

**Third Annual Meeting of the  
CENTER FOR CLIMATE AND ENERGY DECISION MAKING**

**May 20<sup>th</sup> – 23<sup>rd</sup>, 2013  
Carnegie Mellon University**

**Day 1: Monday, May 20<sup>th</sup> 2013, Singleton Room**

12:00 - 13:00	Welcome and organization for the afternoon (lunch provided) - <i>Granger Morgan/Inês Azevedo</i>
13:00 - 14:30	<b>Workshop 1:</b> The role of black carbon in the climate system - <i>Peter Adams</i>
14:30 - 14:50	<i>Coffee/Tea break</i>
14:50 - 16:20	<b>Workshop 2:</b> Basics of options theory – <i>Dalia Patiño Echeverri</i>
16:20 - 17:20	<b>Case competition presentations:</b> Results from RDM case studies – <i>Rob Lempert</i>
17:20 - 18:20	<i>Light social dinner served in the Atrium area near Singleton Room</i>

**Day 2: Tuesday, May 21<sup>st</sup> 2013, Singleton Room**

(Full schedule provided on next page)

**Day 2: Tuesday, May 21<sup>st</sup> 2013, Singleton Room**

08:00 - 08:30	<b>Hot Breakfast (Atrium area near Singleton Room)</b>
08:30 - 08:45	Round of three-sentence introductions
08:45 - 09:15	Overview of CEDM - <i>Granger Morgan and Inês Azevedo</i>
09:15 - 09:30	Open discussion
<b>Session 1: Decisions and Behavior in Energy Efficiency</b>	
09:30 - 09:40	Overview of CEDM work on energy efficiency, consumer behavior and decision making - <i>Inês Azevedo</i>
09:40 - 09:50	Implementing the smart grid: Key behavioral insights - <i>Tamar Krishnamurti (on behalf of the Energy &amp; Behavior group)</i>
09:50 - 10:00	Direct and indirect rebound effects for the U.S. household using IO analysis - <i>Brinda Thomas</i>
10:00 - 10:10	Do we need to redefine energy poverty? - <i>Maryam Rezaei</i>
10:10 - 10:20	Low GHG community energy systems: Why are we failing to realize the potential for ground source heat pumps? - <i>Hadi Dowlatabadi and Thor Jensen</i>
10:20 - 10:30	Open discussion
10:30 - 10:50	<b>Coffee/Tea break</b>
<b>Session 2: Decision-Making in Climate Mitigation Strategies</b>	
10:50 - 11:00	Overview of CEDM work on mitigation - <i>Inês Azevedo</i>
11:00 - 11:10	Avoided health and environmental impacts from wind and solar across the U.S. - <i>Kyle Siler-Evans</i>
11:10 - 11:20	CEIC and the RenewElec project - <i>Jay Apt</i>
11:20 - 11:30	Policy mechanisms for reducing air emissions from coal-fired power plants - <i>Dalia Patiño-Echeverri</i>
11:30 - 11:40	Consumer choice models for vehicles in the U.S. and in China - <i>John Helveston</i>
11:40 - 11:50	Costs and benefits of reducing fuel burn and emissions from taxiing aircraft - <i>Parth Vaishnav</i>
11:50 - 12:00	Health risks from radon-enriched shale gas in Northeast U.S. - <i>Elizabeth Casman and Austin Mitchell</i>
12:00 - 12:15	Open discussion
<b>Lunch Break</b>	
12:15 - 12:35	<b>Box Lunches (Atrium area near Singleton Room)</b>
<b>Session 3: Forecasting Methods for Energy Technology Costs and Deployment</b>	
12:35 - 12:45	Learning curves for energy technologies – <i>Ed Rubin and Paulina Jaramillo</i>
12:45 - 12:55	Expert Elicitation for small modular nuclear reactors – <i>Ahmed Abdulla</i>
12:55 - 13:05	Open discussion
<b>Poster Session</b>	
13:05 - 13:40	60-second presentation on many of the posters in preparation for the poster session
13:40 - 14:20	Poster session
<b>Session 4: Oceans</b>	
14:20 - 14:30	Vulnerabilities of marine ecosystems and ecosystem services to global change - <i>Sarah Cooley</i>
14:30 - 14:35	Siting marine protected areas to maximize coral survivability to climate change - <i>Paul Welle</i>
14:35 - 14:40	Expert assessments of ocean acidification - <i>Granger Morgan</i>
14:40 - 14:50	Open discussion
<b>Session 5: Robust Decision Making for Adaptation</b>	
14:50 - 15:00	Governance, ecosystem services and climate adaptation cases in Costa Rica - <i>Tim McDaniels</i>
15:00 - 15:10	Characterizing uncertain sea level rise projections to support investment decisions: Application for the port of Los Angeles - <i>Rob Lempert</i>
15:10 - 15:20	Improving the representation of ice-sheets in integrated assessment models - <i>Klaus Keller</i>
15:20 - 15:30	Infrastructure decision making for climate adaptation under uncertainty - <i>Costa Samaras</i>
15:30 - 15:40	Open discussion
15:40 - 15:55	<b>Coffee/Tea break</b>
<b>Session 6: Secure Power and Infrastructure in Face of Extreme Events</b>	
15:55 - 16:05	Quantifying the catastrophe risk of hurricanes to offshore wind power - <i>Stephen Rose</i>
16:05 - 16:15	River flow forecasts - <i>Frauke Hoss</i>
16:15 - 16:25	Evolution of climate change attitudes and policies as a function of extreme event feedback - <i>Rob Axtell</i>
16:25 - 16:35	Public perceptions of non-stationary weather events - <i>Gabrielle Wong-Parodi</i>
16:35 - 16:50	Open discussion
<b>Session 7: Collaboration, Outreach, Communication</b>	
16:50 - 17:00	Collaboration, outreach, communication in CEDM: Updates – <i>Inês Azevedo</i>
<b>Wrap-up for first day</b>	
17:00 - 18:00	General round table discussion and any final questions from members of CEDM Advisory Board
18:00	Depart for dinner
19:00	<b>Dinner at Café Sam Restaurant, 5242 Baum Blvd, Pittsburgh, PA 15224 – 412-621-2000</b>

**Day 3: Wednesday, May 22<sup>nd</sup> 2013**

**CEDM investigators meet in the Singleton Room  
Advisory Board members meet in the Dilks Library**

**Advisory Board Members:**

*The Advisory Board will be meeting in Dilks Library [adjacent to the Singleton Room] from 08:30 to 11:45 to write the Advisory Board report. CEDM investigators and students will be available to talk with Advisory Board members on any questions they may have.*

08:00 - 08:30	<b>Hot Breakfast (Atrium area near Singleton Room)</b>
08:30 - 10:00	Writing of the Advisory Board report
10:00 - 10:15	<b>Coffee/Tea break</b>
10:15 - 11:45	Continue writing of the Advisory Board report
11:45 - 12:15	Feedback from Advisory Board Members to CEDM Investigators and Students
12:15 - 13:30	<b>Lunch with CEDM investigators and students (Atrium area near Singleton Room)</b>

**CEDM Investigators & CEDM Students:**

08:00 - 08:30	<b>Hot Breakfast (Atrium area near Singleton Room)</b>	
08:30 - 09:45	<b>Workshop 3: Part 1</b> – What are integrated assessment models - <i>Klaus Keller</i>	
09:45 - 11:00	<b>Workshop 3: Part 2</b> – Why we stopped doing Integrated Assessment - <i>Granger Morgan</i>	Video clip recording for CEDM PhD students ( <i>Baker Hall 129 Conf. Room</i> )
11:00 - 11:15	<b>Coffee/Tea break</b>	
11:15 - 11:45	<b>Workshop 3: Part 3</b> - Discussion on IAM - <i>Klaus Keller, Granger Morgan and Hadi Dowlatabadi</i>	
11:45 - 12:15	Feedback from the Advisory Board Members	
12:15 - 13:30	<b>Lunch with Advisory Board Members (Atrium area near Singleton Room)</b>	
13:30 - onwards	Planning meeting on how to respond to the Advisory Board feedback  Work on NSF Annual Report and Breakout groups to work on pending things  Begin discussion of NSF site visit	
	<b>Dinner on own</b>	

**Day 4: Thursday, May 23<sup>rd</sup> 2013, Baker Hall 129 Conference Room**

08:30 - 09:00	<b>Continental Breakfast</b>
09:00 - 10:30	CEDM Investigators: Planning for the NSF site visit on June 13-14
10:30 - 10:45	<b>Coffee/Tea break</b>
10:45 - 12:00	<b>Workshop 4:</b> Developing a research agenda on extreme weather events - <i>Kelly Klima</i>
12:00 - 13:00	<b>Lunch</b>
<b>Workshops for CEDM Students:</b>	
13:00 - 15:00	<b>Workshop 5:</b> SUCCEED (Summer Center for Climate, Energy, and Environmental Decision-Making) teaching seminar, led by <i>Frauke Hoss and Paul Welle</i>
15:00 - 17:30	<b>Workshop 6:</b> Using deliberative democracy for geo-engineering and nuclear power, led by <i>Casey Canfield</i>

**List of Posters Presented During the Poster Session – Tuesday, May 21<sup>st</sup>, 13:05-14:20, Singleton Room/Atrium:**

Decisions and Behavior in Climate Mitigation

1. Tamar Krishnamurti	Creating an in-home display: Experimental evidence and guidelines for design
2. Casey Canfield	Designing an electricity bill to motivate savings: The effect of format on responses to electricity use information
3. Hadi Dowlatbadi and Thor Jensen	Low GHG community energy systems: Why are we failing to realize the potential for ground source heat pumps?
4. Russell Meyer	Uncertainty in electrical demand-side efficiency reporting: Residential lighting study
5. Maryam Rezaei	Do we need to redefine energy poverty?
6. Jihoon Min	Analyzing consumer preferences for lighting technologies using discrete choice analysis
7. Huijin Tan	Lighting perceptions and preferences for residential lighting technologies
8. Justin Ritchie	Decision-aiding for divestment from high GHG companies
9. Deborah Stine and Elizabeth Casman	Prospects for natural gas vehicles in Pittsburgh
10. Olga Popova and Stephen Rose	Modeling reservoir rock: Implications for CO <sub>2</sub> sequestration in the Appalachian Basin
11. Stefan Schwietzke	Reducing uncertainty in CH <sub>4</sub> emissions from natural gas using atmospheric inversions
12. Chris Wainwright	Climate properties of black carbon emissions from diesel

Decision-Making in Low Carbon Electricity

13. Emily Fertig	Optimal investment strategy in a low carbon energy technology with two-factor learning: A real options approach
14. Felipe Faria	Hydropower development in the Brazilian Amazon
15. Iris Grossmann	Optimizing large-scale solar networks based on hourly scaling of solar insolation data
16. Julian Lamy	Tradeoffs between local and remote wind resources in the Midwest
17. David Luke Oates	Profitability impacts of CCS with solvent storage
18. Roger Lueken	The effects of large-scale storage on the PJM wholesale market
19. Shuchi Talati	The Climate-Energy-Water Nexus in the Southwest U.S.
20. Santosh Harish (Granger Morgan presenter)	Rural electrification in India: Costs of supply and outages
21. Steve Isley	Emission reductions policies sustainable for the long-term: An agent-based analysis with competing interest groups and endogenous technological change

Elicitation and Survey Methods

22. Alex Davis	Changing theories and confidence: Backdating and accommodation
23. Umit Guvenc and Mitch Small	Multi-expert simulation for systematic comparison of expert weighting approaches
24. Jean-Pierre Gattuso, Katharine Mach and Granger Morgan	Ocean acidification and its impacts: An expert survey

Policy Evaluation and Regulatory Design

25. Nathaniel Gilbraith	A state by state analysis of building energy code induced energy and CO <sub>2</sub> savings potential
26. Jinhyok Heo	A computationally efficient air quality model for estimating the social costs of air pollutant emissions
27. Nathaniel Horner	Effects of government incentives on wind innovation in the United States
28. Alan Jenn	Trends in future vehicle fleet mix in response to corporate average fuel economy standards (CAFE) using an optimization construct
29. Long Lam	The rise of China's wind power industry

**List of Posters Presented During the Poster Session (cont.) – Tuesday, May 21<sup>st</sup>, 13:05-14:20, Singleton Room/Atrium:**

Informal Education and Outreach

30. Kelly Klima	SUCCEED: Summer Center for Climate, Energy, and Environmental Decision-Making
31. Robert Cavalier and Tim Dawson	Climate change and public opinion
32. Iris Grossmann	Climate change, impacts and adaptation: New graduate/undergraduate class
33. Justin Ritchie	Blue Terminal - a portal for natural language exploration of energy-economics data and research

Systems Analysis

34. Daniel Posen	Environmental implications of using biomass as a chemical feedstock - Ethylene case-study
35. Fan Tong	An analysis of the trade-offs of different natural gas consumption pathways

## DETAILS REGARDING THE 2013 CEDM ANNUAL MEETING WORKSHOPS

### **Workshop 1: Black carbon and climate change mitigation: science, uncertainties and policy implications, with Prof. Peter Adams. May 20<sup>th</sup> - 13:00 to 14:30. Location: Singleton Room.**

Syllabus: Recently, considerable attention has been paid to short-lived climate forcers in general, and black carbon (BC) in particular, as potential ways to mitigate climate change in the near term. These are appealing for several reasons. According to some estimates, black carbon, light-absorbing particles commonly known as "soot", have a radiative forcing of  $\sim 1 \text{ W m}^{-2}$ , making BC second only to  $\text{CO}_2$  as the leading cause of global warming. Moreover, BC-containing particles have an atmospheric lifetime of  $\sim 1$  week, so emissions reductions will translate quickly into reductions in atmospheric concentrations and have significant climate impacts within a decade of implementation. BC emissions reductions are generally quite inexpensive compared to  $\text{CO}_2$  as well. Last but not least, since BC is a component of atmospheric particulate matter, controlling BC will also pay substantial dividends in terms of human health via reductions in traditional air pollution.

Despite this, controlling short-term climate change with BC reductions is not as straightforward as it might seem at first glance. First, there is considerable disagreement over what the BC forcing is and whether it is systematically underestimated by models. Second, BC-containing emissions also have significant cooling effects since they emit significant amounts of cooling aerosols as well (organic carbon and sulfate) and many combustion particles cool climate by brightening clouds. Therefore, BC mitigation will reduce both the warming and cooling effects of aerosols; the net result is uncertain and has not always been carefully addressed in earlier studies. For similar reasons, the climate effects of a unit of BC depend on the specific emission source and any co-emitted species, so BC is not easily amenable to metrics such as global warming potential.

This workshop will provide a primer on the climate impacts of BC and an overview of the significant scientific uncertainties. Along the way, we will pause periodically to discuss and debate the policy implications of the underlying atmospheric science.

### **Workshop 2: Introduction to the theory of real options, with Prof. Dalia Patiño-Echeverri. May 20<sup>th</sup> - 14:50 to 16:20. Location: Singleton Room.**

Syllabus: This session will provide an introduction to the theory of real options valuation and its application to the analysis of capital and R&D investment decisions in the energy sector. We will begin by discussing the simplest financial option (an European call option) and three equivalent methods to price it. We will then consider an investment opportunity to identify different kinds of "real options", different alternatives to characterize the uncertainty, different valuation methods, and to determine how the framing and valuation of real options relates to, and can be integrated with decision analysis techniques (e.g., decision trees). Throughout the workshop there will be several exercises for participants to get hands-on experience with the material.

### **Workshop 3, Part 1: What are Integrated Assessment models, with Prof. Klaus Keller. May 22<sup>nd</sup> - 08:30 to 09:45. Location: Singleton Room.**

Syllabus: The workshop will focus on the design, use, and potential utility of Integrated Assessment Models to analyze trade-offs associated with climate risk management strategies.

**Workshop 3, Part 2: Why We Stopped Doing Integrated Assessment, with Prof. Granger Morgan, followed by a debate with Profs. Klaus Keller, Granger Morgan and Hadi Dowlatabadi. May 22<sup>nd</sup> - 09:45 to 11:00. Location: Singleton Room.**

Syllabus: The focus on much of the work in our first NSF Center (<http://hdgc.epp.cmu.edu/>) was on developing a large integrated assessment model called ICAM. This model divided the world into multiple regions (each with autonomous agents that could respond to climate change and climate policy), used probability distributions to describe the uncertainties in the value of all key coefficients, populated the model with multiple switches to allow the implications of alternative model functional relations to be explored. Several papers resulted from this work including:

- Hadi Dowlatabadi and M. Granger Morgan, "A Model Framework for Integrated Studies of the Climate Problem," *Energy Policy*, 21(3), 209-221, March 1993.
- M. Granger Morgan and Hadi Dowlatabadi, "Learning from Integrated Assessment of Climate Change," *Climatic Change*, 34, 337-368, 1996.

It became apparent that one could reach VERY different conclusions and insights depending on the plausible assumptions that one made. While others have continued to build integrated assessment models and search of "optimal" global climate policy, we concluded that this made no sense and have moved on to other kinds of analysis. Granger will give a talk that outlines the history of our work on ICAM. This will be followed by a discussion of what (if anything) CEDM should be doing in this space going forward.

**Workshop 4: Developing a research agenda on extreme weather events, with Dr. Kelly Klima. May 23<sup>rd</sup> - 10:45 to 12:00. Location: Baker Hall 129 conference room.**

Syllabus: The scientific consensus is that climate change is occurring and is anthropogenically caused. Since 2007, no scientific body of national or international standing rejects the findings of human-induced effects on climate change. A second scientific consensus is that the frequency and severity of extreme weather events are both increasing. In the last two years (2011 and 2012), the United States has experienced twice the average frequency of record extremes in temperature, precipitation, drought, and tropical cyclones. In 2011 alone, a historic combination of 14 "billion dollar events" including fires, droughts, floods, and severe precipitation events occurred. The first ten months of 2012 were the warmest on record in the contiguous U.S., and July 2012 was the hottest month on record. Scientists have rigorously tested possible links between climate change and certain extreme weather events; the consensus is that climate change has historically increased and is predicted to continue increasing the probability of certain extreme events such as heat waves, heavy precipitation events, and local flooding.

This session will begin to discuss next steps for CEDM in the area of extreme weather events. First, we will seek a group consensus on definitions of commonly used words and phrases such as "extreme events", "extreme weather events", and "resilience". Second, we will briefly review climate change, extreme weather, and possible links between the two. Third, we will identify what areas related to extreme events that CEDM research should encompass, rate how well we are currently performing in those areas, and explore where we may have a comparative advantage to key contributions through research and outreach over the coming couple of years.

**Workshop 5 [for CEDM students]: SUCCEED (Summer Center for Climate, Energy, and Environmental Decision-Making) teaching seminar, led by Frauke Hoss and Paul Welle. May 23<sup>rd</sup> - 13:00 to 15:00. Location: Baker Hall 129 conference room.**

Syllabus: This is a session that will serve as a discussion session for SUCCEED. SUCCEED is an annual summer camp hosted by CEDM with the goal of instructing Pittsburgh youth in climate and energy. The session will begin with an overview of the camp and the classes to be offered. The PhD students that will be instructing at the camp will then present their lesson plans and experiments for discussion and critique. All are welcome to attend and give feedback and advice, as well as offer suggestions for possible future direction and expansion of the camp.

A youth instruction expert, Heidi Zellie, will be brought in to share strategies for effective communication of science and technology to adolescents. While this session is aimed at SUCCEED instructors, all that are interested in science communication are welcome to attend.

**Workshop 6 [for CEDM students]: Using Deliberative Democracy for Geo-engineering and Nuclear Power, led by Casey Canfield. May 23<sup>rd</sup> - 15:00 to 17:30. Location: Baker Hall 129 conference room.**

Syllabus: Using a deliberative democracy approach, we will explore issues related to two case-studies: geo-engineering and nuclear power. For example, should we conduct geo-engineering research? If so, should that research be conducted to benefit society or private entities? If not, who should determine what research is permitted? Are nuclear accidents inevitable? Does this mean we should not build nuclear plants? Are the risks worth the climate benefits? Through an iterative process of discussion, we will identify what values are implicitly embedded in our discussions of climate and energy policies as well as demonstrate the value of a democratic process for policy formation. As a product of this workshop, we will outline the full range of issues that are relevant to developing a policy to address each case study.

Participants are asked to read two short papers beforehand (10 pages total):

- C. Hamilton, "No, We Should Not Just 'At Least Do the Research,'" *Nature*, 496(7444), 139, 2013.
- C. Perrow, "Fukushima and the Inevitability of Accidents," *Bulletin of the Atomic Scientists*, 67(6), 44–52, 2011.