U.S. Government Funding of Clean Energy Technologies: The Case of ARPA-E

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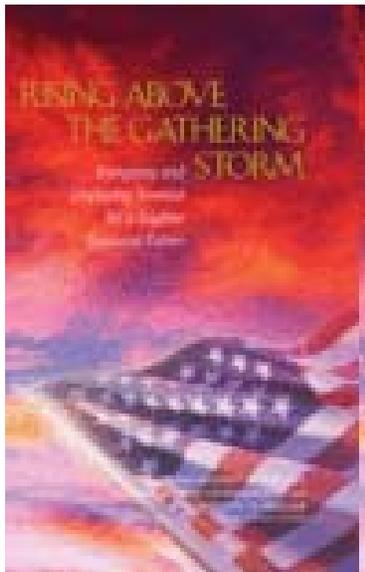### Acting Chief Counsel
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Rising Above the Gathering Storm, 2006 (National Academies)

- Establish an Advanced Research Projects Agency for Energy (ARPA-E)
- "Creative, out-of-the-box, transformational" energy research
- Spinoff Benefit – Help educate next generation of researchers

Background on ARPA-E

America COMPETES Act, 2007

- Authorizes the establishment of ARPA-E with a clear mission and means to achieve it.

American Recovery and Reinvestment Act of 2009 (Recovery Act)

- $400M provided for ARPA-E
- President Obama launches ARPA-E in a speech at National Academy of Sciences on April 27, 2009

Mission and Means

Mission:

- To "enhance the economic and energy security of the US" through:
    - "Reduction in energy imports"
    - "Improvement in energy efficiency"
    - "Reduction in energy-related emissions, including greenhouse gasses"

- To "ensure" US "technological lead in developing and deploying advanced energy technologies"

ARPA-E Competitive Awards

First Funding Opportunity

- Open to all ideas, best well formulated high impact projects across all energy technologies

- Utilize concept papers as first phase before selecting best for full proposals

- 37 projects selected for funding out of nearly 3,700 concepts received, processed, and reviewed in First Funding Opportunity

Second and Third Rounds of Funding Opportunities

- Solicited proposals on topics with clear needs and some emergent opportunities

- Program-focused approach, building portfolios around specific technology challenges that need more development and input to formulate

- Specific challenges with cost and / or performance metrics

  - BEEST
  - IMPACCT
  - GRIDS
  - ADEPT
  - Electrofuels
  - BEETIT

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ARPA-E's Focus

ARPA-E funds energy technology projects that (1) translate scientific discoveries and cutting-edge inventions into technological innovations and (2) accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of high technical or financial risk.

The Stages of Technology Development

Discovery / Basic Science	Technology Translation	Technical Prototyping	Commercial Viability Demonstration	Productization: Manufacturing & Deployment
Basic Research & Scientific Exploration	Continual Improvement	Technical Prototype	Early Product Development / Proof of Commercial Viability	Development Taking Product to Market
	(Evolutionary Innovation)			
	Transformational Improvement	Technical Prototype		
	(Revolutionary Innovation)			
	ARPA-E			

ARPA-E Technology Selection

Innovative Technical Approach

- Focused on high risk/high reward R&D

- Seeking new approaches that establish new learning curves, rather than advance along existing learning curves

- Identifying new areas of research not covered by existing Government R&D programs ("white space")

Under-served by private sector investment

- Very high technical risk (and reward)

- Very high market risk

Best-in-class people and teams

- Strong preference for teams/consortia comprised of leaders in different scientific fields and technology areas

- Strong interest in bringing new researchers to energy research

Entities Funded by ARPA-E

Large Businesses
19%

Other Non-Profit
3%

Small Businesses
43%

Educational Institutions
35%
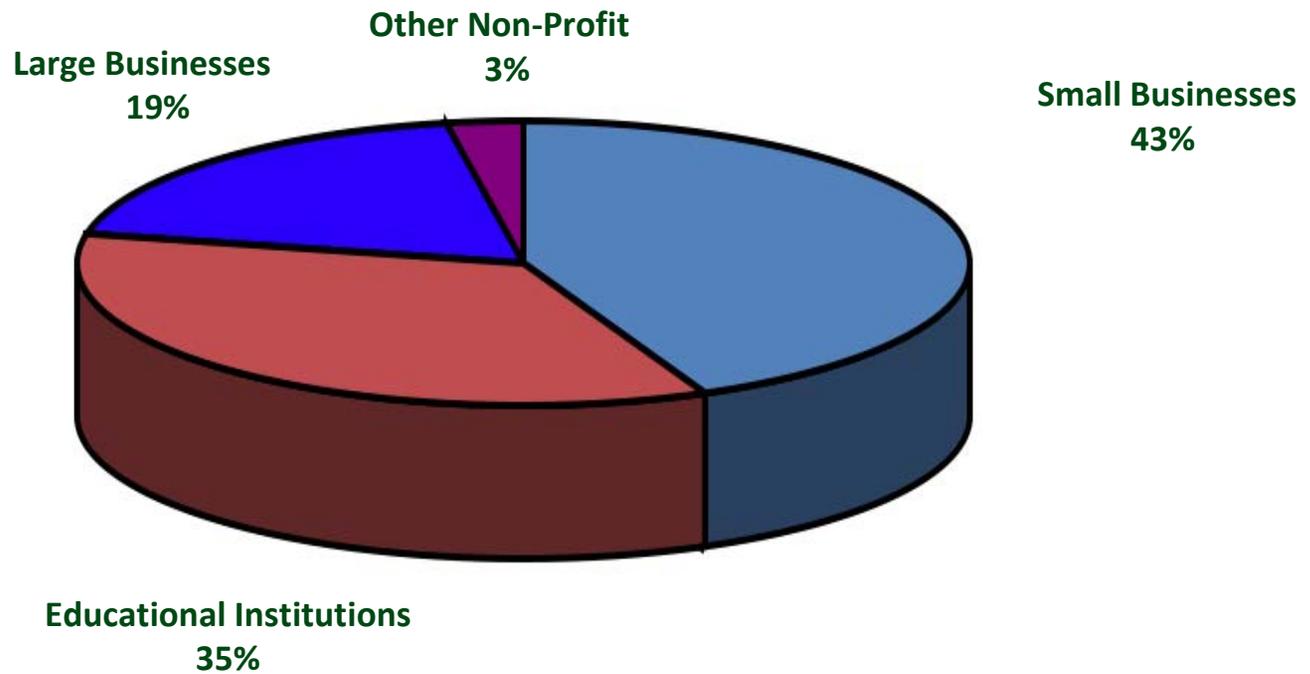
Location of ARPA-E Recipients

ARPA-E Program Management is Active and Flexible

The selected teams don't just get ARPA-E funding, they will get full coordinated support and scrutiny from ARPA-E team.

- Operations Team (legal and Procurement) <u>expedites transactions</u>
- Program Team (Program Directors) <u>provides technical help</u> and <u>monitor technical progress</u>
- Outreach Team (Public Affairs and Legislative Affairs) <u>highlights progress</u> to public, media, Congress.
- Commercialization Team provides <u>feedback and links to/from potential adopters</u>

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Regular Site Visits, Meetings, and Conference Calls

- ARPA-E is substantially involved in Recipients' work.

- ARPA-E Program Directors:
  - Visit each Recipient at least twice per year
  - Hold periodic meetings, conference calls, and webinars with Recipients
  - May modify or terminate projects that fail to achieve the requisite milestones and deliverables

- ARPA-E's Goal: To learn about Recipients' technical progress and engage in a constructive dialogue about technical and other issues they may be facing.

Commercialization

ARPA-E's Commercialization Team:

- Works with Recipients to deploy ARPA-E-funded technologies
- Establishes partnerships with industry, inventors, and others to provide continued support for the development and deployment of ARPA-E-funded technologies
- Conducts seminars, workshops, and similar events to educate Recipients on key issues relating to deployment of their technologies
- Assists Recipients to overcome non-technical barriers to further development and deployment of their technologies
- Works with non-profits and other Government agencies to provide mentoring and networking opportunities for ARPA-E Recipients

Cooperative Agreements

- Cooperative Agreements are ARPA-E's primary instrument to provide financial support to Recipients.

- Cooperative Agreements differ from Grants, as follows:
  - substantial agency involvement vs. minimal agency involvement
  - active, hands-on supervision throughout project vs. hands-off approach

- Under a Cooperative Agreement, the Government and Recipients share responsibility for the management, control, direction, and performance of the project.