



# Industrial Innovation and Greenhouse Gas Reduction

---

David C. Mowery  
Haas School of Business  
U.C. Berkeley



# Overview

---

- Characteristics of industrial innovation.
- Implications for GHG-reducing innovation.
- Public policy and industrial innovation for GHG reduction.
- University-industry collaboration and GHG-reducing innovation.

# Industrial Innovation

- Combines “radical” and “incremental” innovation.
  - Performance improvements in technologies once introduced are driven by incremental innovation.
- Sources of incremental innovation:
  - Design improvement
  - Better understanding of operations & maintenance.
  - Improvements in production of the technology itself.
  - Incremental innovations come from users as well as producers of new technologies.
- Realizing the benefits of innovation requires that a technology be adopted.
  - Uncertainty is severe in early stages of adoption.
  - Broader adoption can support learning that leads to incremental improvement.
  - Incremental improvement lowers costs, improves performance, accelerates adoption.
- Adoption and innovation are two sides of same coin.
  - Faster adoption supports more rapid improvement.
- Both processes are driven by investment.
  - Incentives are central.



# Implications for GHG-reducing innovation

---

- Near-term gains from GHG-reducing innovation strategy depend on exploitation of existing technologies.
  - Recombination, modification of existing technologies requires innovation, knowledge, learning.
  - Broader adoption of existing technologies can accelerate their improvement.
  - Key issues: strength of adoption incentives, feedback loop into innovation, evenhanded structure of incentives
- Longer-term reductions will rely on development, adoption of new technologies for GHG reduction, alternative energy sources.
  - Incentives to support exploitation, adoption of near-term technological solutions should enhance incentives for R&D on long-term solutions.

# Implications for GHG reduction

## policies

### Simplicity

- Carbon tax arguably preferable to cap & trade, because of greater simplicity, evenhandedness among sectors & technologies.
  - Measurement of carbon content of fuels, rather than emissions.
- Credibility
  - Key issue in US energy policy (especially alternative energy technologies) is weak incentive effects.
    - Would an “ARPA for energy” be effective without procurement?
  - Lack of stability in past policy => skepticism among potential investors in GHG-reducing technologies about credibility of incentives.
- Performance orientation
  - Favor results, not technologies.
  - Results orientation also can create incentives for adoption of current technologies, in addition to supporting investment in “radical” breakthroughs.

# University-industry collaboration for GHG-reducing innovation

■ University-industry collaboration has a long history in US.

- UC Berkeley chemistry professor Frederick Cottrell: early 20<sup>th</sup>-century inventor, patentholder and licensor in antipollution technologies.
- Collaboration between MIT and forerunner of Exxon Mobil in refining, petrochemicals.
- Biomedical R&D and Prop. 71-supported stem cell research in CA.
- Since the Bayh-Dole Act of 1980, U.S. universities have emphasized patenting and licensing of research results as a central mechanism for collaboration.
  - UC system is a leading technology licensor.



# Managing University-Industry collaboration

- Collaboration rests on a 2-way flow of people, ideas.
- Many channels of interaction in addition to patenting & licensing.
  - Manage relationships to maximize efficient operation of all of them.
- Intellectual property rights (and quest for royalties) should facilitate, not impede, collaboration.
  - Net returns to universities from licensing are dwarfed by industry-supported research.
  - UC systemwide gross licensing revenues averaged \$77M/year for FY 2001 – 2004; net licensing contributions to UC systemwide & campus operating budgets averaged \$16M/year, less than 1% of annual UC research budget.
    - Industry sponsored \$235M of research at UC in FY 2003.
- Collaboration must serve the public interest.
  - Current collaborations build on infrastructure created by large investments of public funds from state & federal sources.
  - Minimize any impediments to scientific research from “patenting science,” limiting dissemination of research inputs.