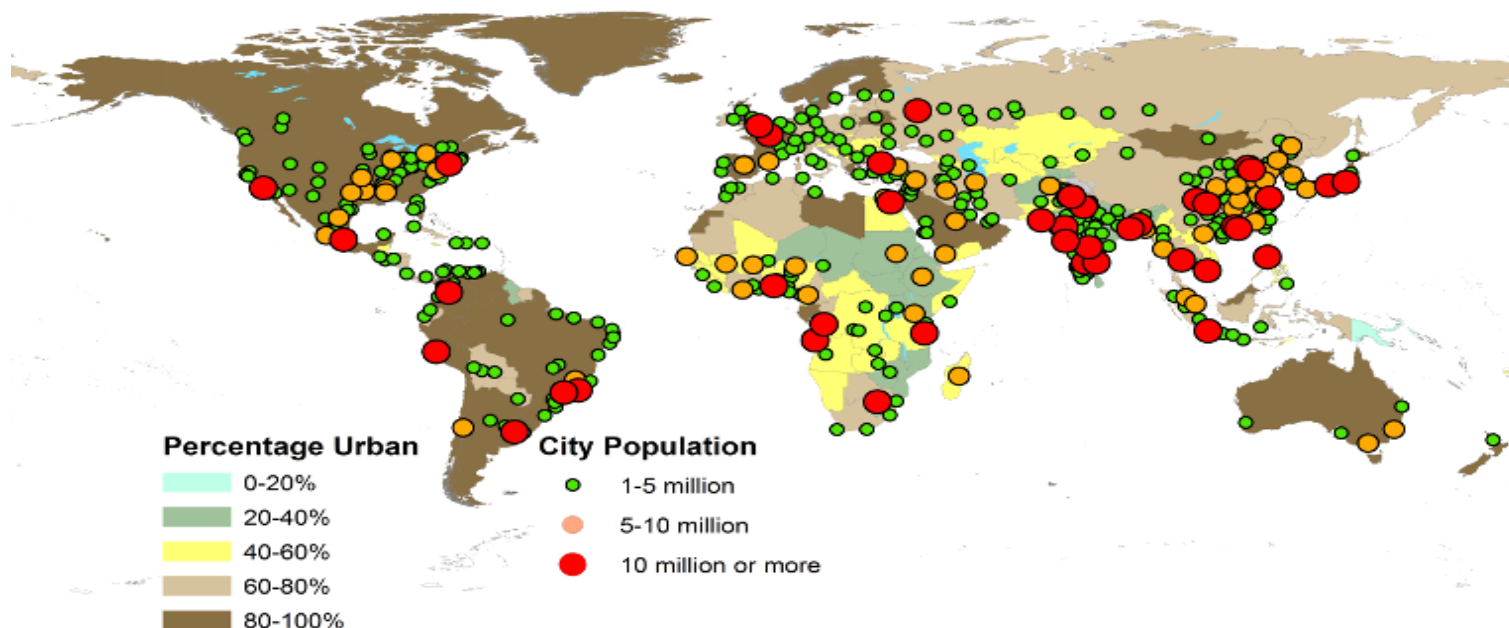
1970

1990

2014

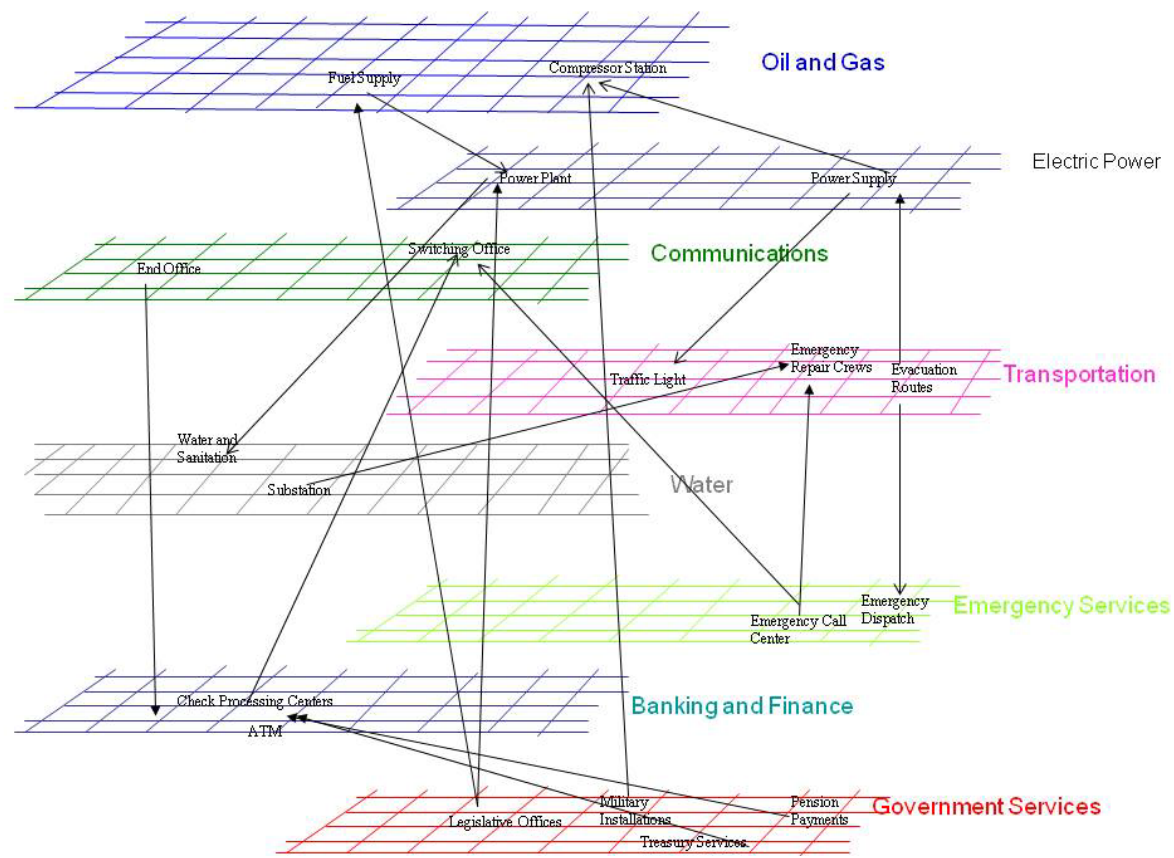
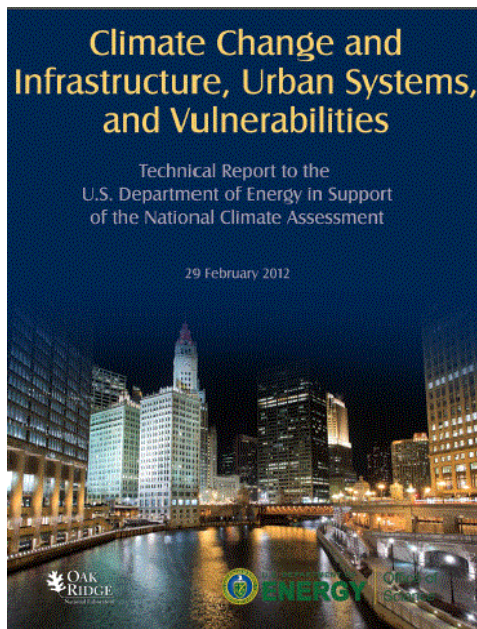
2030

(click on the image to open a full version of the map, in PDF)



Note: Designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

More IAV Context – Climate, Water, Extremes Impacts on Multiple, Connected Infrastructures



Interactive and Interoperable Visualization

Development of High Performance,
Scalable Analytics

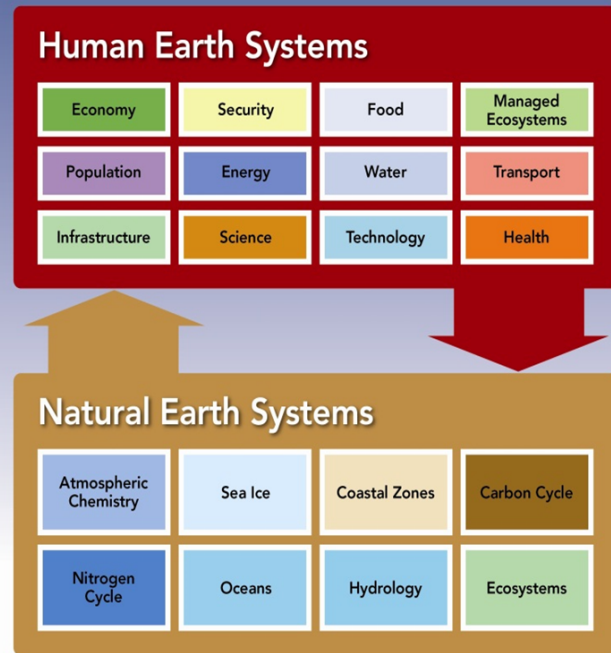
Analysis Models and Tools Development

Knowledgebase Creation

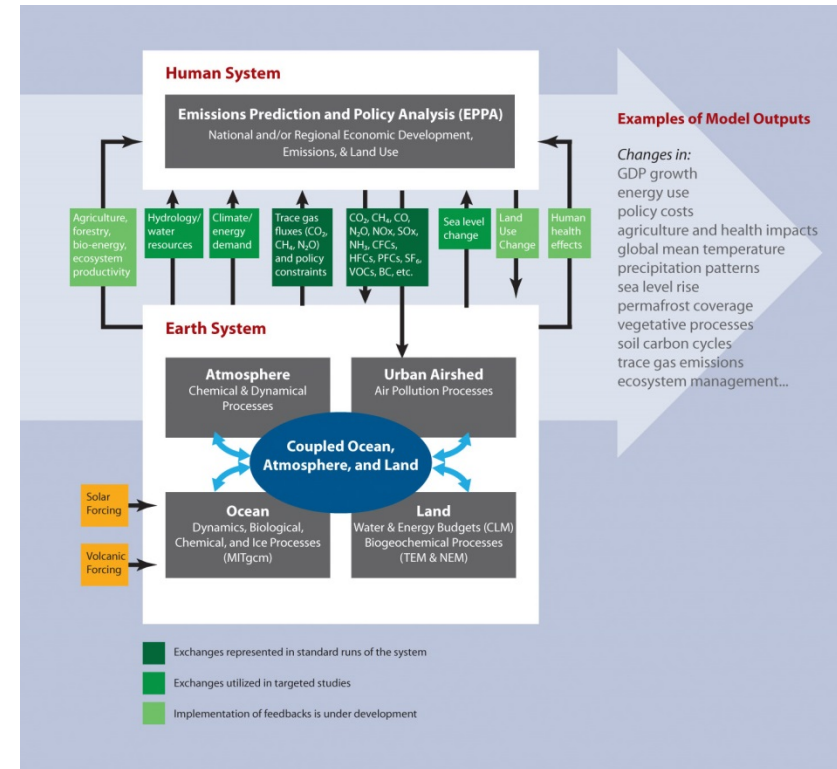
Dynamic Collection, Integration,
Management and Dissemination of
Disparate Data Resources

Different Approaches to Complexity and Scale: IA Examples

Integrated Assessment Models



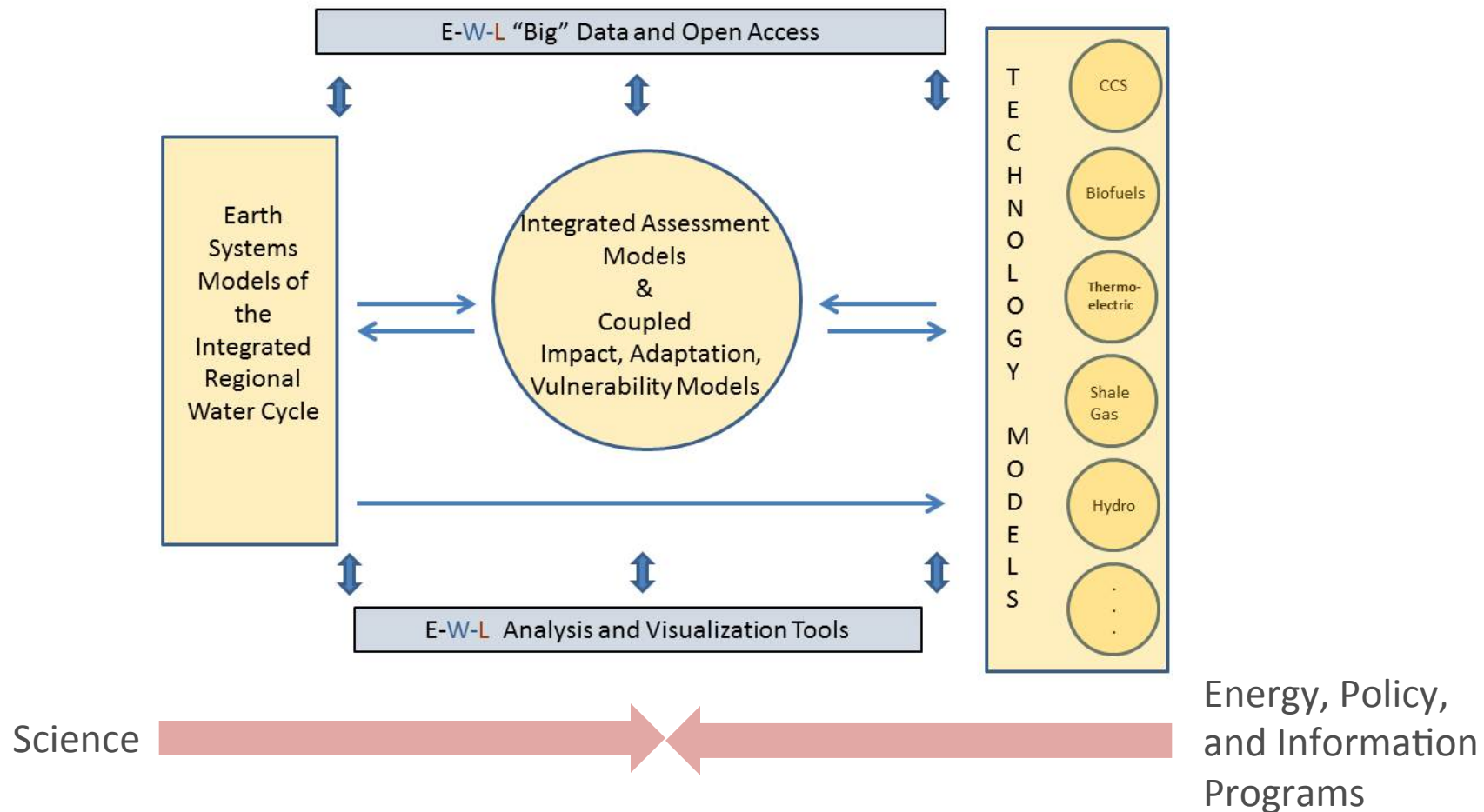
GCAM - EMIC based. Evaluating a new emulator that can reflect impacts, adaptations, and feedbacks.



IGSM - EMIC based on dialed back and adapted major components of CESM.

And basic models such as PAGE, DICE, FUND

Components and Communities



Summary – Challenges and Opportunities

- Multi-model frameworks and flexible couplings
- User-driven typologies
- Software development and modular designs
- IAV representations (within IAMs and separately)
- Spatial and temporal scales that matter for IAV
- “Telescopic” capabilities
- System shocks and extreme events
- Hindcasting and model evaluation.
- Emulation
- Uncertainty characterization
- Sensitivity studies and interpretation of results
- Scenarios
- Data science, data analytics, and data fusion methods.