Agenda

External Advisory Board Agenda
Institute for Environmental Science and Policy
September 29, 2010

9:00 am Coffee and refreshments

9:15 Greetings, introductions

9:30 State of the Institute, Thomas L. Theis, Director
   Updates
   New programs and activities

10:30 Vision for Research at UIC, A Conversation with
   Joe G. N. “Skip” Garcia, VCR

11:30 The New Energy and UIC, Professor George Crabtree, Argonne
   National Laboratory and the Department of Physics, UIC

12:15pm Working Lunch

12:30 Discussion of Research Opportunities for the Institute

2:15pm Adjourn
New External Advisory Board Members

Jennifer B. Dunn, Ph.D.
Project Manager
URS Corporation

Michael D. Manzella
Senior Vice President
Environmental, Health, Safety, & Quality
Chief Sustainability Officer
RR Donnelley

George P. Nassos, PhD
Industry Associate Professor
Director, Center for Sustainable Enterprise
Stuart School of Business
Illinois Institute of Technology

Natashia Holmes
Policy Advisor
Division of Public & Intermodal Transportation
Illinois Department of Transportation

Doug Widener
Executive Director
U.S. Green Building Council, Chicago Chapter
IESP Mission Statement

• To advance interdisciplinary research and scholarship within the environmental health sciences and engineering, economics, social thought, and policy among UIC’s faculty and students,
• To advance our understanding of sustainable systems with a particular focus on urban regions
• To transmit workable solutions for environmental problem to the public and private sectors, and
• To prepare the next generation of environmental decision-makers
IESP Mission

This mission is built upon a four-tiered foundation:

• Advance knowledge on environmental science and policy through scholarly research

• Facilitate interdisciplinary collaboration among scholars to develop new paradigms of inquiry that address and define local, regional, and global research priorities

• Gather together multidisciplinary teams of scholars and counterparts in the public and private sectors to devise sustainable solutions for society’s complex environmental challenges

• Prepare the next generation of environmental decision makers through cross-disciplinary education, such that future leaders gain an understanding of the interrelated roles of science, technology, economics, and policy as they apply to environmental sustainability
Interdisciplinary Research...

“...a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice”

NAE/NAS/IOM, 2005
IESP Key Activities

• Joint faculty appointments and faculty clusters in support of interdisciplinary research
• Ph.D. fellowships
• Seminars
• Conferences and meetings
• Campus activities
IESP Crosscutting Themes

• Human-Natural Interactions
  Ecological restoration
  Systems ecology
  Landscape ecology
  Environmental chemistry

• Urban Sustainability
  Urban ecology
  Transportation systems
  Urban planning

• Environmental manufacturing
  Life cycle assessment
  Industrial ecology
  Design for the environment
  Material flow analysis
  Occupational health and safety
  Environmental technology

• Environmental Policy Analysis
  Market-based tools for pollution control
  Computational modeling
  Risk assessment
# Joint IESP Faculty

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<th>Name</th>
<th>Depart/Col</th>
<th>Expertise</th>
<th>Rank</th>
<th>Percent</th>
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<td>K. Nagy</td>
<td>Ea &amp; Env Sci</td>
<td>Env.Geochem</td>
<td>Professor</td>
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<td>N. Esmen</td>
<td>EOHS/SPH</td>
<td>Risk Assess/ Env.Decision</td>
<td>Professor</td>
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<td>J. Lin</td>
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<td>Trans Sys/ Air Quality</td>
<td>Asst Prof</td>
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<td>M. Zellner</td>
<td>UP/CUPPA</td>
<td>Public Policy/ Sustain of Nat Resources</td>
<td>Asst Prof</td>
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<td>D. Wise</td>
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<td>Ecosystem processes</td>
<td>Professor</td>
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<td>E. Minor</td>
<td>Biological Sci/LAS</td>
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<td>CUPPA</td>
<td>Urban Sustainability</td>
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IESP Research Expenditures FY 2010

Apportioned IESP Research Expenditures ($741K)

Apportioned Departmental Research Expenditures ($1.93M)
Research

• 26 current projects with 70 PIs+co-PIs across 31 units
• New Research Initiatives (sample)
  • Urban Long Term Research Area: Connecting the Social and Ecological Sciences With Planners, Managers, and the Public: Building a Broad Foundation for the Chicago Region ULTRA, NSF/USFS (Wise/Zellner/Minor et al.)
  • Workshop on Life Cycle Aspects of Nanoproducts, Nanostructured Materials, and Nanomanufacturing Problem Definitions, Data Gaps and Research Needs, NSF/EPA (Theis et al.)
  • Partnership to Develop an Integrated, Advanced Travel Demand Model and Fine-Grained, Time-Sensitive Network, TRB of the National Academies (Lin)
  • Learning Environmental Science Through Complex System Simulations: Natural Resources, Human Impact, & Environmental Policy, NSF (Lyons/Zellner/Minor/Goldman/Pellegrino/Moher)
  • Green Infrastructure Plan for Illinois, IL EPA (Jaffe/Gonzalez-Meler/Minor/Zellner)
Other Highlights

Seminars:

- Ambassador Pekka Lintu (Finland) “Green Public Diplomacy: Sustainability as Finland’s Message in the U.S.”
- Prof. Tim Gutowski, MIT “The Dr. Greenhouse Low Carbon Diet or Carbon Emissions from Alternative Life Styles in the U.S.”
- Prof. Deb Niemeier, UC Davis “California: Bellwether or Bust?”
- Prof. Dan Sperling, UC Davis “Two Billion Cars: Is it Sustainable?”

- New Course: “Environmental Sustainability and Public Policy” (Theis)
- Co-Sponsor, Chicago Wilderness 7th Biennial Congress
- New Environmental Planning Concentration (Urban Planning and Policy)
- New Energy Council & Summer (2011) Institute: “Sustainability and Energy for the Citizen” (Crabtree)
- Michael Iversen (Urban Planning) observer at COP 15
- New Assistant Director for Business (Urszula Lizak)
The New Energy and UIC

George Crabtree

Departments of Physics, Electrical
and Mechanical Engineering
University of Illinois at Chicago
and
Materials Science Division
Argonne National Laboratory

Outline

• the energy challenges: oil and carbon dioxide
• what is sustainability?
• the needs and opportunities
• some UIC responses
Background Reading

The road to sustainability
George Crabtree and John Sarrao

Controlling the Functionality of Materials for Sustainable Energy
George Crabtree
John Sarrao

RISING ABOVE THE GATHERING STORM, REVISITED
Rapidly Approaching Category 5

National Academy of Sciences
National Academy of Engineering
Institute of Medicine

Science for Energy Technology: Strengthening the Link between Basic Research and Industry - The Full Report

http://www.physicsworld.com/cws/article/print/40527
http://www.annualreviews.org/journal/conmatphys
http://www.sc.doe.gov/bes/reports/list.html
http://www.nap.edu/catalog.php?record_id=12999
The Problem: Dependence on Imported Oil

Unpredictable supply threatens economy, lifestyle, national security

find alternatives to imported oil
  biofuels, electricity, solar fuels

Cost to economy
$350 B/yr at current prices transferred to foreign oil producers

http://tonto.eia.doe.gov/energy_in_brief/foreign_oil_dependence.cfm
The Problem: Greenhouse Gases and Climate Change

2/3 of carbon dioxide emissions come from power plants and autos.

Permanent changes in weather patterns, agricultural networks and coastal geography.

Cost of accommodation may be higher than preventive cost of reducing emissions.

IPCC Fourth Assessment 2007
http://www.ipcc.ch/graphics/gr-ar4-syr.htm SPM1
Driving our cars on imported oil

Unfettered emission of $CO_2$

Foundations of decades-long economic success

Alternatives require transformational change to business as usual

more sustainable
next-generation energy technology
Sustainable energy technologies are in their infancy. They perform far below their ultimate potential.

Dramatic improvements are needed – incremental tuning of the present state of the art is not sufficient

Breakthroughs needed understand and control materials and chemistry at molecular and nanoscale levels
What is Sustainability?

- Lasts a long time
  - Oil in 1900
  - Coal in 2010

- Does no harm
  - Nuclear electricity: no CO$_2$
  - Biofuels: reduced CO$_2$

- Leaves no change
  - Closed chemical cycle
  - Electricity, hydrogen
**Sustainable Next-Generation Energy Technologies**

**Sustainability Profile**
- lasts a long time 😊
- does no harm 😊
- leaves no change 😊

**Solar electricity: a fully sustainable energy chain**

Breakthroughs needed
- lower cost, higher efficiency photovoltaics
- third generation materials and nanostructures
- electricity storage

Crabtree and Sarrao, Physics World 22(10), 24 (2009)
The Transition to Sustainable Energy: High Tech Materials and Chemistry

Traditional energy

- gas \( \text{CH}_4 \)
- oil \( \text{CH}_2 \)
- coal \( \text{CH}_{0.8} \)

Commodity materials
Disposable fuels

Combustion

Heat → Useful work

Sustainable energy

- sunlight
- wind
- water
- geothermal
- biomass

Electricity
Biofuels
Solar chemical fuel

Useful work

Direct conversion

Sustainable energy requires controlling complex, functional, high tech materials and chemistry

High tech materials and chemistry
- e.g., photovoltaics, electrodes, superconductors, catalysts
Complexity Equals Functionality

Levels of Complexity
- compositional structural → functional unit
- architectural → connecting functional units
- temporal → connecting sequential steps
- many interacting degrees of freedom

Artificial light-gathering and reaction center complex
The New Energy

- wind
- biofuels
- solar
- nuclear
- carbon sequestration
- superconducting electricity grid
- batteries
- electric cars

Crabtree and Sarrao, Physics World 22(10), 24 (2009)
Not Only Technology, But Living Patterns and Lifestyle

Traditional view
City dwellers produce large amounts of $CO_2$

Emerging view
City dwellers produce small amounts of $CO_2$
Per Household

from Moira Zellner and Thomas L. Theis
New Frameworks for Urban Sustainability Assessments
And Policy

energy sustainability

environmental sustainability

economic sustainability

a multidimensional, interactive challenge
The Needs

Research and development of alternative energy technologies
   interdisciplinary basic science and engineering breakthroughs

Education of future energy practitioners
   interdisciplinary complex materials and chemistry
technical curriculum development

Education of future energy decision makers
   e.g., interaction of solar, nuclear, wind, biofuels and transportation
   regulatory policies for integrating renewables on the grid
   incentives for promoting chosen technologies

Forum for critical examination of proposed paths forward
   decisions now for next development steps
Some Activities

New course

Energy for Future Decision Makers
George Crabtree, spring 2011
for budding scientists, engineers, industry leaders, legislators, policy makers
no technical prerequisites beyond high school arithmetic
general education credit
pending approval

Summer Institute

Sustainability and Energy for the Global Citizen
August 7-19, 2011 Lecture Center F and Lincoln Hall
60 students: graduate and advanced undergraduate
social, economic, policy and technical issues
guest lecturers from UIC, NU, UC, Argonne, nation
stress urban energy issues
competitive admission
Large Potential Scope

Draw on interdisciplinary UIC resources

Promote energy and sustainability coordination
Research by individual investigators
Interdisciplinary collaborative centers (EFRC, MRSEC, . . .
Curriculum across many departments
Interdisciplinary colloquia series
Energy services and analysis
Campus energy and sustainability planning
Campus energy events
UIC Strategic Vision for Scholarship and Discovery

**Urban Resilience and the Global Environment**- expertise in Urban Economics, Urban Infrastructure, Transportation, Global Change, Sustainability, Art & Architecture, and Energy

**Biomedical Discovery**- expertise in Molecular Bioscience, Predictive Life Science, Genetics & Genomics, Neuroscience, Stem Cell-Based Therapies, Transplantation Science, Vascular Pathobiology, Cancer Biology.

**Community Disparities**- expertise in civic engagement in a scholarly way via Population Health, STEM education, Social Justice, Educational and Economic Disparities, Strengthen Community Research and Health Disparities.
Perspective

Energy is making an historic transition fossil to alternative, clean, sustainable

The transition will take decades

Alternative energies are in their infancy breakthrough research and development define the “big picture” energy landscape

Opportunity and challenge for UIC interdisciplinary research and development education of energy decision makers address today’s energy issues
Questions

and

Discussion