

# Agenda

## External Advisory Board Agenda

Institute for Environmental Science and Policy  
September 29, 2010

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|---------|--|
| 9:00 am | Coffee and refreshments  |
| 9:15    | Greetings, introductions   |
| 9:30    | <i>State of the Institute</i> , Thomas L. Theis, Director<br>Updates<br>New programs and activities                          |
| 10:30   | <i>Vision for Research at UIC</i> , A Conversation with<br>Joe G. N. "Skip" Garcia, VCR                                      |
| 11:30   | <i>The New Energy and UIC</i> , Professor George Crabtree, Argonne<br>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”

## IESP Key Activities

- Joint faculty appointments and faculty clusters in support of interdisciplinary research
- Ph.D. fellowships
- Seminars
- Conferences and meetings
- Campus activities

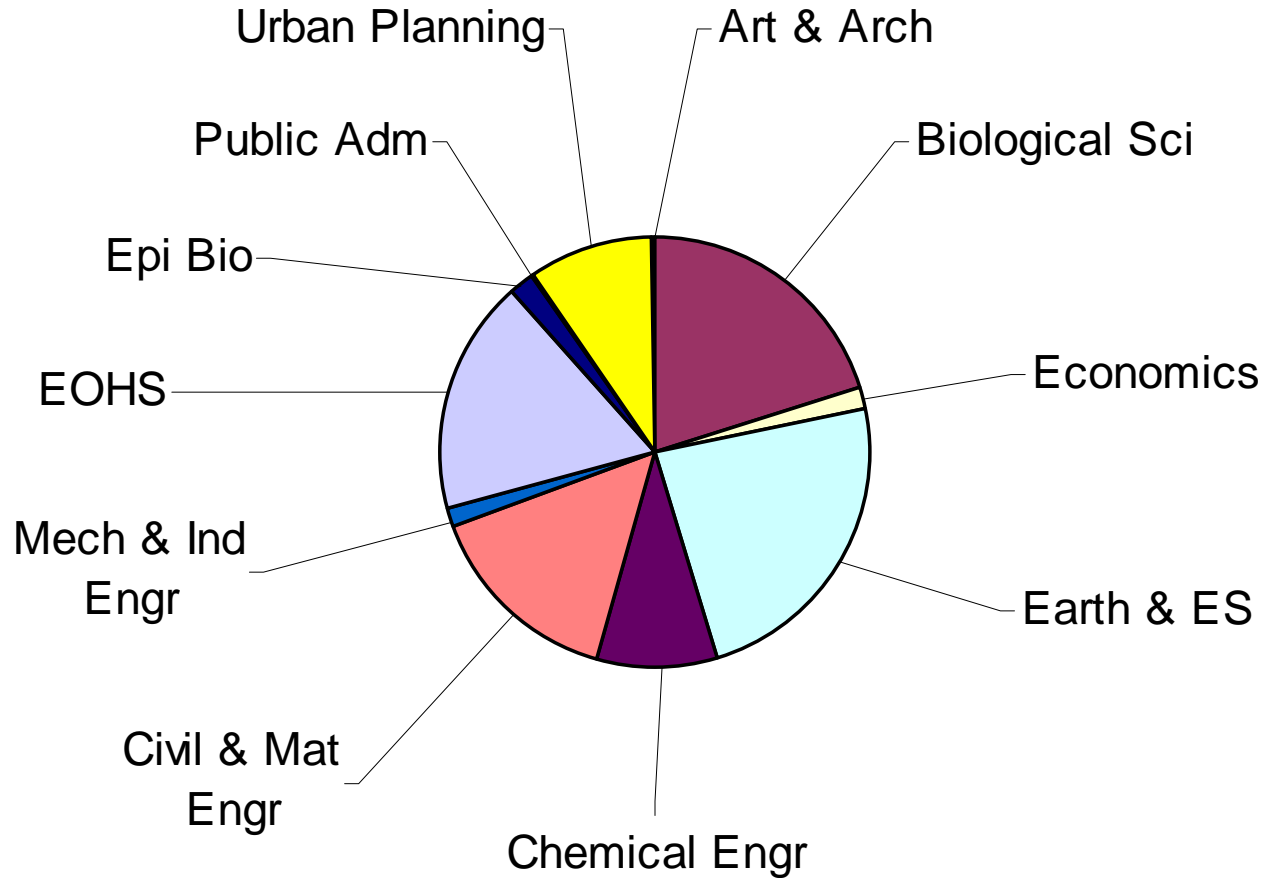
# IESP Crosscutting Themes

- 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

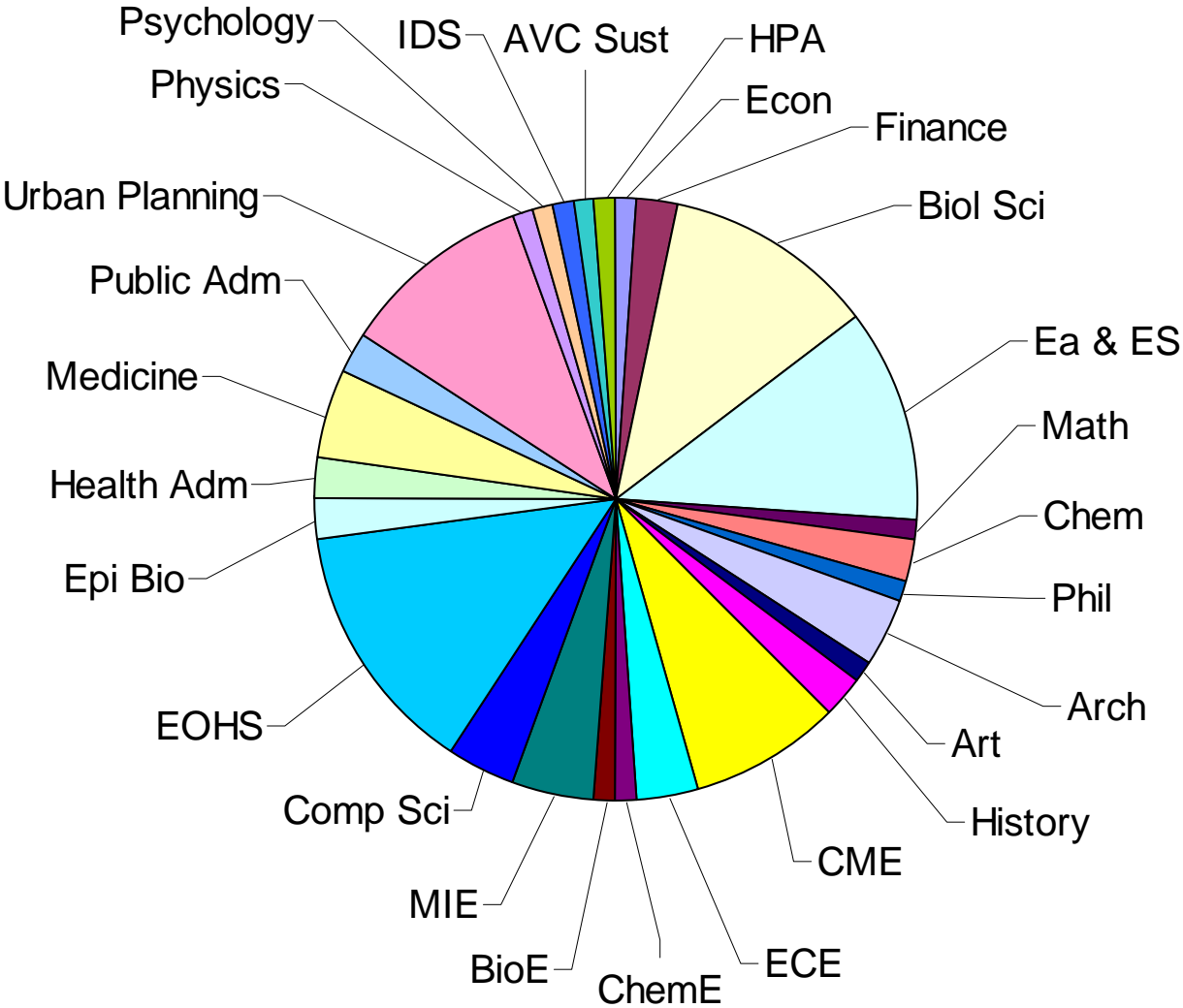
# Joint IESP Faculty

<b>Name</b>	<b>Depart/Col</b>	<b>Expertise</b>	<b>Rank</b>	<b>Percent</b>	<b>Appointed</b>
K. Nagy	Ea & Env Sci	Env.Geochem	Professor	40	2002
N. Esmen	EOHS/SPH	Risk Assess/ Env.Decision	Professor	37	2003
J. Lin	CME/COE	Trans Sys/ Air Quality	Asst Prof	43	2003
M. Zellner	UP/CUPPA	Public Policy/ Sustain of Nat Resources	Asst Prof	50	2006
D. Wise	Biological Sci/LAS	Ecosystem processes	Professor	50	2006
E. Minor	Biological Sci/LAS	Landscape ecology	Asst Prof	50	2008
New appt	EOHS	Urban Health		50	2010
New Appt	CUPPA	Urban Sustainability		50	2011

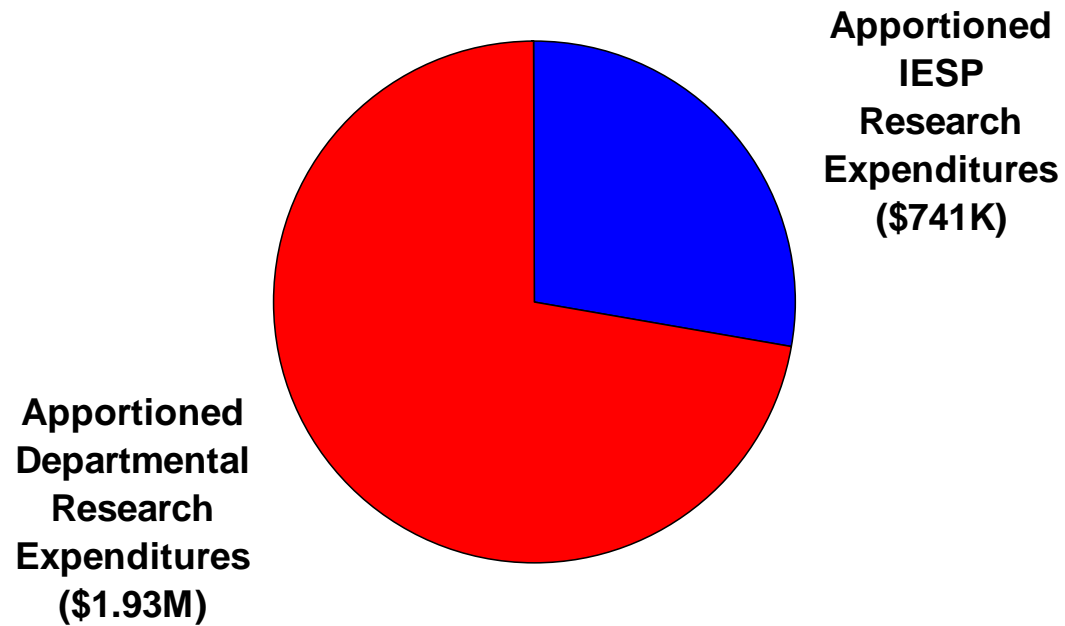
# IESP Dollar Allocations by Department



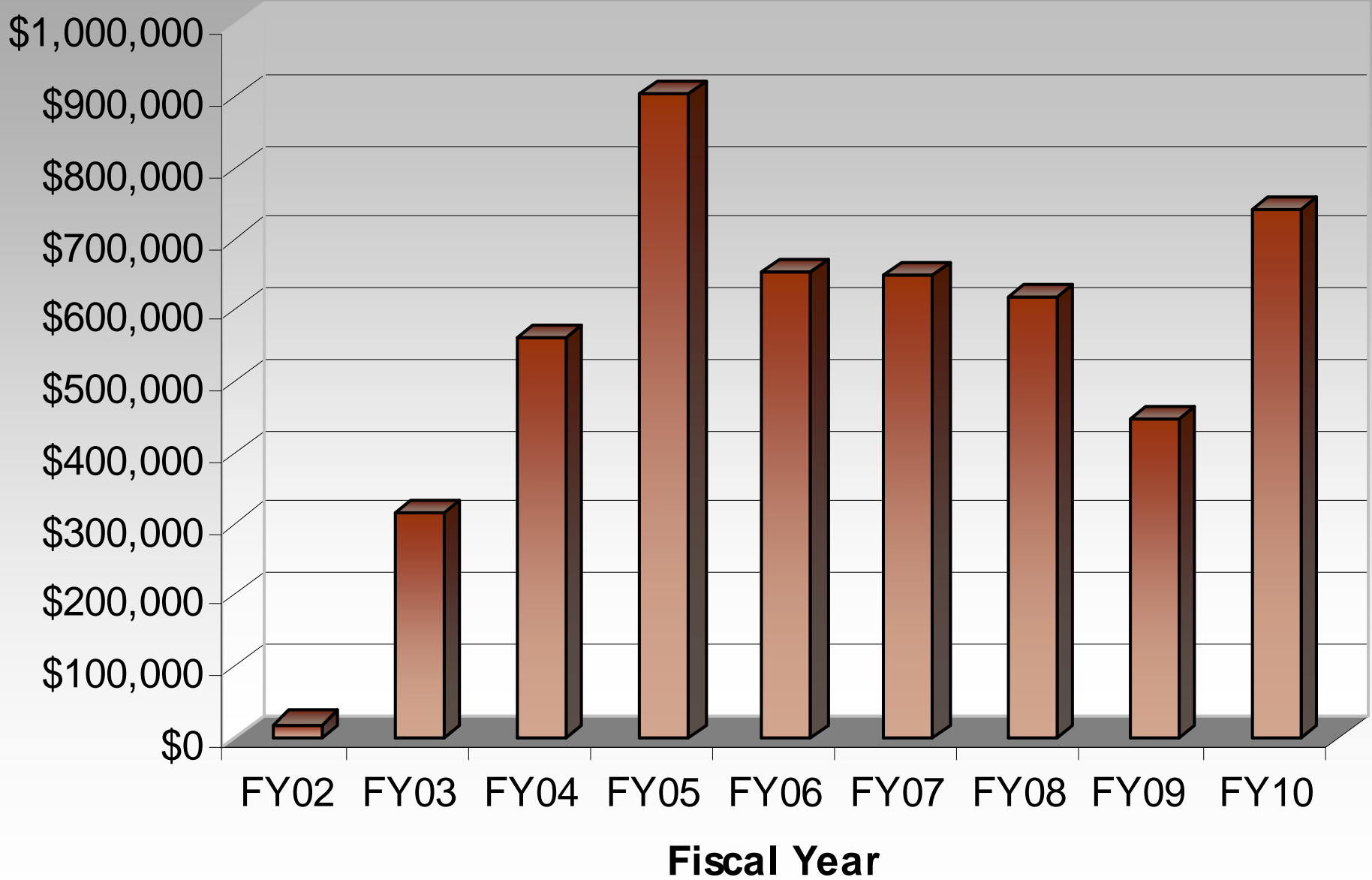
# Distribution of Faculty with Environmental Interests by Department (~88 total)



# IESP Research Expenditures FY 2010



# IESP Research Expenditures



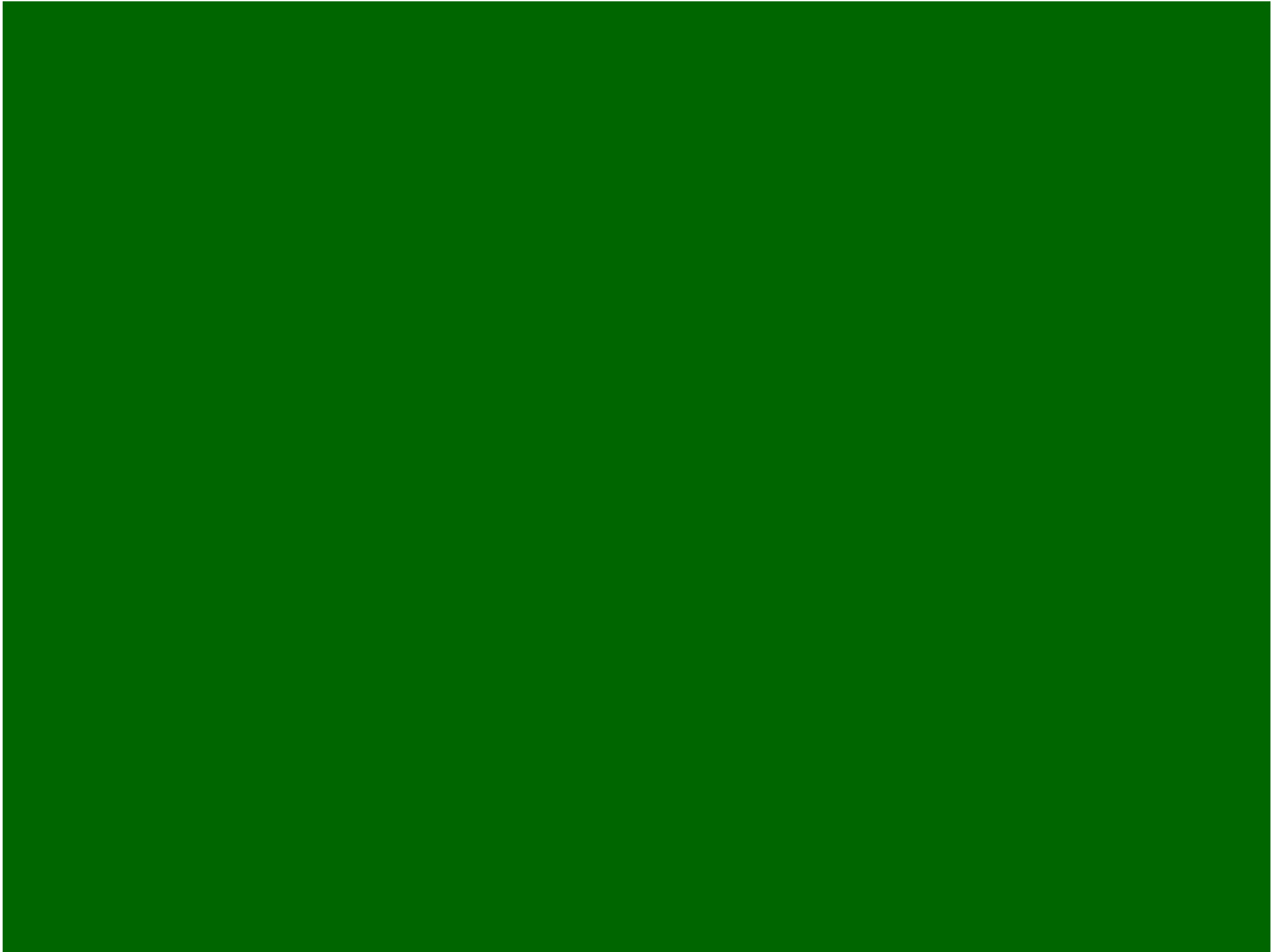
# Research

- 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 7<sup>th</sup> 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)



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# *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 energy puzzle: Sustainability



physicsworld.com  
October 2009

## The road to sustainability

George Crabtree and John Sarrao

**George Crabtree** is a Distinguished Fellow in the Materials Science Division of the Lawrence National Laboratory, and **John Sarrao** is a physical and Program Director in the Office of Science Program of the Lawrence National Laboratory. **www@slac.gov**

The oil shock of the 1970s triggered worldwide awareness of oil dependency and launched a search for alternative sources of energy. But three decades on, these efforts have barely had an impact: oil still accounts for almost 40% of global energy use, and fossil fuels make up 85%. The US, for example, imported 20% of its oil in 1970; today the figure is 60%, and other countries import even larger fractions of the oil they consume. The problem of oil dependency is compounded by cost. Before the current recession, the price of oil peaked at \$140 a barrel – five times its price in 2002 and 10 times its price in 1970 – rewriting the economics of transportation, food, manufacturing and trade that underlie the operation of society. In addition to dependency and

higher than they were before the Industrial Revolution, and they are rising at an accelerating pace, driven by the human combustion of fossil fuels. The potential implications for global warming and climate change are sobering. Left unchecked, climate change could produce dislocations in the agricultural, trade and demographic patterns that define global economic and social structures. A particularly worrying feature of global warming is the timescale involved. It takes 400–1000 years for carbon dioxide in the atmosphere to equilibrate in the deep ocean. Hence, the carbon dioxide that we have already added – and continue to add – to the atmosphere will affect not only our grandchildren but also

<http://physicsworld.com/ws/article/print/40527>

*Controlling the Functionality  
of Materials for Sustainable Energy*

George Crabtree  
John Sarrao



ANNUAL REVIEW OF  
CONDENSED MATTER  
PHYSICS

October 2010

<http://www.annualreviews.org/journal/conmatphys>

## RISING ABOVE THE GATHERING STORM, REVISITED

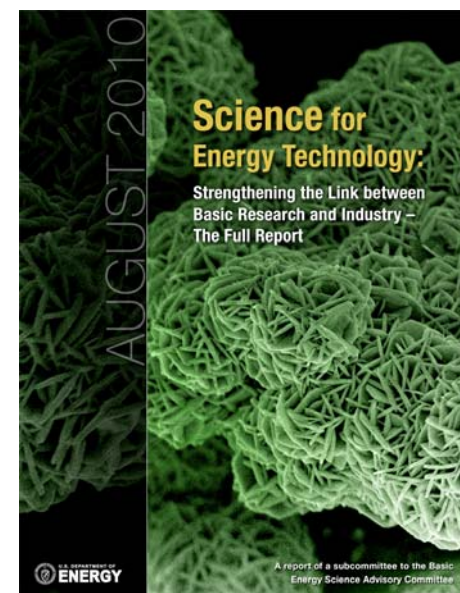
Rapidly Approaching Category 5

By Members of the 2005 "Rising Above the Gathering Storm" Committee

Prepared for the Presidents of the  
National Academy of Sciences  
National Academy of Engineering  
Institute of Medicine

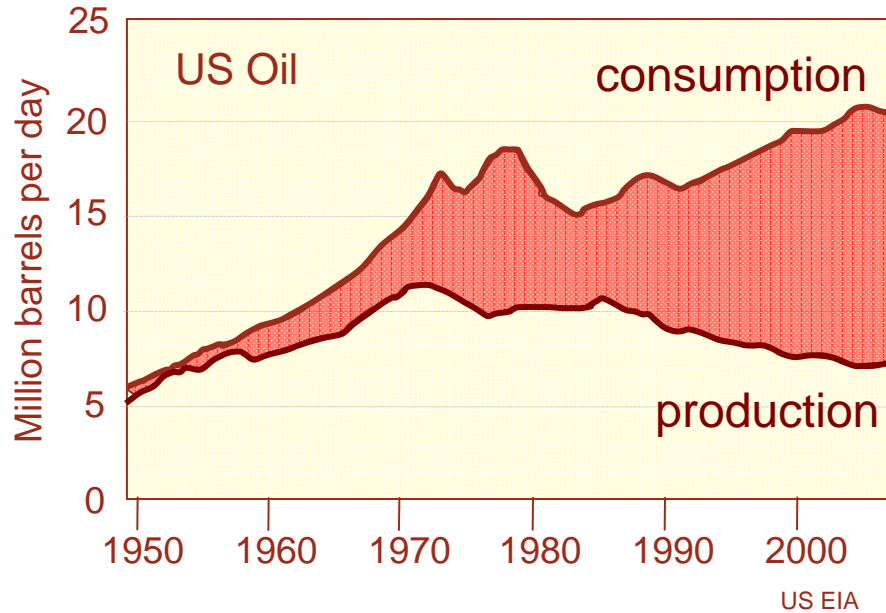
National Academy of Sciences  
National Academy of Engineering  
Institute of Medicine

[http://www.nap.edu/catalog.php?record\\_id=12999](http://www.nap.edu/catalog.php?record_id=12999)



<http://www.sc.doe.gov/bes/reports/list.html>

# The Problem: Dependence on Imported Oil



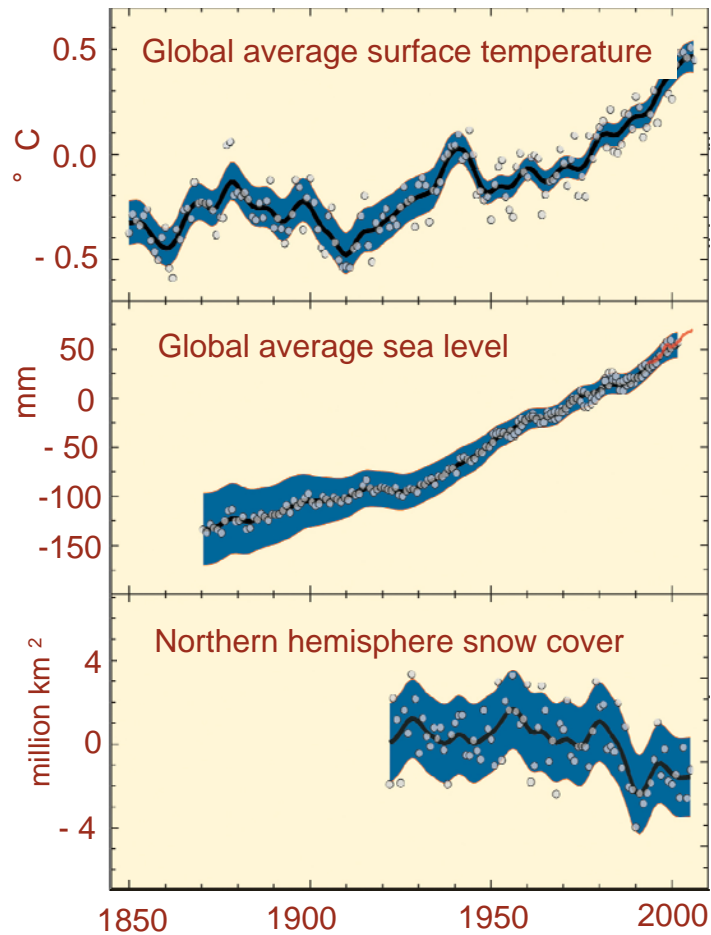
Unpredictable supply  
threatens  
economy, lifestyle, national security

find alternatives to imported oil  
*biofuels, electricity, solar fuels*

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



# The Problem: Greenhouse Gases and Climate Change



IPCC Fourth Assessment 2007  
<http://www.ipcc.ch/graphics/gr-ar4-syr.htm> SPM1



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

## ***Oil and Carbon Dioxide: Woven into the Fabric***

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*Driving our cars on imported oil*

*Unfettered emission of CO<sub>2</sub>*

Foundations of decades-long economic success

*Alternatives require transformational change  
to business as usual*

more sustainable  
next-generation energy technology

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# Roadblocks to Sustainable Energy Technologies

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Performance: fossil is cheaper

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

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# What is Sustainability?

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Lasts a long time

*Oil in 1900*

*Coal in 2010*

Does no harm

*Nuclear electricity: no CO<sub>2</sub>*

*Biofuels: reduced CO<sub>2</sub>*

Leaves no change

*Closed chemical cycle*

*Electricity, hydrogen*

# Sustainable Next-Generation Energy Technologies

## Sustainability Profile

lasts a long time ☺

does no harm ☺

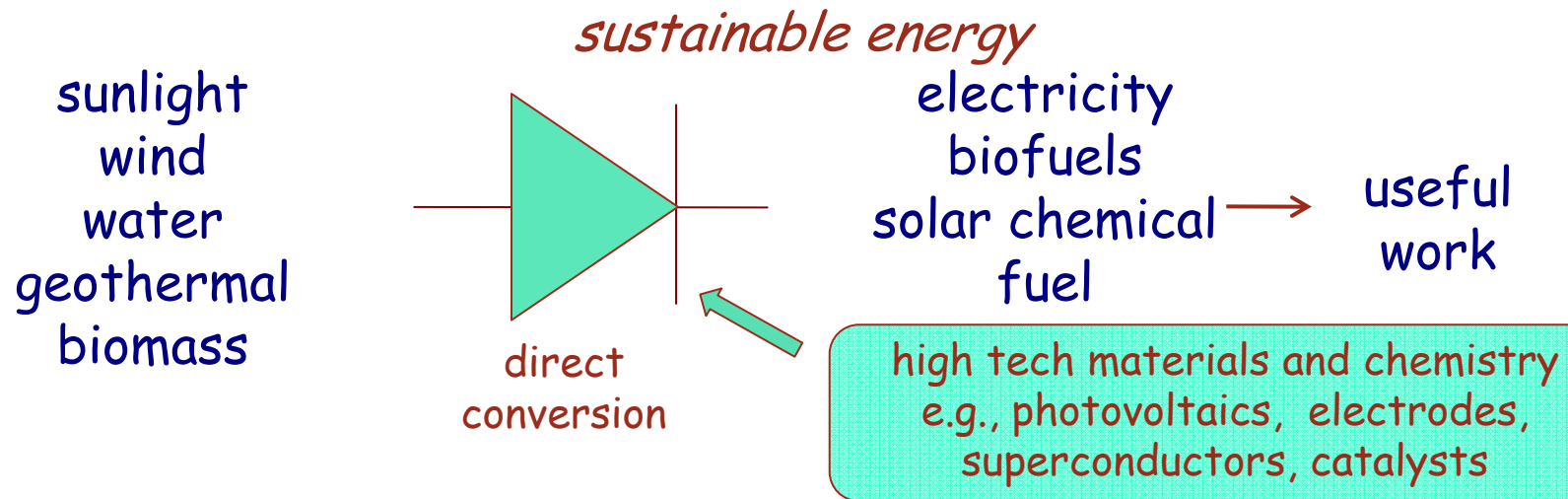
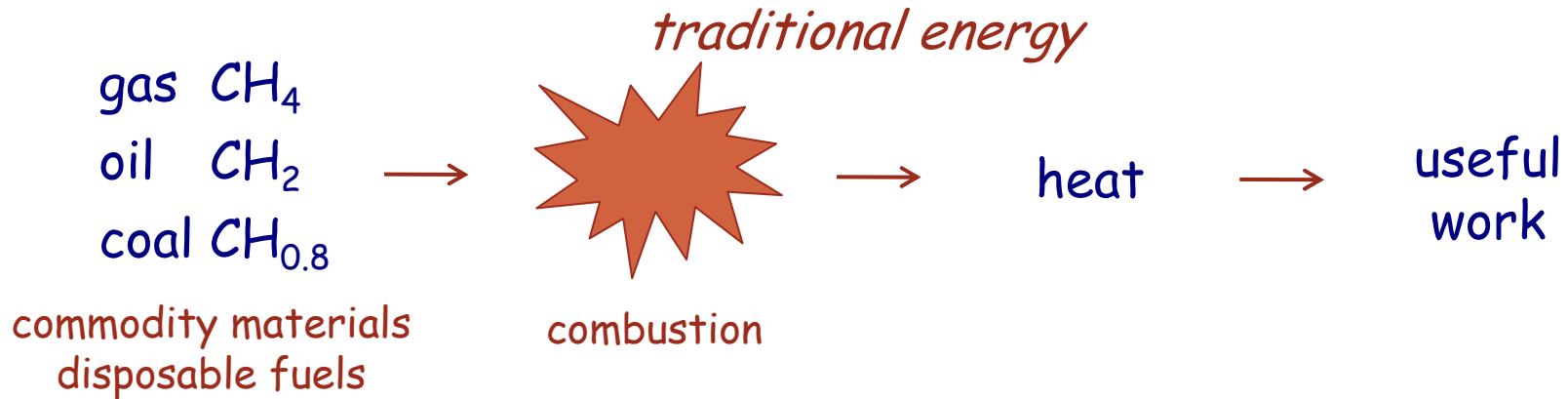
leaves no change ☺



Solar electricity: a fully sustainable energy chain

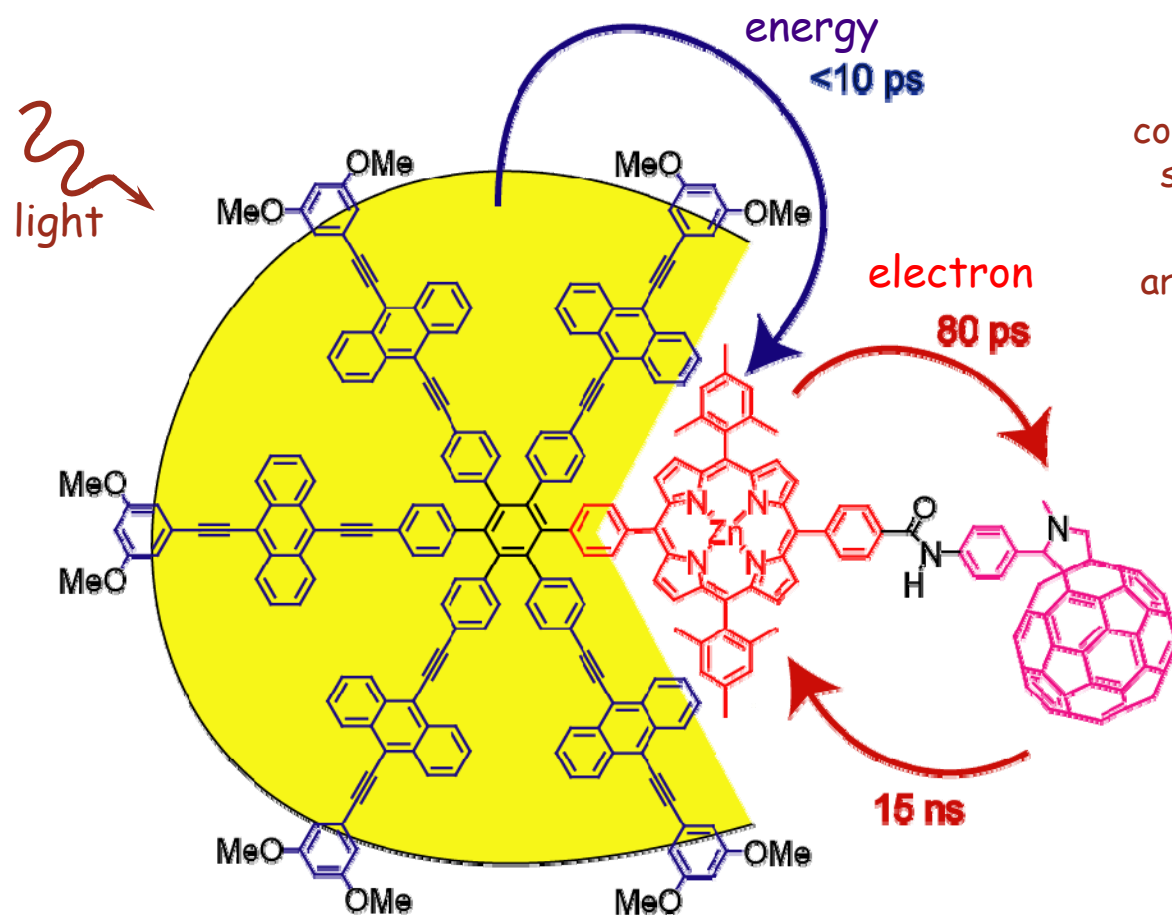
*breakthroughs needed*  
lower cost, higher efficiency photovoltaics  
third generation materials and nanostructures  
electricity storage

# The Transition to Sustainable Energy: High Tech Materials and Chemistry



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

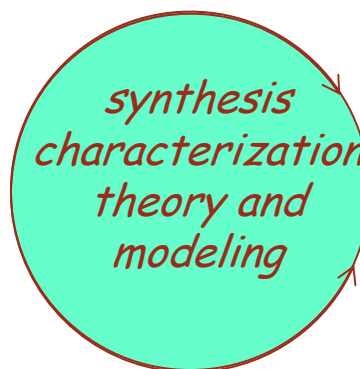
# Complexity Equals Functionality



## 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

Kodis et al, JACS 128, 1818 (2006)

Crabtree and Lewis, *Solar Energy Conversion*, Physics Today 60(3), 37 (2007)

# The New Energy



wind



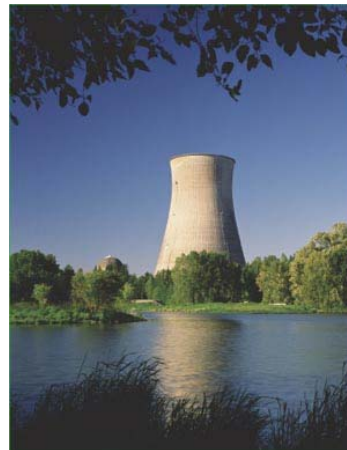
biofuels



batteries



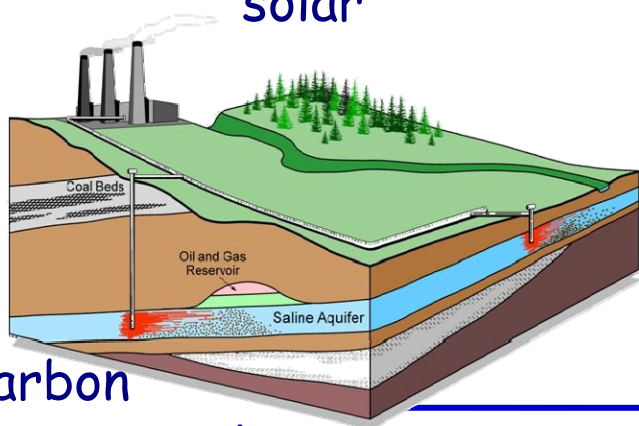
solar



nuclear



electric cars



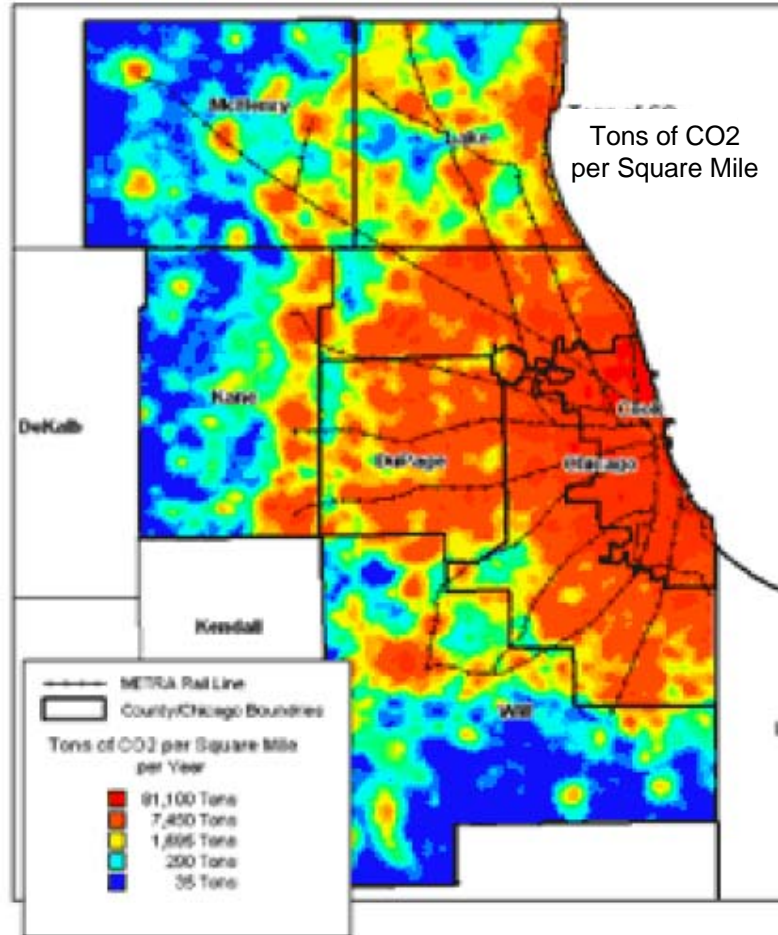
carbon sequestration

superconducting electricity grid

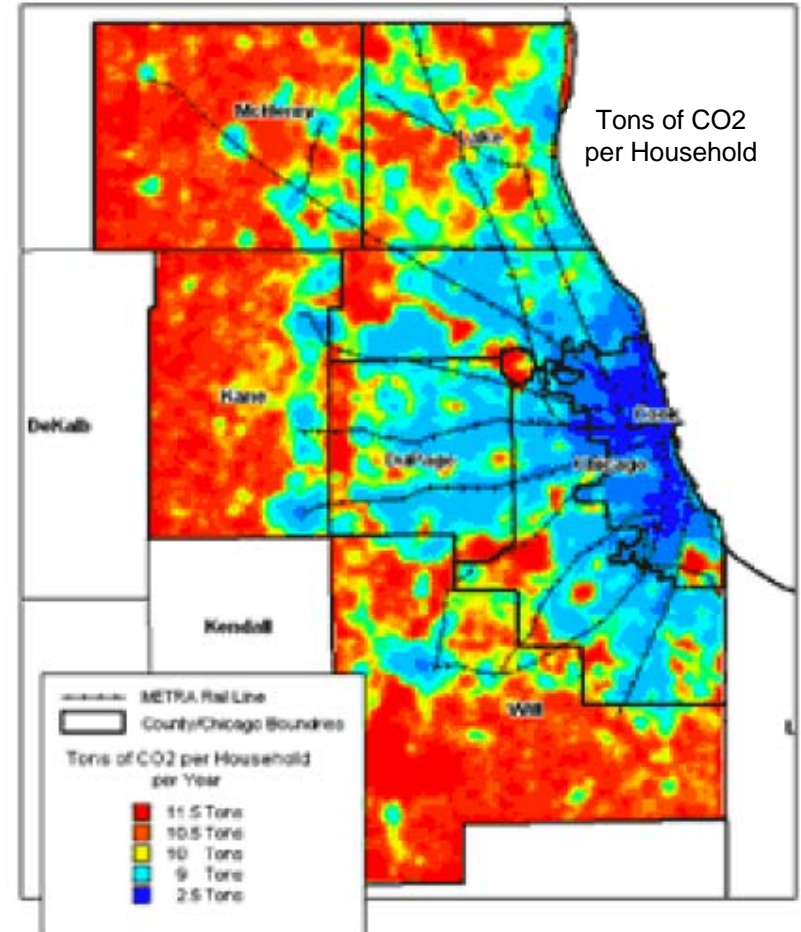


# Not Only Technology, But Living Patterns and Lifestyle

Traditional view  
City dwellers produce large amounts of CO<sub>2</sub>



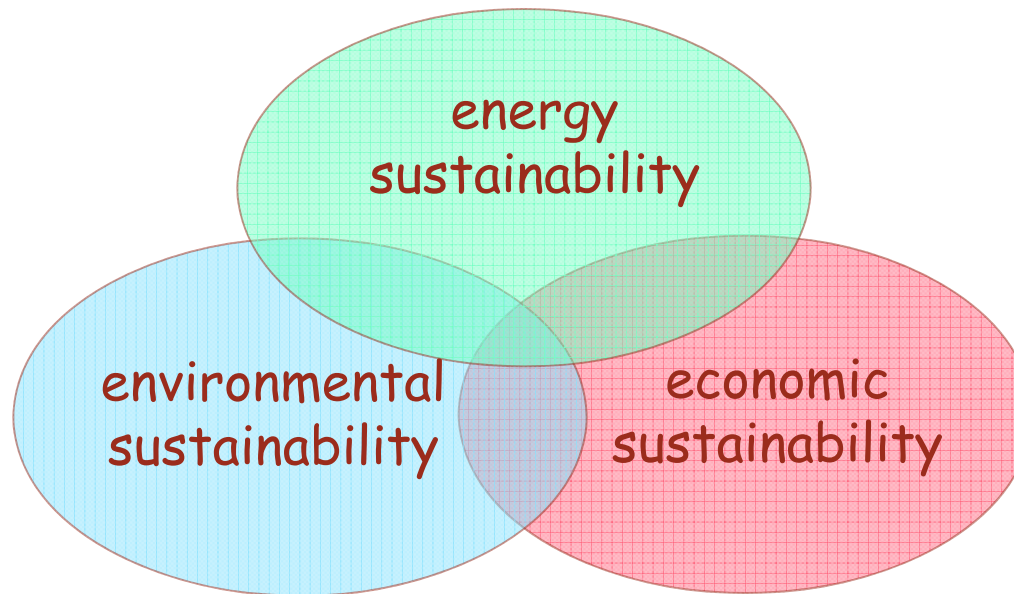
Emerging view  
City dwellers produce small amounts of CO<sub>2</sub>  
*Per Household*



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

## *... And Policy*

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a multidimensional, interactive challenge

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# The Needs

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*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

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# Some Activities

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*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

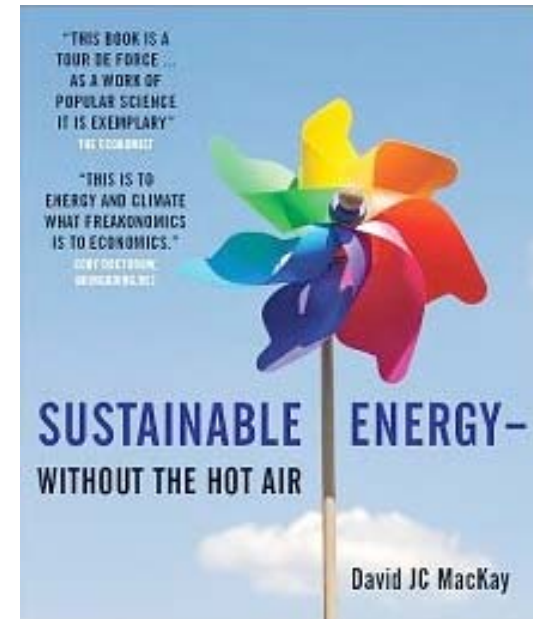
social, economic, policy and technical issues

guest lecturers from UIC, NU, UC, Argonne, nation

stress urban energy issues

competitive admission

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# ***Large Potential Scope***

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*Draw on interdisciplinary UIC resources*

Physics, Chemistry, Biology, Earth and Environmental Sciences, Sociology, Political Science, Mechanical, Chemical, Bio, Electrical and Computer Engineering, Economics, Public Health, Urban Planning, Architecture, . . .

*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

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# ***UIC Strategic Vision for Scholarship and Discovery***

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**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.

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# *Perspective*

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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

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Questions

and

Discussion

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