Advanced Research Projects Agency – Energy (ARPA-E)

Program Overview

January 27, 2010
Three Sputniks of our Generation

- Energy Independence & Security
- Greenhouse Gas Emissions & Climate Change
- US Technological Lead
We are falling behind in the clean energy race

Photovoltaics

Worldwide shipments of Solar Photovoltaics – in Megawatts

Source: PV News, April 2009
(revised: 09-2009)
Imagine all of this happening in a span of 10-20 years...

That is what we need now to address the biggest challenge of our lifetimes...

Identify and support today’s Haber, Bosch, Borlaug, Bardeen, Shockley, Brattain, Salk, Wright brothers, Kilby, Noyce, Gates, Jobs, Page, Brin of the energy field
Background on ARPA-E

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
- Secretary Chu (then Director of Berkeley National lab) on committee

America COMPETES Act, 2007

- Authorizes the establishment of ARPA-E

American Recovery and Reinvestment Act of 2009 (Recovery Act)

- $400M provided for ARPA-E
- President Obama launches ARPA-E in a speech at NAS on April 27, 2009
Energy Innovation Pipeline

ARPA-E

Existing Programs
Office of SC (5B)

Applied Programs (4B)

Loan Guarantees ($128B)

Basic Science

Applied Science

Prototype/Demos

Asset Investors

Tech Gap

Tech Gap

Commercialization Gaps

ARPA-E

Markets

What ARPA-E will do
- Disruptive transformational projects
- High risk, high potential programs
- Projects in need of rapid and flexible experimentation/engineering
- Marry technical opportunities with mission gaps
- Breakthrough science that can transform a field
- Outcome focused: to meet climate & energy security objectives; not on a particular scientific problem
- Technology development

What ARPA-E will not do
- Basic Research
- Lowest Technology Readiness Levels project
- Projects longer than 5 years
- Evolutionary improvements
- Large scale commercial viability demos
Report on First Funding Opportunity Announcement
ARPA-E has moved on from an extensive review process to an aggressive award schedule

**FOA 1 Overview**

- **Concept Paper Phase**
  - Received 3682
  - Encouraged Full Applications
  - April - June 2009

- **Full Application Phase**
  - Panel Reviews
  - June - July 2009

- **Final Selection**
  - 37 Projects (avg. $4M) (2-3 years)
  - Announced on October 26

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**Award Negotiation**

- Between October 26th and January 15th, ARPA-E completed negotiations totaling:
  - 35 out of 37 (95%) of award agreements signed
  - $134 M out of $151 M (89%) total FOA 1 funding awarded

- All negotiations will be completed by January 31, including three TIA (Other Transactions)
- ARPA-E has cut 60% off the average DOE procurement cycle time, defining a new benchmark for program performance
Summary of Applications Funded

Application Distribution by Topical Panel
- Bio 22%
- Vehicles 19%
- Solar 8%
- Efficiency 22%
- Conventional 16%
- Grid 14%

Lead Organization Type for Selected Projects
- Large Businesses 19%
- Educational Institutions 35%
- Small Businesses 43%
- Other Non-Profit 3%

National Lab Participation
- 6 Applications with National Lab Team Members 19%
- 31 Applications without National Lab Team Members 81%

College & University Participation
- 21 Applications with College & Universities Team Members 57%
- Other 43%
**High Amperage Energy Storage Device:**

**Energy Storage for the Neighborhood – MIT**

**Proposed Technology vs. State of the Art**

A new approach: Liquid Metal Battery (LMB)

More energy than Li-ion, cheaper than Lead-Acid

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**Agrivida**

GreenGenes™ Technology

Trigger biomass breakdown using plants’ own genes

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**Breakthrough High Efficiency**

**Mixer/Ejector Wind Turbine (MEWT) – FloDesign Wind Turbine Corp.**

**Proposed Technology vs. State of the Art**

- Mimic jet engines, not propellers for wind turbine
- 40% lower cost expected vs. horizontal axis wind turbines (HAWT)

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**CO₂ Capture using a Synthetic Analogue of Carbonic Anhydrase - UTC**

Mimic biology for carbon capture
Funding Opportunity Announcement 2

Announced Dec. 7th, Closed Jan. 15th
Innovative Materials and Processes for Advanced Carbon Capture Technologies (IMPACCT)

Today: CO$_2$ + Amines OR (Bi)Carbonates → Bind, Isolate & Release → $70-100/tCO_2$

ARPA-E High-Risk/High-Reward: CO$_2$ + New Material → Potentially much lower than $70/tCO_2$

RFI + ARPA-E Workshop on Oct 29th
Batteries for Electrical Energy Storage for Transportation (BEEST)

RFI+ ARPA-E Workshop on Next Gen. Batteries, Nov 3rd

Energy Density (Wh/kg)

- Office of Vehicles/BATT Investment
- Novel Architectures/Manufacturing Processes
- Practical Value for Engines

Japanese govt investing $60M/yr
Electrofuels

CO₂
3. Greenhouse gas emissions

H₂
2. Difficult to store

Electricity
1. Difficult to store

RFI + ARPA-E Workshop on Direct Solar-to-Fuel, Oct 21

Gasoline
4. 60% imported
ARPA-E: Innovations in Process

- **Organization**: Flat, nimble, agile, collaborative, internal debates and discussions

- **Excellence**: Recruit all-star team to ARPA-E; focus on highly selective and potentially game-changing ideas; enable creation and support of the best teams

- **Openness**: Open to best ideas regardless of origin; sharing and partnership with Congress and other stakeholders; public understanding of value of technology for society

- **Integrity**: New program creation and proposal review process

- **Speed**: Streamline transactions; accelerate science to market; respond to community input

- **Metrics of Success**: Quantitative value creation
The funded teams don’t just get ARPA-E $….

They will get full coordinated support and scrutiny from ARPA-E team…..

Program Team will provide technical help and monitor technical progress

Operations Team will expedite transactions within constraints of Congressional statute

Commercialization Team will provide feedback and links to from potential adopters

Outreach Team will highlight progress to media, Congress, Energy Innovation Fair, etc.
Community Building & Outreach

• **ARPA-E Energy Innovation Summit (March 2\textsuperscript{nd} & 3\textsuperscript{rd})**
  – Annual Event in Washington DC
  – Purpose
    • Showcase ARPA-E technology innovations
    • Provide platform for PIs who did not get funded by ARPA-E to other potential investors
    • Engage stakeholders and discuss means to create smooth innovation pipeline

• **ARPA-E Day on the Hill (Day before the Energy Innovation Fair)**
  – Explain our vision/mission and showcase ARPA-E technologies

• **ARPA-E -Venture Capital Day (Annual event)**
  – Identify strategies for leveraging
  – Identify strategies to accelerate scaling of ARPA-E technologies for market impact