The Energy Technology Innovation Project

Analyzing, Informing, and Shaping Energy Policy

Belfer Center for Science & International Affairs
John F. Kennedy School of Government
Harvard University

2007
ETIP

- ETIP is a joint project of the Program on Science, Technology, and Public Policy (STPP) and the Environment and Natural Resources Program (ENRP)

- Both STPP and ENRP are programs of the Belfer Center for Science & International Affairs (BCSIA), which is the largest research center in the John F. Kennedy School of Government at Harvard University

(above) John Holdren presents report of the National Commission on Energy Policy; (below) Ministry of Science & Technology official XU Jing consults with ETIP Research Fellow Guodong SUN.
Objectives

1. To determine and promote adoption of effective strategies for developing and deploying advanced energy technologies in:

   The United States of America
   China, and
   India

2. To study and recommend policies that will reduce conventional air pollution, minimize emissions of climate-altering gases, lessen dependence on imported fuels, stimulate economic development, and alleviate poverty.
Approaches

**Exploration of the relationship between technology and policy:**
- How does policy promote (or fail to promote) innovation in advanced energy technologies?
- How can (and should) technological developments inform policymakers?
- How can policy enable the more rapid acceleration of advanced energy technologies in the marketplace?

**Use of interdisciplinary methods:**
- Employment and integration of methods and insights drawn from the natural sciences, engineering, economics, political science, history, management, and law.

**Formation of partnerships:**
- Build and utilize collaborations among programs in BCSIA; among centers at KSG; across schools at Harvard; among universities in the USA and elsewhere; among the academic, corporate, governmental, and NGO sectors; and among countries around the world.
ETIP’s Niche

- Academic excellence in policy research and analysis
- Policy “entrepreneurship”
- Good convening power for strategic dialogues
- Mentoring and training of top young energy researchers
- Partnerships with key institutions in the United States, China, and India

(above) Agreement being signed between U.S. EPA and China’s EPA, facilitated by ETIP; (below) Rita Bajura of the National Energy Technology Lab presenting at a workshop at Harvard
Main Research Areas

United States
- Policies for innovation in transportation
- Policies for development and deployment of cleaner coal technologies
- Carbon capture and storage technology policy
- U.S. climate change policy

China and India
- Development and deployment of cleaner & more efficient coal technologies
- Development and deployment of cleaner & more efficient vehicles
- Development and deployment of biomass gasification technologies

Cross-Cutting
- Patterns and processes of energy-technology innovation
- Measurement and performance of energy-technology innovation
- International climate change policy
- International energy cooperation among the three countries
Who We Are

Director: Kelly Sims Gallagher, Ph.D.

Principal Investigators: Professors John P. Holdren and Henry Lee

Project Coordinator: Samuel Milton

Research Fellows and Associates (alphabetical):
Jeff Bielicki (CCS in the United States)
Ananth Chikkatur, Ph.D. (biomass and advanced coal in India)
Gustavo Collantes (transportation policy)
Robert Frosch, Ph.D. (vehicles and innovation policy)
Aleks Kalinowski (Visiting Scholar from Geoscience Australia) (carbon storage)
Hongyan He Oliver, Ph.D. (clean vehicles and enviro. regulations in China)
William Rosenberg (U.S. energy policy)
Ambuj Sagar, Ph.D. (energy innovation policy, vehicles and biomass in India)
Lifeng Zhao, Ph.D. (advanced coal in China)

Affiliates: Alan Leifer, Senior Fellow, Center for Business and Government (energy and transportation); Jennie Stephens, Ph.D., Clark University (carbon capture and storage policy); Gloria Visconti, Center for International Development (biofuels policy)

Research Assistants: Jason Meyer, MPP student, John F. Kennedy School of Government
Sarah Cebron, Harvard College
Our Main Collaborators

United States
Princeton University
MIT
Lawrence Berkeley National Laboratory (LBNL)

China
Ministry of Science & Technology (MOST)
Chinese Academy of Sciences (CAS)
China Automotive Technology & Research Center (CATARC)
Tsinghua University

India
The Energy Research Institute (TERI)
Indian Institute of Management, Ahmedabad
Examples of Our Current Work

- *Innovation in Transportation* project to explore a CO$_2$-based alternative to CAFÉ using a system approach
- *5-year Collaboration with China Ministry of Science and Technology* (MOST) on development of advanced-coal technologies in China
- *Development of vehicle fuel-efficiency standards in China* and study of barriers and incentives to deployment of advanced vehicle technologies in China (see *China Shifts Gears* – MIT Press 2006)
- *In-use vehicle emissions testing project* in Tianjin, Beijing, Shanghai with CATARC, Tsinghua, and UC Riverside
- *Development of proposed road-map for advanced coal technologies in India* by Chikkatur and Sagar
Highlights from Past Work

- **President’s Council of Advisors on Science & Technology (PCAST)** reports on Federal Energy R&D (1997) and International Energy Collaboration (1999)

- **Development of incentive program for gasification-based technologies** (loan-guarantee “3-Party Covenant” concept) embodied in EPAct 1995.

- **Annual workshops with Ministry of Science & Technology in China** on advanced coal and/or vehicle technologies since 2001.
  - Latest was on barriers & incentives to hybrids in China (May 2006)

- **Co-organization of “Energy Technology Research and Development in India and The United States: Opportunities for Collaboration”** workshop with TERI (Aug. 2004).
## Current Support

### Grants
- The Energy Foundation
- The William and Flora Hewlett Foundation
- The U.S. Environmental Protection Agency
- The Pew Center for Global Climate Change
- The Winslow Foundation
- BP Alternative Energy (*pending*)
- BP Carbon Mitigation Initiative (*pending*)
- The David and Lucille Packard Foundation (*pending*)

### Gifts
- Ford Motor Company China
- GM China
- Shell Exploration and Production
## CMI Collaboration

### Matrix of ETIP-BP-Princeton Work Streams on CCS, Low-Carbon Electricity, and Energy-Technology Policy

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<th>CCS</th>
<th>Low-Carbon Electricity</th>
<th>Energy-Technology Policy</th>
<th>Cross-Cutting Integration</th>
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<td>United States</td>
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<td>China</td>
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Core Research Team on Advanced Coal and CCS
Dr. John P. Holdren

Background

• ETIP Co-PI; Teresa and John Heinz Professor of Enviro. Policy and Director of the Program on Science, Technology, and Public Policy at the Kennedy School of Gov’t; Prof. of Enviro. Science and Public Policy in the Department of Earth and Planetary Sciences at Harvard; and Director of the Woods Hole Research Center. He is also Co-Chair of the bipartisan National Commission on Energy Policy; immediate Past President, American Association for the Advancement of Science

Research focus

• Policies to promote development and deployment of advanced energy technologies

Particular research topics

• Energy-technology policy, climate change policy, nuclear non-proliferation policy
Dr. Kelly Sims Gallagher

Background
• ETIP Director; Ph.D. from Fletcher School, Tufts University

Research Focus
• U.S. energy-technology and climate change policy, especially for transport sector; Chinese energy policy; international energy cooperation

Particular research topics
• U.S. investments in energy-technology innovation
• Technology transfer and innovation in Chinese automobile industry
• U.S. and Chinese energy and transportation policies
Jeff Bielicki

Background
• ETIP Research Fellow, Ph.D. Student in Public Policy, Mechanical Engineer

Research focus
• Engaged in research of CCS as an ‘Engineering System’ - the behavior of the system in its entirety (geo-techno-economics, social choice, and deliberate policy interventions)

Particular research topics
• How should CCS be deployed? (e.g. optimal control framework coupled to derived supply curve)
• Will CCS centralize electricity production? (e.g. evolution of electricity system over time and impact of CCS ‘tug’ on power plant locations)
• How will public react? (e.g. valuation and tradeoff of storage risk and permanence)
Dr. Ananth Chikkatur

Background
• ETIP Research Fellow, Ph.D. in Physics (MIT)

Research Focus
• Energy-technology innovation, energy policy in India, small-scale/rural energy systems

Particular Research Topics
• Policies for developing and deploying clean coal technologies in India and the United States
• Energy efficiency in electric power in India
• Climate change and development; role of CDM
• Indian energy policy
Aleks Kalinowski

**Background**
- ETIP Research Fellow; Visiting Scholar from Geoscience Australia; joint fellow with MIT’s Lab on Energy & Environment

**Research focus**
- Policies to promote carbon dioxide capture and storage in the United States

**Particular research topics**
- The status / overview of geological assessment or characterisation for geological storage of carbon dioxide in Australia and the United States. How is the U.S. doing? What is going well? What and how can be improved?
- How government and private R&D money is invested in three areas – clean coal technology, carbon dioxide capture and storage, and hydrogen; and how this compares with the applicable roadmaps.
Dr. Jennie Stephens

**Background**
- Former ETIP Fellow; Asst. Prof., Clark Univ., Ph.D from CalTech

**Research focuses**
- Policies for CCS; chemical approaches to carbon storage; strategic use of scientific and technical information in government-industry interactions during the development and implementation of environmental regulations

**Particular research topics**
- Public attitudes towards CCS
- Role of public in siting of low-carbon technologies at the state level
Dr. Lifeng Zhao

Background
• ETIP Research Fellow; Visiting from Institute of Engineering Thermophysics (IET), Chinese Academy of Sciences (CAS); IET Associate Professor;
• Research on roadmap for the development of coal gasification based co-production technology in China
• Academic assistant to the Experts Group on Clean Coal Technology of High Tech R&D Program of China for MOST

Research focus
• Development and deployment of advanced coal technology in China

Particular research topics
• Updated landscape of status of advanced coal technology in China
• Assessment of the economic hurdles in the Chinese context to deploying advanced coal technology
• Organization of joint workshop to be supported by MOST, CAS and ETIP on advanced coal and CCS in May 2007
U.S. Government Investments in Energy RD&D
U.S. DOE Energy RD&D
1978-FY2008 Administration Request

- Hydrogen (non-fossil)
- Electricity T&D
- Fossil (including CCT demo)
- Renewables
- Efficiency
- Fusion
- Fission

million 2005$
Composition of DOE Fossil Energy RD&D Spending (FY1978-FY2008 Admin. Request)

Note: Fuel cells from FY05-on are included under the hydrogen category.