



HARVARD Kennedy School

BELFER CENTER

for Science and International Affairs



Lessons from a Survey of Energy Innovation in U.S. Businesses

Energy Technology Innovation Policy
Charles Jones & Laura Diaz Anadon
with Jeffery Kerwin, Westat

The Study

- A two stage survey of business establishments
- Targeted at energy and likely innovators
- To answer:
- What is the role of the private sector in the United States in supporting energy technology innovation?
- How is the investment distributed by technology area, by type of firm and industry?
- How can policy encourage innovation or address gaps?

Highlights

- Energy technology innovation is widespread
- Many small-scale participants
- Especially among start-ups
- Both market and process barriers
and so we recommend:
- Price on carbon and
- Support of innovation process

Why did we do it?

- ETI about \$8.5b in 2005 \$3.3b DOE, only:
 - 0.8% of energy expenditures
 - 0.3% of energy company revenue
 - 1.1% of all R&D
- Energy in 2008 BRIDS *still* not available
- In 2005 SIRD, energy only asked of few
- In both, single vague question
- Vacuum of information

Results - response

- Only 192 / 1305 (14.7%) (13.8% weighted)
- w/ bias study, reached 247 (19% / 18.6%)
- Second mailing less likely ETI
- Bias results between 1st & 2nd mailing
- Bias in the response bias study
- An expensive phone screener may help
- Political climate?

Results - prevalence

- 21(se=12)% energy, 19(11)% innovation
- 17(11)% energy related innovation
- 11(10)% actually perform ETI
- Assuming worst response bias,
2.4 (se~1.3)% energy related innovation

Widespread, more than prior estimates

Results - scale

- Most respondents < \$200k / year
- Many only do special projects
- Start-up more likely to innovate and spend 75% of VC on innovation
- Every stage and most technologies even in small sample

Small scale and start-ups are important

Results - process

- If they measure, they use payback time
With < 2 year timescale
- Costs drive ETI more than opportunity
- Grants more impact than tax credits
- Innovation process and lack of markets
are equally challenging
- Cooperation is important

Market pull and technology push

Policy relevant lessons

- It is possible to do easy relevant survey
- Response & bias expensive to fix
- Many more partners & users of ETI
- Information, cooperation, grants work
- Most start-ups innovate, ~75% of VC
- Still do not know enough, especially gaps

Theory & Model lessons

Learning curve, performance, new technology might depend (most strongly) on:

- Public grants and private investment
- Information, infrastructure, partnership
- Energy prices / carbon price
- Market creation
- VC availability (for startups)
- Prevalence of effort?
- Cost cutting opportunities?

Policy recommendations

Price emissions (or limit)

- Market creation and price signal
- Firms respond to cost by innovating

Directed support of innovation

- Information sharing and signaling
- Cooperate and fund to help process
- Unique services

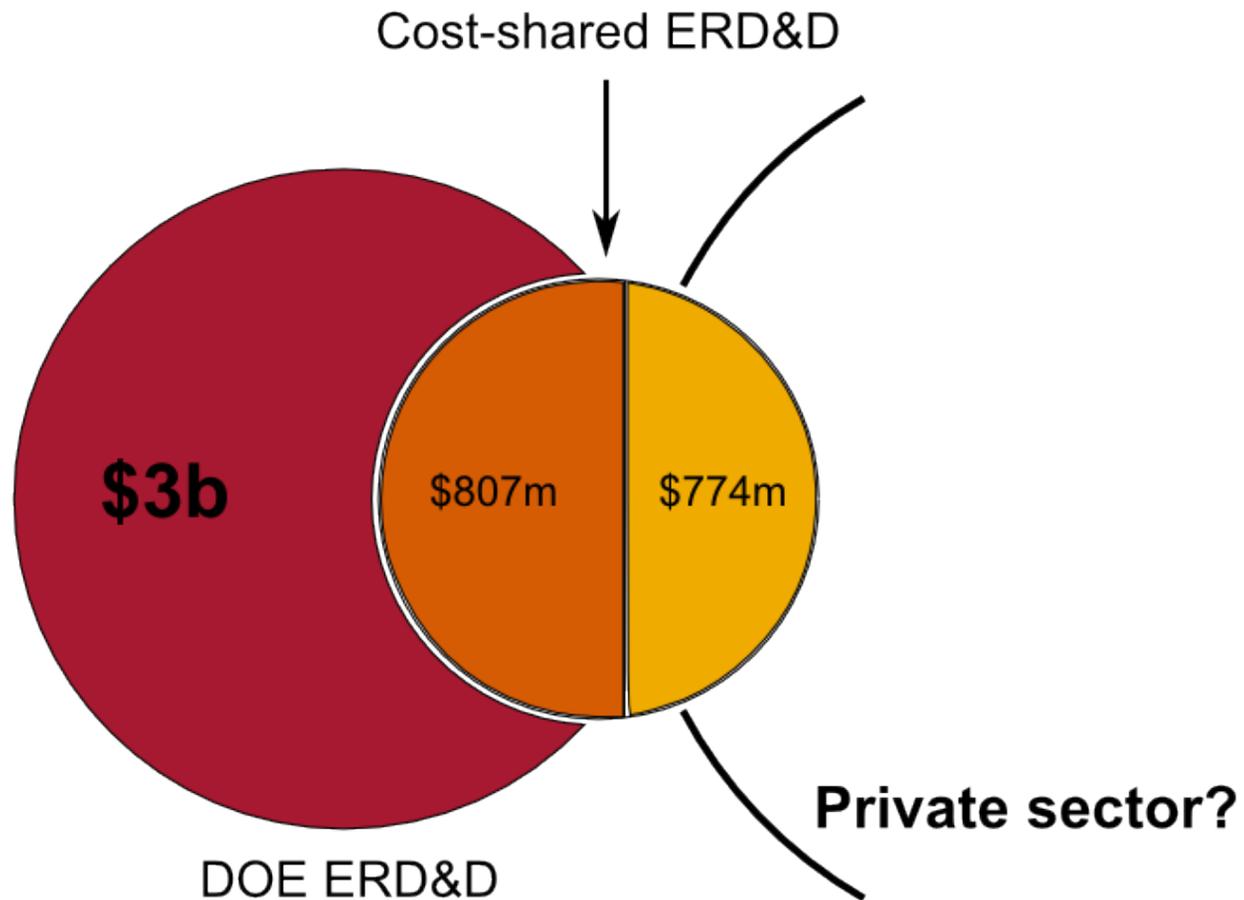
Questions and ideas

How to use results

How to improve survey

Thank you

Motivation for the survey



Design principles

- Balanced design
- Easy to complete
- Managers over theory / accounting
- All non-farm businesses but stratified
- Specific activities
- Process of innovation

Sample

Type of firm maps to the use of innovation:

Energy and Related Equipment

New or improved equipment

Large Energy Users

Reducing own energy use

Engineering and R&D Providers

Research for other firms use

Utilities, Resources, Distribution

New or improved energy systems

Product Manufacturers

More efficient products

Energy Services Providers

Better solutions for customers

Sample

- All non-farm non-govt establishments
- From Dunn & Bradstreet (12m entities)
- Plus 32 “seeded”
- Plus 50 from Bloomberg NEF (start-up)
- Stratified by NAICS
- 1502, 1305 deliverable / in-sample
- 192 responses (14.7%)
- 258 for response bias study, 82 answered

Sample - lessons

- D&B, Bloomberg et al do not know stats
- Professional statisticians know stats only
- Several months to get good sample

Instruments

- Screener and follow-up
- Cognitive interviews (3 then 2)
- Academic, industry review
- Language of managers
- Consistent answers, same as intended
- Most can complete < 30 min

Section A: Energy-Related Activities

1. We would like to know if this business establishment does any of the activities listed below.

Please note that an establishment is generally a single physical location where business is conducted or where services or industrial operations are performed. We realize that your company may have multiple locations. Any of your locations could have been sampled for this project. While the one location addressed in this survey may not represent your entire company, the locations sampled for the project are representative of workplaces in selected industrial sectors across the nation.

For this study, we randomly sampled the establishment based at this address:

[- PRINT ADDRESS HERE -]

Please indicate whether or not this establishment does each of the following:

	Yes	No
A. Provide energy resources or services (such as extraction, refining, generation or delivery)?	<input type="checkbox"/>	<input type="checkbox"/>
B. Design or manufacture energy equipment – that is, equipment for providing energy services (such as extraction, refining, generation or delivery), or for managing energy resources (such as storage or conservation)?	<input type="checkbox"/>	<input type="checkbox"/>
C. Produce materials, components, or capital goods for customers that either provide energy services or manufacture energy equipment?	<input type="checkbox"/>	<input type="checkbox"/>
D. Use significant amounts of energy in its operations, such that sources or costs of energy are important for management decisions?	<input type="checkbox"/>	<input type="checkbox"/>
E. Design or manufacture products that use energy such that customers may consider reducing energy use an important feature?	<input type="checkbox"/>	<input type="checkbox"/>
F. Provide R&D or engineering services for customers that provide energy services, equipment or components, or that seek to reduce the energy consumption of their products?	<input type="checkbox"/>	<input type="checkbox"/>
G. Provide consulting services for customers that use significant amounts of energy, to help them reduce or better manage their energy use?	<input type="checkbox"/>	<input type="checkbox"/>

Section B: Innovation Activities

B1. Does this establishment conduct or fund any innovation activities, such as research, development, testing, product or process improvement?

- Yes
 No

B2. Does another part of your company conduct or fund any innovation activities (such as research, development, testing, product or process improvement)?

- Yes
 No
 Does not apply – this is the company's sole establishment

B3. Are innovations resulting from activities external to your company (for example, universities, other companies, national laboratories, etc.) important for this establishment's business operations?

- Yes
 No

Section C: Innovation Activities and Energy

C1. Did you answer at least one "yes" in BOTH section A and B?

- Yes
 No → [Skip to Section D](#)

C2. Are any of the innovation activities you reported in Section B related to the energy activities reported in Section A?

- Yes
 No

A3. Of the amount you reported above, please estimate what percentage was devoted to each of the following types of innovation activities:

	Percentage
a. Improving our own energy resources or services (such extraction, refining, generating, or delivery)	_____ %
b. Improving energy equipment or components that we design or manufacture – that is, equipment or components for providing energy services or for managing energy resources	_____ %
c. Improving equipment or practices in order to reduce our own energy use	_____ %
d. Improving or developing products that we design or manufacture in order to reduce customers' energy use	_____ %
e. Technical or R&D services for customers that provide energy resources, services, equipment, or components, or that seek to reduce the energy consumption of their products	_____ %
f. Technical or consulting services for customers that use significant amounts of energy, to help them reduce or better manage their energy use	_____ %
g. Innovation activities NOT related to energy	_____ %
TOTAL	<u>100%</u>

A4. Considering all of your establishment's energy-related innovation activities (indicated in items a-f in question A2 above) during 2009, approximately what percentage of the funding for these activities came from each of the following sources:

	Percentage
a. Your own company?	_____ %
b. Other companies?	_____ %
c. Non-profit foundation grants or contracts?	_____ %
d. Federal government grants or contracts?	_____ %
e. State/local government grants or contracts?	_____ %
f. Other sources? (please specify) _____	_____ %
TOTAL	<u>100%</u>

A5. For the energy-related Innovation activity conducted, funded, or directed by your establishment during 2009, approximately what percentage was conducted at each of the following:

	Percentage
a. Your own establishment?	_____ %
b. Other establishments in your company?	_____ %
c. Other companies within the U.S.?	_____ %
d. Other companies outside the U.S.?	_____ %
e. Academic, cooperative, or non-profit research facilities	_____ %
f. Government research facilities	_____ %
TOTAL	<u>100%</u>

A6. For each category below, please indicate whether or not it describes any of the energy-related Innovation activity conducted, funded, or directed by your establishment during 2009:

	Yes	No
a. Basic or applied research	<input type="checkbox"/>	<input type="checkbox"/>
b. Technology development	<input type="checkbox"/>	<input type="checkbox"/>
c. Pilots or field demonstrations	<input type="checkbox"/>	<input type="checkbox"/>
d. Initial commercial-scale activities	<input type="checkbox"/>	<input type="checkbox"/>
e. Product design/Improvement	<input type="checkbox"/>	<input type="checkbox"/>
f. Process design/Improvement	<input type="checkbox"/>	<input type="checkbox"/>
g. Technology search or evaluation	<input type="checkbox"/>	<input type="checkbox"/>
h. Intellectual property management	<input type="checkbox"/>	<input type="checkbox"/>

Procedure

- Paper /mail only
- Letter, survey, reminders
- Follow-up if energy related innovation
- Phone version for response bias test
- Weights adjusted for response rate
- Error estimated with multi-factor jackknife method (JKn)