# ENERGY MODELING FORUM

Workshop on Climate Change Impacts and Integrated Assessment (CCI/IA)
Snowmass, Colorado
July 23 – August 3, 2007
***Tentative Agenda***

(as of 7/24/07)

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**Sunday, July 22**

6:00-8:00 PM *Registration and Informal Reception for Attendees and all Guests*
*Gatehouse, Top of the Village*

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**Monday, July 23**:
10:00 AM Registration Continues

11:30 *Lunch for Conference Attendees*

**REGIONAL IMPACTS AND THEIR REPRESENTATION IN ECONOMIC AND INTEGRATED ASSESSMENT MODELS: WHAT HAVE WE LEARNED FROM IPCC AR4?**

Themes And Objectives:

- Learn about relevant AR4 results and look towards future directions
- Focus on a limited # of sectors and 'walk through' from downscaled regional climate impacts assessment to incorporation into CGE and IA models.
- Review state of the art and identify future directions for 1) regional impacts assessments and 2) incorporation of impacts into econ modeling
- Revive White Paper on incorporation of impacts into econ/IAMs.

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12:15 PM **Welcoming Remarks** • John Weyant, Stanford University

12:30 *Keynote Speaker*
**Summary of new insights on impacts from IPCC WG2 AR4 and a framework for identifying key risks and vulnerabilities**
• Stephen Schneider, Stanford University

*2:00 – 2:20: Break*

**Climate & Socio-Economic Scenarios: The Regional Story**

2:20 **Regional patterns and downscaling approaches; Insights from IPCC WG1**
• Ruby Leung, Pacific Northwest National Laboratory

3:05 **Downscaling demographic drivers from SRES scenarios**
• Brian O'Neill, The International Institute for Applied Systems Analysis

*3:50 – 4:10 Break*

**Potential Climate Change Impacts in Key Sectors**

4:10 **IPCC WG2 human health effects, vulnerable world populations**
• Sari Kovats, London School of Hygiene & Tropical Medicine

4:55 Adjourn

*6:30 PM* *Welcoming Dinner for Conference Participants and all Guests*

**<u>Tuesday, July 24</u>:**

*7:30 AM* *Continental Breakfast – Gatehouse, Top of the Village*

**Potential Climate Change Impacts in Key Sectors (continued)**

9:00 **US CCSP human health impacts and U.S. air quality impacts assessment**
• Anne Grambsch, U.S. Environmental Protection Agency

9:45 **Agricultural impacts; economic and biophysical effects**
• Bruce McCarl, Texas A&M University

*10:30–10:50* *Break*

10:50 **US CCSP and IPCC WG2 on energy production and use, and human settlements**
• Thomas Wilbanks, Oak Ridge National Laboratory

11:35 **Patterns of observed changes to natural systems and attribution to climate change**
• Terry Root, Stanford University

*12:20–1:30* *Lunch*

1:30 **US CCSP and IPCC WG2 ecosystems; valuation of services**
• Anthony Janetos, Joint Global Change Research Institute

**Multi-Sectoral Impacts Studies at the Regional Scale**

2:15 **State of California multi-sector impacts assessment initiative**
• Guido Franco, California Energy Commission

3:00 **Union of Concerned Scientists' impacts assessment in New England**
• James McCarthy, Harvard University

*3:45 – 4:15* *Break*

**Need for Impacts Assessments to Reflect Risks of Extreme Events and Adaptation**

4:15 **Adaptation measures to reduce human health risks**
• Kristi Ebi, EEL, LLC

5:00 Adjourn / Informal Discussion

**Wednesday, July 25:**

*7:30 AM* *Continental Breakfast – Gatehouse, Top of the Village*

**Need for Impacts Assessments to Reflect Risk of Extreme Events and Adaptation (continues)**

8:30 • Joel Smith, Stratus Consulting

**Representation of Impacts in Economic and Integrated Assessment Models**

9:15 **Integrated assessment and impacts modeling with IMAGE**
• Elke Stehfest, Netherlands Environmental Assessment Agency

*10:0 –10:30* *Break*

10:30 **Impacts and adaptation responses represented in FUND**
• Richard Tol, Economic and Social Research Institute, Ireland

11:15 **Impact assessment models in AIM**
• Naota Hanasaki, National Institute for Environmental Studies, Japan

*12:30 –1:30* *Lunch*

1:30 **Approaches for incorporating impacts into MiniCAM**
• Hugh Pitcher, Joint Global Change Research Institute

2:15 **Impacts representation and development within IGSM**
• John Reilly, Massachusetts Institute of Technology

*3:00 – 3:30* *Break*

4:00 **Accounting for extreme events and abrupt changes in economic damage estimates**
• Gary Yohe, Wesleyan University

5:00 Adjourn / Informal Discussion

*8:00-10 PM* *Energy Efficiency Workshop Reception for Attendees and all Guests Gatehouse, Top of the Village*

**ENERGY EFFICIENCY WORKSHOP**
**(Sponsored by the Precourt Institute for Energy Efficiency)**

**Thursday, July 26**

*7:30AM Continental Breakfast –Gatehouse, Top of the Village*

9:00 **Overview** • James L. Sweeney, Stanford University

**Autos/Transport**

9:45 • David Greene, Oak Ridge National Laboratory

*10:30 Break*

10:45 • Terry Penney, National Renewable Energy Laboratory

11:30 • Ian Parry, Resources for the Future

*12:15 Lunch*

**Buildings/Appliances**

1:30 • Richard Newell, Duke University

2:00 • Alan Sanstad, Lawrence Berkeley National Laboratory

*2:45 Break*

**Implementation through Utility-Based Programs**

3:00 • Audrey Chang, Natural Resources Defense Council

3:45 •Steve Kline, Pacific Gas & Electric Company

4:30 **Group Discussion:** James Sweeney, Moderator

*6:30PM Western BBQ for Attendees and all Guests, Snowmass Rodeo Grounds*

**Friday, July 27**

*7:30AM Continental Breakfast – Gatehouse, Top of the Village*

**International Perspectives**

9:00 • Richard Moss, United Nations Foundation

9:45 • Scott Nyquist, McKinsey & Company

*10:45 Break*

**Behavioral Issues**

11:00 • Carrie Armel, Stanford University

*12:00 Lunch*

**Electric Technology**

1:00 • Marek Samotyj, Electric Power Research Institute

**Energy Efficiency: How Much, How Cheap**
1:45 • Amory Lovins, Rocky Mountain Institute

*2:45* *Break*

**Modeling Energy Use (Panel)**
3:00 • Jae Edmonds, Joint Global Change Research Institute
• Tatsuya Hanaoka, National Institute for Environmental Studies

**Energy Efficiency Discussion (Panel)**
4:30 • **James** Sweeney, Moderator

5:00 Adjourn / Informal Discussion

**Sunday, July 29**
*7:00 PM* *Informal Reception & Dessert Gathering for Attendees and all Guests Gatehouse, Top of the Village*

**Monday, July 30:**
*7:30 AM* *Continental Breakfast – Gatehouse, Top of the Village*

9:00 **Understanding and Incorporating Climate Impacts into Integrated Assessment Models**
• Anthony Janetos, Chairman

*1:00 PM* *Lunch*

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**NEW SCENARIOS FOR ANALYSIS OF SOCIO-ECONOMIC, EMISSIONS, CLIMATE CHANGE, IMPACTS, AND RESPONSE STRATEGIES**
Session Co-Organizers: Richard Moss, Jerry Meehl, John Weyant

BACKGROUND
A scenario is a "coherent, internally consistent, and plausible description of a possible future state of the world." The main types of scenarios used in climate research include:

- Emissions scenarios
- Climate scenarios
- Scenarios of socio-economic conditions relevant for impacts, adaptation, and vulnerability
- Environmental scenarios: e.g., land use / cover change, sea-level rise

Scenarios are useful devices for exploring the implications of uncertainty and for examining the potential implications of different choices and policies for addressing climate change. They have also been used as coordinating mechanisms in end-to-end integrated assessment of climate change and response options. IPCC has used scenarios to coordinate across Working Groups and chapters of its reports since its Second Assessment Report (1995). Other national and international assessments (e.g., US Global Change Research Program, U.K. Climate Impacts

Program, and Millennium Ecosystem Assessment) have also used scenarios to coordinate their work.

In the past, the IPCC prepared its own emissions scenarios (IPCC 1990; 1992; 2000). These emissions scenarios were used in climate model experiments, which in turn were used to generate climate scenarios used in modeling of impacts, adaptation, and vulnerability (IAV). For a variety of reasons, including the large commitment of human and computational resources invested in realizing the IPCC scenarios, other assessments and organizations have used these scenarios and derived climate projections.

In April 2006, the IPCC decided that its role would be limited to catalyzing the development of scenarios in the scientific community, except for the preparation of a technical paper identifying "benchmark concentration scenarios" that would be used to initiate a new scenario development process. In May 2007, the IPCC decided to alter its decision, determining the benchmark scenarios would be identified during an expert meeting to be held in September 2007.

Preparing scenarios in this new fashion, i.e., without IPCC coordination, will require an increased level of coordination across different segments of the climate research community to ensure that scenarios needed for coordination are available in time for research and future assessments. Another purpose of the September 2007 expert meeting is to provide an opportunity for the relevant research communities to take stock of plans and coordination mechanisms for developing and applying scenarios.

A number of meetings have already been held to formulate a scenarios strategy. Some of these have been convened by the IPCC itself, including expert meetings and workshops in Washington, Laxenburg, and Seville. A new "parallel process" has been suggested over the course of these meetings in which climate modelers and IAM groups work in parallel using agreed "benchmark concentration scenarios." A key advantage of this process is to shorten the time needed to develop integrated sets of emissions and climate scenarios for use in impacts research. A climate and Earth system modeling research agenda is summarized in a paper published in EOS by Kathy Hibbard, Jerry Meehl, and colleagues. The paper outlines experiments on two broad time scales ("near term"—initially defined as extending to approximately 2030; and "long term" – beyond 2100).

The proposed strategy raises a number of science and methodological questions that need to be addressed in IAM, climate, and IAV modeling communities. Some of the most important of these are represented in the program.

PURPOSE OF THE SESSION

This session will examine the proposed scenario coordination process and serve as a forum for identifying strategies for addressing some of the most important remaining scientific and methodological issues. Among the key issues to be considered are:

- The overall process for coordinating across IAM, ESM, and IAV research communities
- Past experience of the GCM community in coordinating its activities
- The potential role of an IAM consortium in coordinating IAM inputs and research
- Identification of candidate benchmark concentration scenarios
- Data requirements for atmospheric chemistry, carbon cycle, land use, and other models

- Incorporating important qualitative dimensions (e.g., level of globalization, ease of technology transfer, prevalence of failed states) and coordinating "families" of socio-economic scenarios useful as assumptions in IAV research
- Working across scales
- Incorporating uncertainties and probabilistic analysis
- Needs and activities of other international organizations
- Research agendas for IAM and IAV research, given the timescales and issues proposed in the EOS article

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**PANEL I: A NEW PROCESS FOR A SET OF COORDINATED SCENARIOS**

2:00 PM **Overview of "new scenarios" process and methodological/science issues**
• Richard Moss, United Nations Foundation

2:30 **Earth-system modeling perspectives and experience with model inter-comparison and coordination**
• Jerry Meehl, National Center for Atmospheric Research
• Kathy Hibbard, National Center for Atmospheric Research

3:00 **Integrated assessment modeling research needs and coordination**
• John Weyant, Stanford University
• Mikiko Kainuma, National Institute for Environmental Studies
• Nebojsa Nakicenovic, IIASA

3:30 Informal Discussion

**PANEL II: BENCHMARK SCENARIOS: CANDIDATES, REQUIREMENTS, USES, AND ISSUES**

4:30 **Benchmark concentration scenarios**
• Jae Edmonds, Joint Global Change Research Institute
• Keywan Riahi, IIASA
• Elke Stehfest, Netherlands Environmental Assessment Agency
• Steve Rose, U.S. Environmental Protection Agency

5:00 Adjourn / Informal Discussion

**Tuesday July 31**

*7:30 AM* *Continental Breakfast – Gatehouse, Top of the Village*

**PANEL II: BENCHMARK SCENARIOS: CANDIDATES, REQUIREMENTS, USES, AND ISSUES (CONTINUES)**

9:00 **After the benchmarks: what next?**
• Francisco De la Chesnaye, U.S. Environmental Protection Agency
• Hugh Pitcher, Joint Global Change Research Institute

9:30 **Bounding scenario uncertainties**
• Jean Pascal van Ypersele, Universite Catholique de Lovain, Belgium

10:00 **From global to regional scales: socio-economic and emissions modeling**
• Jiang Kejun, Energy Resource Institute, China

10:30 Discussion

*11:00* *Break*

11:30 **Interpolating and scaling using simple climate models and EMICS**
• John Mitchell, MET Office, United Kingdom

12:00 **Atmospheric chemistry modeling requirements, opportunities, and challenges**
• Jean-Francois Lamarque, National Center for Atmospheric Research

12:30 **Coordinating land use assumptions**
• **Peter** Thornton, National Center for Atmospheric Research

*1:00 p.m.* *Lunch*

2:00 Discussion of scenario data requirements, needs, and uses

**PANEL III: RESEARCH AGENDAS AND NEEDS**

3:00 **Overview of scenario activities and needs of other international organizations**
• Monika Zurek, Food & Agricultural Organization, United Nations (FAO)

3:30 **Impacts, adaptation, and vulnerability studies: scenario needs and research opportunities**
• Tim Carter, Finnish Environment Institute (SYKE)

4:00 **Research needs and opportunities for IAM research**
• John Weyant, Stanford University

4:30 **Panel and general discussion focusing on issues requiring further attention and coordination**

6:00 Adjourn / Informal Discussion

**Wednesday, August 1st:**

*7:30 AM* *Continental Breakfast – Gatehouse, Top of the Village*

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## IMPROVING IAM REPRESENTATIONS OF A SCIENCE-DRIVEN ENERGY FUTURE

**Focus:**

How to better reflect the promise and uncertainties of science-driven energy innovations in integrated assessment research and models?

**Background:**

- With significant progress in nanoscience, biology, and related interdisciplinary fields, transformational advances appear more promising than ever for applications in energy supply, storage, transmission, conversion, and utilization.
- While possessing many specific strengths, some of the current equilibrium-based IA models are somewhat challenged to simulate highly disruptive, potentially paradigm shifting innovations in energy. And even incremental technology improvements often require extensive manipulations of the models and model build-out.
- The Climate Change Science Program (CCSP) Synthesis and Assessment Product 2.1 has demonstrated that there is "time" for science driven innovation to significantly alter our energy future and to influence global stabilization scenarios in dramatic if not somewhat unpredictable ways.
- Gaining insight into the opportunities and uncertainties associated with science driven innovation, especially crosscutting, systems level innovation, is a high priority and a significant challenge for the IA modeling community. Undoubtedly, policy makers will demand models and tools that can readily address the "what ifs", especially as more and more breakthroughs emerge and the pace of innovation accelerates. Defensible, science-based tools will be needed to inform the debate on how much now versus wait for something better...and what are the impacts?

**Objectives:**

- Reveal the current capabilities and limitations of IA models in terms of how they handle transformational innovations, not just for discrete technological improvements, but the implications for broad crosscutting energy systems innovations.
- Gain improved understanding of the connection between the form of the models, the maturity of the models, and broader elements of the issue, for example, how energy innovation scenarios are constructed and how uncertainty is addressed at every step of the process.
- Challenge the IA community to think "next-generation", extending beyond the current modeling constructs (i.e., equilibrium models) to determine if alternative modeling methods or combinations of methods could create new and improved analytic capabilities.
- Inform and incentivize the discussions within the IA community with examples of possible transformational energy science. Bring a sense of scale to the science opportunities. Engage the community in discussions of what this might mean and how models might have to be adapted to handle such disruptive shifts.
- Challenge participants to create the underpinnings for a subsequent plan, including ideas and priorities for moving forward.
- Expand the Snowmass community of practice to include a broader set of energy innovation modelers and critical connections with the energy science community.

***POTENTIAL TRANSFORMATIONS THROUGH SCIENCE***

9:00 **Introduction and Overview**

- Bob Vallario (U.S. Department of Energy) – Overview
- John Weyant (Energy Modeling Forum)
- Francisco De la Chesnaye (U.S. Environmental Protection Agency)

9:20 **Keynote Speaker -** Bob Rosner – Director, Argonne National Laboratory - *Science-Based Transformations of Our Energy Future*

10:00 **Guest Speaker -** Nate Lewis (CalTech) - *Scales and Dimensions of our Science-Directed Energy Challenge*

*10:30-10:40 Break*

10:45 ***Transformations through Science – Looking for the Paradigm Shifts*** (15 minutes each with short Q&A at end)

- Jay Keasling (Lawrence Berkeley National Laboratory) *Transformations through Biology*
- Don Sadoway (Massachusetts Institute of Technology)- *Energy Storage*
- Paul Grant (W2AGZ Technologies) - *Energy Systems and Grid Concepts*

*11:45-1:00 LUNCH* with guest speaker- Bill Nordhaus (Yale University) – *IA Approaches to Modeling Innovation* (invited)

1:00 ***Transformations through Science – Looking for the Paradigm Shifts*** (15 minutes each with short Q&A at end)--Continues

- ***Global Climate Energy Partnership (GCEP) and its Implications of, Photon Capture and Materials Advances,*** John Weyant, (Stanford University/GCEP)
- **Energy Conversion,** Zhiyu Hu (Oak Ridge National Laboratory)
- **Perspectives on Science-Driven Innovations,** Chris Green (McGill University, Canada)

2:00 Panel Session - (comprised of Panel Speakers above)

*2:45-3:00 Break*

3:00 Breakout Groups - **Transformational Innovations: A Suite of Possibilities and Challenges for IA Models**

4:30 Reports from the Breakout Groups

5:00 Adjourn / Informal Discussion

*6:30 PM Closing Workshop Dinner for Attendees and all Guests*

**Thursday, August 2**

*7:30 AM* *Continental Breakfast – Gatehouse, Top of the Village*

**INTEGRATED ASSESSMENT MODELS AND THE ENERGY "WHAT IFS?"**

9:00 Orientation • Bob Vallario

9:05 Guest Speakers

- **Needs for and challenges of modeling science-driven innovation** • Tom Wilbanks, Oak Ridge National Laboratory
- **Overview of model forms, contributions, strengths and weaknesses** • Ferenc Toth, International Atomic Energy Agency (IAEA), Austria

*10:15-10:30* *Break*

10:30 IAM SPEAKERS – **IA Approaches to Modeling S&T Innovation** (20 minutes each followed by short Q&A)

- Jake Jacoby (Massachusetts Institute of Technology)
- Jae Edmonds (Joint Global Climate Research Institute)
- Nebojsa (Naki) Nakicenovic (IIASA)
- Rich Richels (Electric Power Research Institute)

*12:00-1:30* *Lunch*

*11:45 -1:00* *LUNCH* with guest speaker – Bill Nordhaus (Yale University) – *IA Approaches to Modeling Innovation* (invited)

1:30 Panel Speakers - **Alternative Modeling Perspectives: Challenges and Opportunities in Modeling Innovation, From Macro to Micro**
(Seven speakers - 10 minutes each including short Q&A)

- David Popp (Syracuse University)
- Richard Newell (Duke University)
- Erin Baker (University of Massachusetts, Amherst)
- Brian Flannery (Exxon Mobil)
- Tom Rutherford (Ann Arbor, MI)
- Ian Foster (Argonne National Laboratory)
- Alan Sanstad (Lawrence Berkeley National Laboratory)
- Geoffrey Blanford (Electric Power Research Institute)

*3:15-3:30* *Break*

3:30 Panel Session (moderated by John Weyant)

4:10 Summary Panel – **Challenging the Status Quo - Toward a New Generation of IA Model**s

(Brief comments by each followed by 20-30 minutes discussion and Q&A)

- John Weyant (Energy Modeling Forum)
- Tom Wilbanks (Oak Ridge National Laboratory)
- Ferenc Toth (International Atomic Energy Agency)
- Jake Jacoby (Massachusetts Institute of Technology)
- Jae Edmonds (Joint Global Change Research Institute)
- Naki Nakicenovic (IIASA)
- Rich Richels (Electric Power Research Institute)
- Haroon Kheshgi (ExxonMobil Research & Engineering Company)

5:00 Adjourn / Informal Discussions

**Friday, August 3**

*7:30 AM* *Continental Breakfast – Gatehouse, Top of the Village*

9:00 **IPCC Review and Possible Future Community Activities**
Chairman, John Weyant

*1:00 PM* *Lunch for Attendees and all Guests*