WELCOME

To the first CEDM Advisory Board meeting 2011 June 13

Introduction

First (distributed) meeting of the CEDM Advisory Board
2011 June 13

Prof. M. Granger Morgan
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Lester Lave (1939-2011)

After completing a BS at Reed and a PhD at Harvard, both in Economics, Lester joined the faculty of Carnegie Mellon in 1963 and spent his entire career here. He died at his home a few weeks ago.

Copies of his resume, a set of “elevator speeches” from his friends and colleagues, and several other items are available at www.epp.cmu.edu.

A bit of background

Our group has been very fortunate over the years to have won three large distributed NSF centers that have focused on issues of assessment and decision making in the context of climate change:

1995 to 2003	Center for the Integrated Study of the Human Dimensions of Global Change (HDGC)
2004 to 2011	Center for Climate Decision Making (CDMC)
2010 for ≥5 yrs	Center for Climate and Energy Decision Making (CEDM)

The central focus of HGGC…

…involved the construction of one of the first large integrated assessment models (ICAM).

A central focus of this effort was to do an adequate job of describing and dealing with uncertainty.

Thus, we elicited probability density functions from experts, and we populated the model with many “switches” that allowed us to explore the implications of alternative model functional forms.

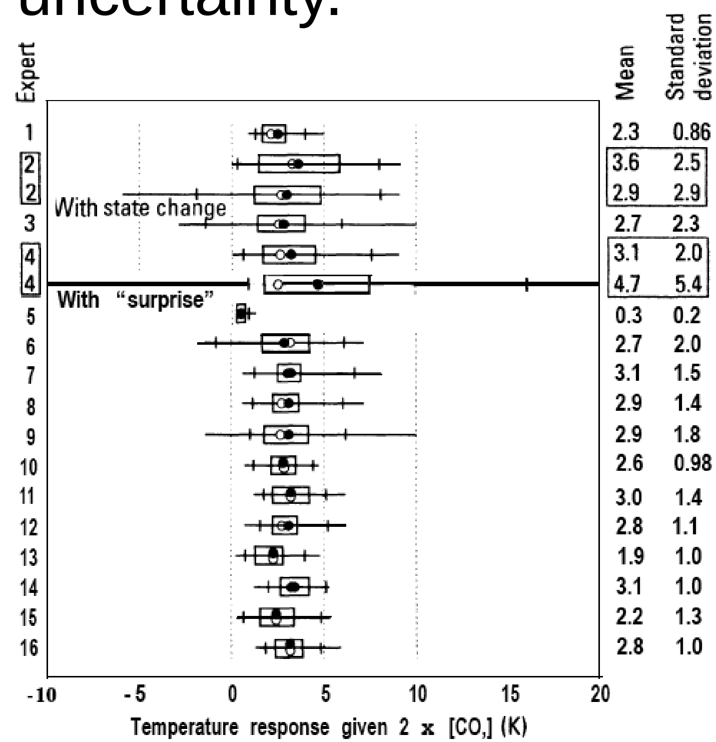
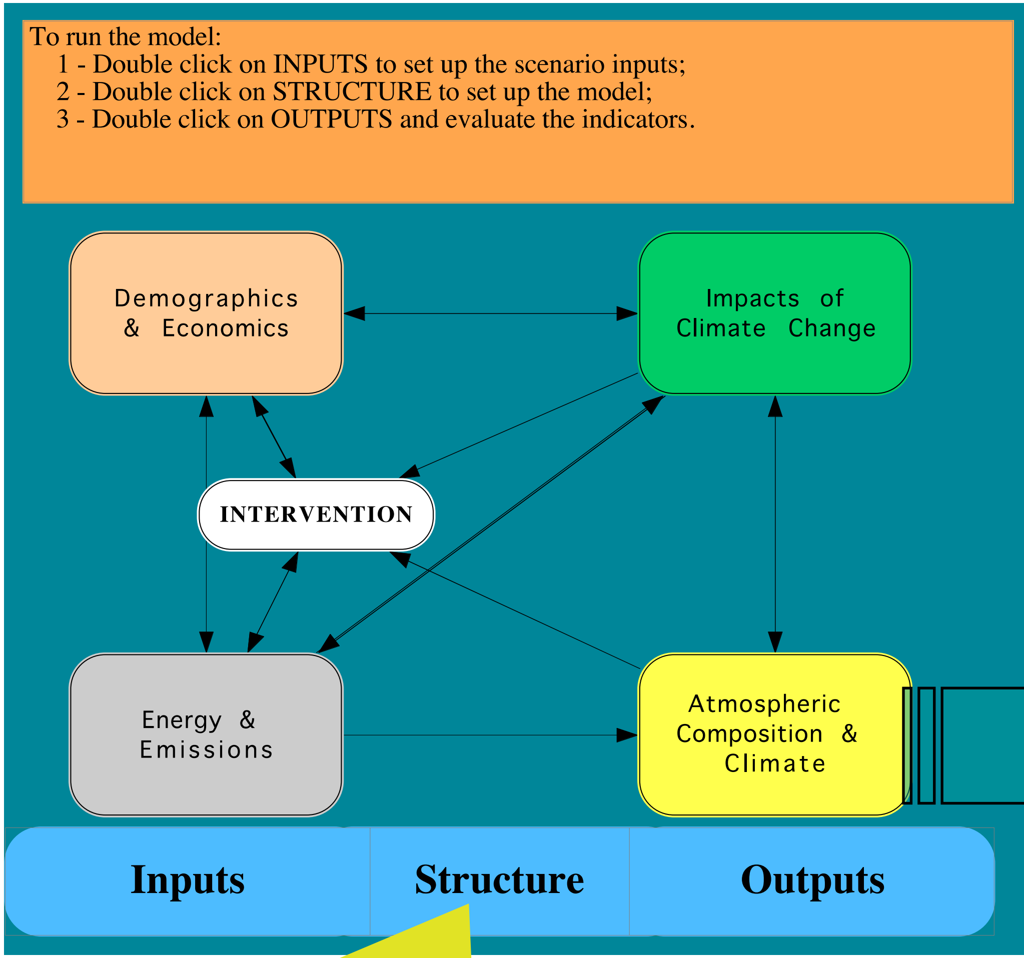


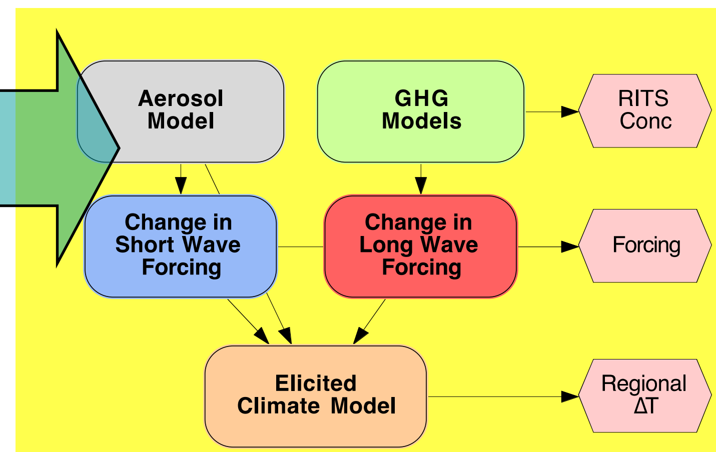
Figure from Morgan and Keith, *ES&T*, 1995.

ICAM
Integrated Climate Assessment Model

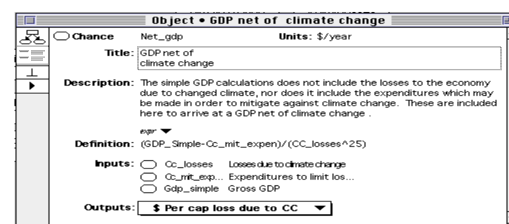
A very large hierarchically organized stochastic simulation model built in Analytica®.



Allows user to set “switches”



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



We found that…

Depending on the plausible ways in which we set the model's "switches" we could get almost any outcome one wanted.

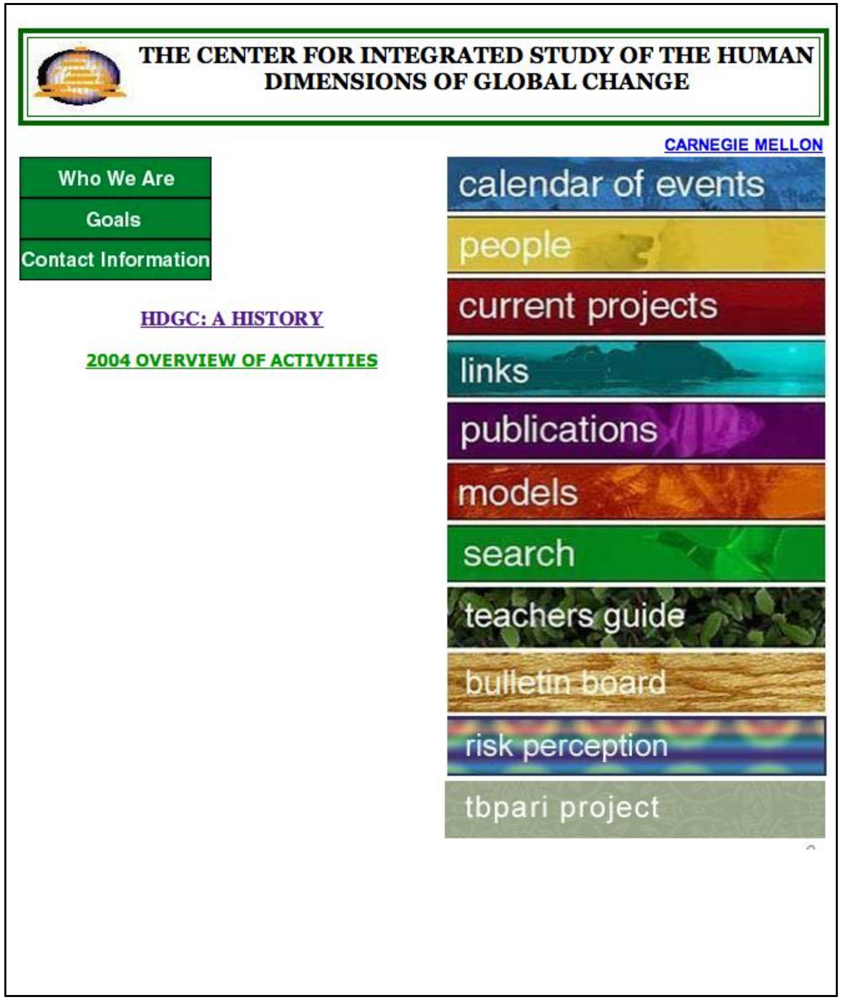
From this we concluded that prediction and policy optimization are pretty silly analytical objectives for much assessment and analysis related to the climate problem.

It makes much more sense to:

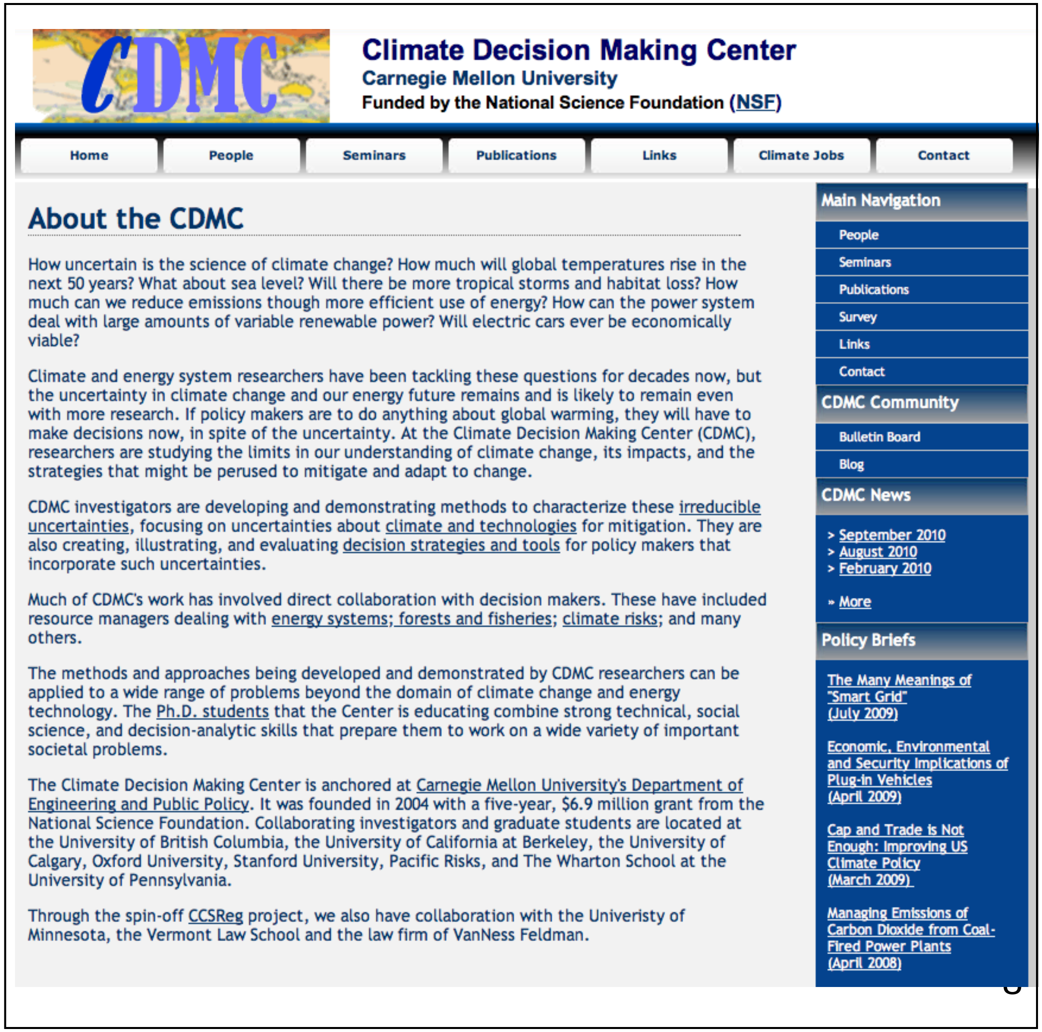
- Acknowledge that describing and bounding a range of futures may often be the best we can do.
- Recognize that climate is not the only thing that is changing, and address the problem in that context.
- Focus on developing adaptive strategies and evaluating their likely robustness in the face of a range of possible climate, social, economic and ecological futures.

Subsequent work by Robert Lempert and colleagues takes a very similar approach (e.g., Lempert, Popper, Bankes, 2003).

http://hdgc.epp.cmu.edu/



http://cdmc.epp.cmu.edu/



About the CDMC

How uncertain is the science of climate change? How much will global temperatures rise in the next 50 years? What about sea level? Will there be more tropical storms and habitat loss? How much can we reduce emissions though more efficient use of energy? How can the power system deal with large amounts of variable renewable power? Will electric cars ever be economically viable?

Climate and energy system researchers have been tackling these questions for decades now, but the uncertainty in climate change and our energy future remains and is likely to remain even with more research. If policy makers are to do anything about global warming, they will have to make decisions now, in spite of the uncertainty. At the Climate Decision Making Center (CDMC), researchers are studying the limits in our understanding of climate change, its impacts, and the strategies that might be perused to mitigate and adapt to change.

CDMC investigators are developing and demonstrating methods to characterize these irreducible uncertainties, focusing on uncertainties about climate and technologies for mitigation. They are also creating, illustrating, and evaluating decision strategies and tools for policy makers that incorporate such uncertainties.

Much of CDMC's work has involved direct collaboration with decision makers. These have included resource managers dealing with energy systems; forests and fisheries; climate risks; and many others.

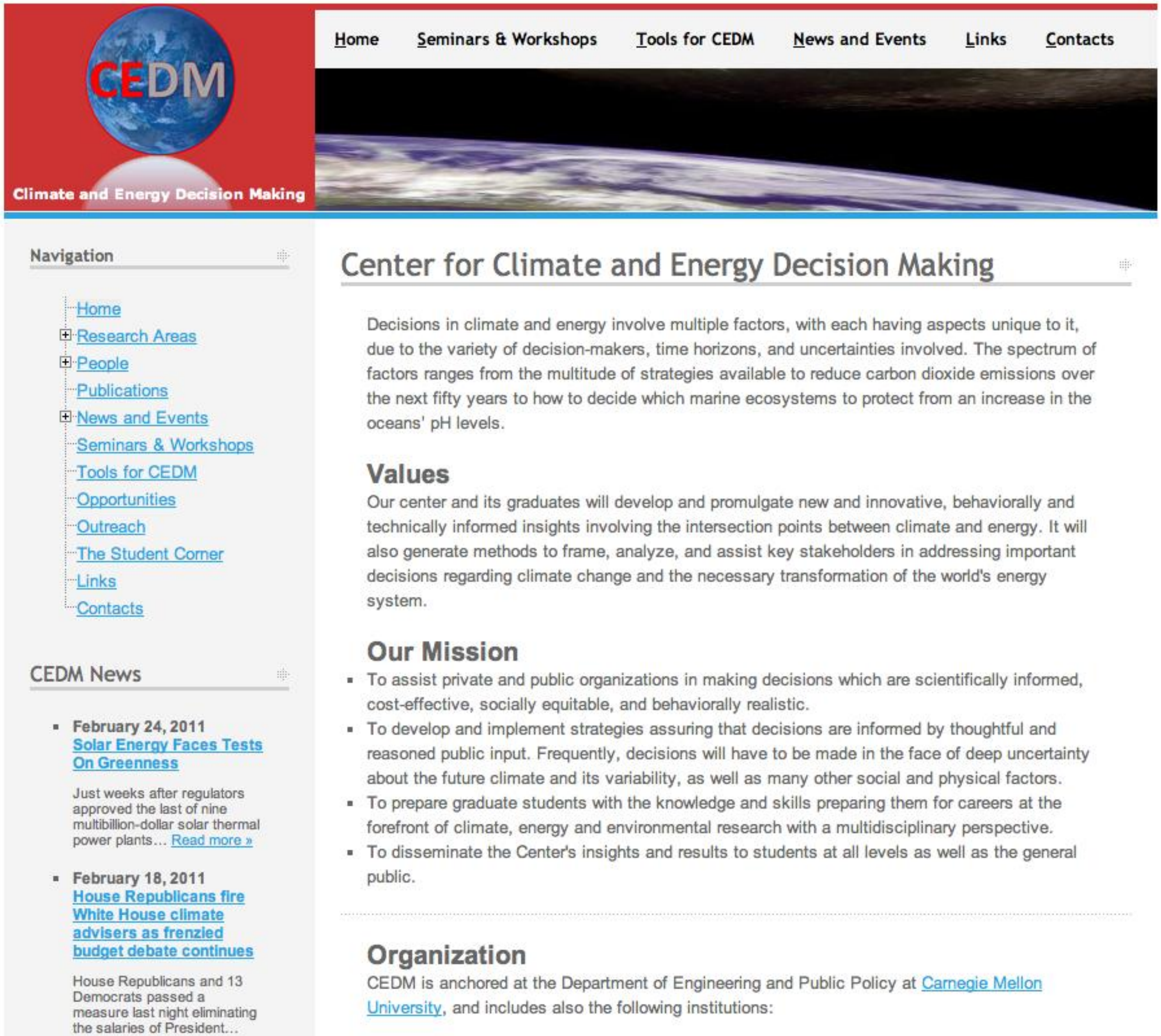
The methods and approaches being developed and demonstrated by CDMC researchers can be applied to a wide range of problems beyond the domain of climate change and energy technology. The Ph.D. students that the Center is educating combine strong technical, social science, and decision-analytic skills that prepare them to work on a wide variety of important societal problems.

The Climate Decision Making Center is anchored at Carnegie Mellon University's Department of Engineering and Public Policy. It was founded in 2004 with a five-year, $6.9 million grant from the National Science Foundation. Collaborating investigators and graduate students are located at the University of British Columbia, the University of California at Berkeley, the University of Calgary, Oxford University, Stanford University, Pacific Risks, and The Wharton School at the University of Pennsylvania.

Through the spin-off CCSReg project, we also have collaboration with the Univeristy of Minnesota, the Vermont Law School and the law firm of VanNess Feldman.

The new CEDM Center

http://cedm.epp.cmu.edu/



Home | Seminars & Workshops | Tools for CEDM | News and Events | Links | Contacts

Climate and Energy Decision Making

Navigation

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CEDM News

- **February 24, 2011**
  Solar Energy Faces Tests On Greenness
  Just weeks after regulators approved the last of nine multibillion-dollar solar thermal power plants… Read more »
- **February 18, 2011**
  House Republicans fire White House climate advisers as frenzied budget debate continues
  House Republicans and 13 Democrats passed a measure last night eliminating the salaries of President…

Center for Climate and Energy Decision Making

Decisions in climate and energy involve multiple factors, with each having aspects unique to it, due to the variety of decision-makers, time horizons, and uncertainties involved. The spectrum of factors ranges from the multitude of strategies available to reduce carbon dioxide emissions over the next fifty years to how to decide which marine ecosystems to protect from an increase in the oceans' pH levels.

Values

Our center and its graduates will develop and promulgate new and innovative, behaviorally and technically informed insights involving the intersection points between climate and energy. It will also generate methods to frame, analyze, and assist key stakeholders in addressing important decisions regarding climate change and the necessary transformation of the world's energy system.

Our Mission

- To assist private and public organizations in making decisions which are scientifically informed, cost-effective, socially equitable, and behaviorally realistic.
- To develop and implement strategies assuring that decisions are informed by thoughtful and reasoned public input. Frequently, decisions will have to be made in the face of deep uncertainty about the future climate and its variability, as well as many other social and physical factors.
- To prepare graduate students with the knowledge and skills preparing them for careers at the forefront of climate, energy and environmental research with a multidisciplinary perspective.
- To disseminate the Center's insights and results to students at all levels as well as the general public.

Organization

CEDM is anchored at the Department of Engineering and Public Policy at Carnegie Mellon University, and includes also the following institutions:

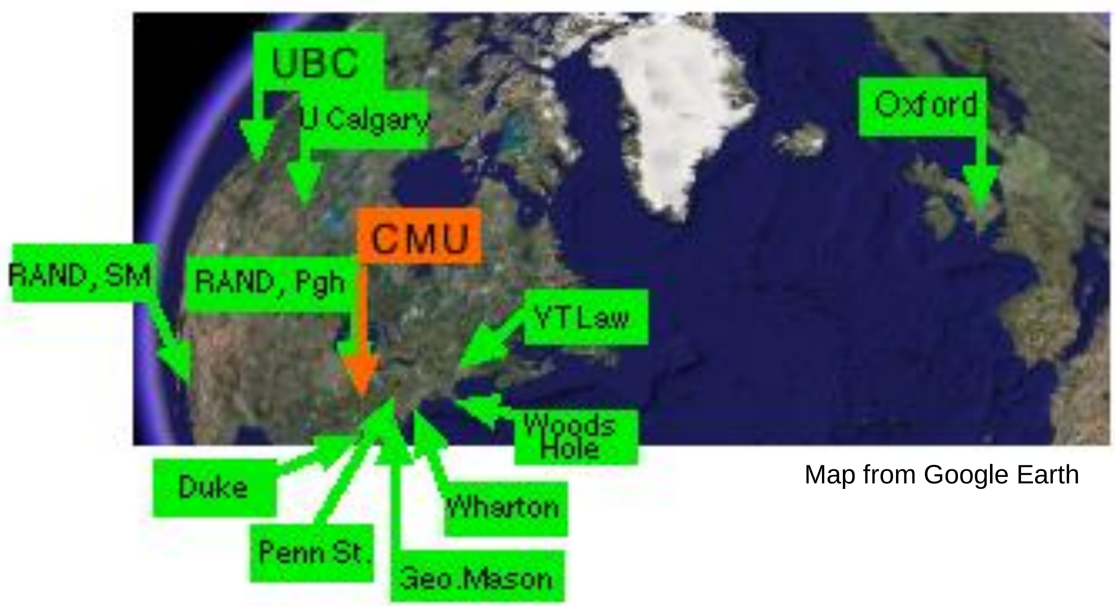
This was in no sense…

…a renewal proposal.

- Over 100 pre-proposals were submitted
- There were 36 full proposals
- Seven groups were site visited
- Ultimately four centers were funded (an 11% success rate from the full proposal stage!)

CEDM is a distributed center anchored in EPP.

I am Director and Inês Azevedo is Executive Director



Map from Google Earth

The Center's investigators:

At Carnegie Mellon:

Plus several others

At RAND:

At Geo. Mason:

At UBC:

At Calgary:

At Penn St.:

At Oxford:

At VT Law:

At Duke:

At WHOI:

At Wharton:

Strategic plan

A copy of the Center’s current strategic plan has been distributed in your packet.

First annual meeting

The first annual meeting of investigators and students was held in Pittsburgh on May 16-17. A copy of the agenda is included in your packet.

Vision and Mission

Vision

To develop and apply behaviorally and technically informed methods to address global climate change and energy system decision.

Mission

CEDM center's mission is five-fold:

1. We will assist private and public organizations to make climate- and energy-related decisions that are scientifically informed, cost-effective, socially equitable, and behaviorally realistic. Often these decisions will have to be made in the face of deep uncertainty about future climate and its variability, as well as many other social and physical factors;
2. We will advance the basic state of the art and develop and demonstrate new methods and approaches for decision-making under uncertainty;
3. We will prepare a new generation of graduate students with the knowledge and skills for careers at the forefront of basic and applied research and problem solving on climate, energy and environmental problems using a multidisciplinary perspective;
4. We will employ a variety of methods and outreach activities to disseminate the Center's insights and results to students at many levels and to the general public;
5. We will create and sustain a strong interdisciplinary collaborative research environment across multiple disciplines and institutions in order to achieve the goals and advance the missions of the Center.

The Center's research…

… is organized around four broad areas:

1. Climate mitigation strategies
2. Climate adaptation strategies
3. Interactions between abatement and adaptation strategies
4. Unexpectedly rapid or large change or impacts

We are building links between individual research projects.

In order to increase SBD content, a committee reviews each research project to suggest changes and additions.

As methodological issues arise, we are adding them to the list of candidate topics for the Theory and Method Workshops (T&MWs)

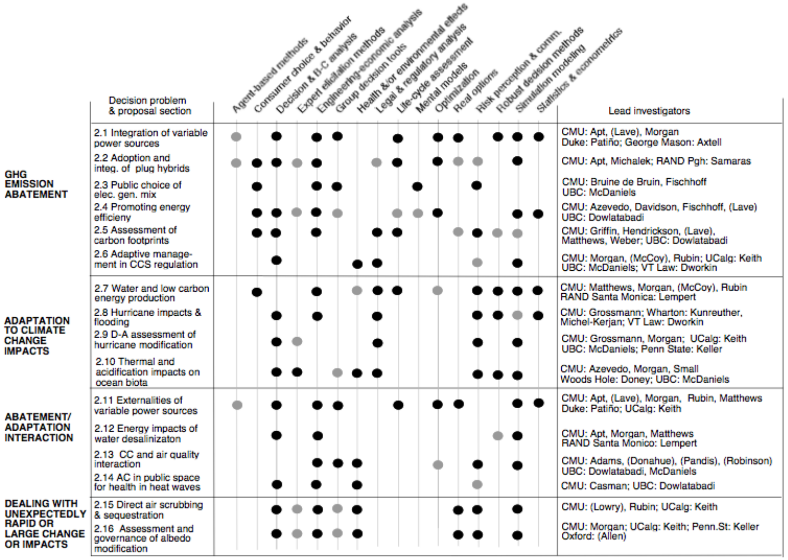
Research

	Decision problem & proposal section	Agent-based methods	Consumer choice & behavior	Decision & B-C analysis	Expert elicitation methods	Engineering-economic analysis	Group decision tools	Health &/or environmental effects	Legal & regulatory analysis	Life-cycle assessment	Mental models	Optimization	Real options	Risk perception & comm.	Robust decision methods	Simulation modeling	Statistics & econometrics	Lead investigators
GHG EMISSION ABATEMENT	2.1 Integration of variable power sources	○		●		●	●			●		●	●		●	●	●	CMU: Apt, (Lave), Morgan Duke: Patiño; George Mason: Axtell
	2.2 Adoption and integ. of plug hybrids	○	●	●	○	●			○	●		●	○	○		●		CMU: Apt, Michalek; RAND Pgh: Samaras
	2.3 Public choice of elec. gen. mix		●			●	●				●			●				CMU: Bruine de Bruin, Fischhoff UBC: McDaniels
	2.4 Promoting energy efficieny		●	●	○	●	○			○	○	●				●	●	CMU: Azevedo, Davidson, Fischhoff, (Lave) UBC: Dowlatabadi
	2.5 Assessment of carbon footprints		●	●		●			●	●			○	●	○	○		CMU: Griffin, Hendrickson, (Lave), Matthews, Weber; UBC: Dowlatabadi
	2.6 Adaptive manage-ment in CCS regulation			●				●	●					○		●		CMU: Morgan, (McCoy), Rubin; UCalg: Keith UBC: McDaniels; VT Law: Dworkin
ADAPTATION TO CLIMATE CHANGE IMPACTS	2.7 Water and low carbon energy production		●			●		○	●	●		○		●	●	●	●	CMU: Matthews, Morgan, (McCoy), Rubin RAND Santa Monica: Lempert
	2.8 Hurricane impacts & flooding			●		●			●					●	●	○	●	CMU: Grossmann; Wharton: Kunreuther, Michel-Kerjan; VT Law: Dworkin
	2.9 D-A assessment of hurricane modification			●	○				●					●		●		CMU: Grossmann, Morgan; UCalg: Keith UBC: McDaniels; Penn State: Keller
	2.10 Thermal and acidification impacts on ocean biota			●	●		○	●	●					●	●	●		CMU: Azevedo, Morgan, Small Woods Hole: Doney; UBC: McDaniels
ABATEMENT/ ADAPTATION INTERACTION	2.11 Externalities of variable power sources	○		●		●	●			●		●	●			●	●	CMU: Apt, (Lave), Morgan, Rubin, Matthews Duke: Patiño; UCalg: Keith
	2.12 Energy impacts of water desalinizaton			●		●									○	●		CMU: Apt, Morgan, Matthews RAND Santa Monico: Lempert
	2.13 CC and air quality interaction					●	●	●				○		●		●		CMU: Adams, (Donahue), (Pandis), (Robinson) UBC: Dowlatabadi, McDaniels
	2.14 AC in public space for health in heat waves			●		●		●						○				CMU: Casman; UBC: Dowlatabadi
DEALING WITH UNEXPECTEDLY RAPID OR LARGE CHANGE OR IMPACTS	2.15 Direct air scrubbing & sequestration			●	○	●	○	●					●	●		●		CMU: (Lowry), Rubin; UCalg: Keith
	2.16 Assessment and governance of albedo modification			●	○	●	○	●					●	●		●		CMU: Morgan; UCalg: Keith; Penn.St: Keller Oxford: (Allen)

Fig 1: Summary of research planned in the proposed Center. Solid dots indicate areas in which applications are definitely planned. Gray dots indicate areas in which we hope to develop applications. Investigators who will participate but are not supported in this proposal's budget are shown in brackets.

Today’s agenda

Obviously we only have time to tell you about, and seek your comments on, a subset of what we are doing. Rather than run through projects in the order listed in this summary table, we’ve chosen to present examples of our work in five areas:



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1. Decision Making;
2. Engineering and Economic Analysis (in support of DM);
3. Solar Radiation Management;
4. Theory and Methods Workshops;
5. Outreach and Education.

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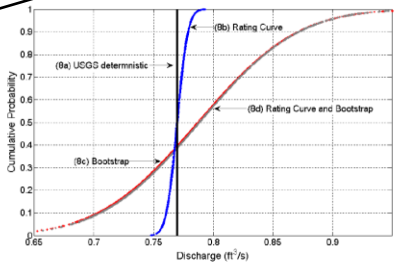
Fig 1: Summary of research planned in the proposed Center. Solid dots indicate areas in which applications are definitely planned. Gray dots indicate areas in which we hope to develop applications. Investigators who will participate but are not supported in this proposal's budget are shown in brackets.

A word about research we'll *not* talk about today

See: www.CCSReg.org
Multiple Hill briefings
RFF Press book will have a chapter

2.5 Assessment of Carbon Footprints

2.6 Adaptive Management of CCS



2.7 Water and Low Carbon Energy Production


ENVIRONMENTAL Science & Technology

POLICY ANALYSIS

pubs.acs.org/est

Does It Make Sense To Modify Tropical Cyclones? A Decision-Analytic Assessment

Kelly Klima,*† M. Granger Morgan,† Iris Grossmann,† and Kerry Emanuel‡

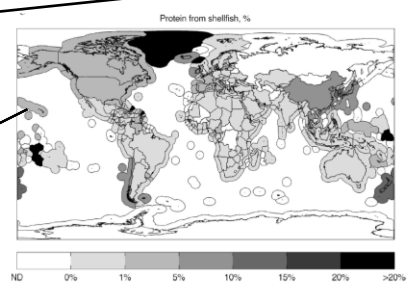
†Engineering and Public Policy, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, Pennsylvania 15213, United States
‡Earth, Atmosphere, and Planetary Science, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139, United States

Supporting Information

ABSTRACT: Recent dramatic increases in damages caused by tropical cyclones (TCs) and improved understanding of TC physics have led DHS to fund research on intentional hurricane modification. We present a decision analytic assessment of whether it is potentially cost-effective to attempt to lower the wind speed of TCs approaching South Florida by reducing sea surface temperatures with wind-wave pumps. Using historical data on hurricanes approaching South Florida, we develop prior probabilities of how storms might evolve. The effects of modification are estimated using a modern TC model. The FEMA HAZUS-MH MR3 damage model and census data on the value of property at risk are used to estimate expected economic losses. We compare wind damages after storm modification with damages after implementing hardening strategies protecting buildings. We find that if it were feasible and properly implemented, modification could reduce net losses from an intense storm more than hardening structures. However, hardening provides "fail safe" protection for average storms that might not be achieved if the only option were modification. The effect of natural variability is larger than that of either strategy. Damage from storm surge is modest in the scenario studied but might be abated by modification.

INTRODUCTION

2.8/9 Hurricane impacts, modification, etc.



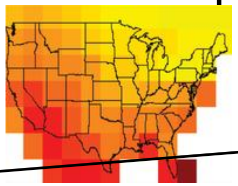
2.10 Ocean thermal impacts and acidification

2.12 Energy for water desalination

PhD student may start
(but may do CO_2 and aviation)

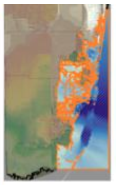
Also:
Perception paper at *Risk Analysis.*
Storm surge paper in almost final form.

2.13 CC and air quality



2.15 Direct air scrubbing

Admitted PhD student declined to come



On methods, Rob Axtell is working to find applications for Agent Based models and Rob Lempert for Robust DM Methods.

Today's agenda…(Cont.)

10:00 – 10:10	Welcome and introductions
10:10 – 10:25	Overview of the Center – *Granger Morgan*
10:25 – 10:30	Q&A
Examples of work on Decision Making:	
10:30 – 10:40	Public preferences for low carbon electricity generation – *Lauren Fleishman*
10:40 – 10:45	Q&A
10:45 – 10:55	(Lack of) Planning for heat wave refugee in Vancouver – *Hadi Dowlatabadi*
10:55 – 11:00	Q&A
11:00 – 11:10	Decision support for investments in low-carbon generation – *Dalia Patiño*
11:10 – 11:15	Q&A
11:15– 11:30	Open discussion
Examples of work on Engineering and Economic Analysis:	
11:30 – 11:40	Integrating large amounts of variable and renewable generation: the RenewElec Project – *Jay Apt*
11:40 – 11:45	Q&A
11:45 – 11:55	Opportunities for distributed generation and CHP – *Kyle Siler Evans*
11:55 – 12:00	Q&A
12:00 – 12:10	Valuing plug-in vehicles air emissions and oil consumption benefits – *Costa Samaras*
12:10 – 12:15	Q&A
12:15 – 12:25	Overview of work in energy efficiency – *Inês Azevedo*
12:25 – 12:30	Q&A
12:30 – 12:45	Open discussion and lunch break

Today's agenda…(Cont.)

Examples of work on Solar Radiation Management	
12:45 – 12:55	Science update – *David Keith*
12:55 – 13:00	Q&A
13:10– 13:20	Distributional Issues – *Kate Ricke*
13:20 – 13:25	Q&A
13:25 – 13:40	Open discussion
Examples of work of Plans for Theory and Methods Workshops	
13:40 – 13:45	Rebound effect – *Inês Azevedo*
13:45 – 13:50	Q&A
13:50 – 14:00	Combining experts – *Umit Guvenc*
14:00 – 14:05	Q&A
Examples of work on Outreach and Education	
14:05 – 14:15	Web-tools and text to for decision support – *Tim McDaniels*
14:15 – 14:20	Q&A
14:20 – 14:30	SUCCEED a program for high school students and teachers – *Kelly Klima*
14:30 – 14:35	Q&A
General discussion and wrap-up	
14:35 – 15:05	Open discussion and Q&A – *Anthony Janetos (CEDM advisory board Chair)*
15:05 – 15:20	Instruction on written follow up from members – *Anthony Janetos (CEDM advisory board Chair)*