



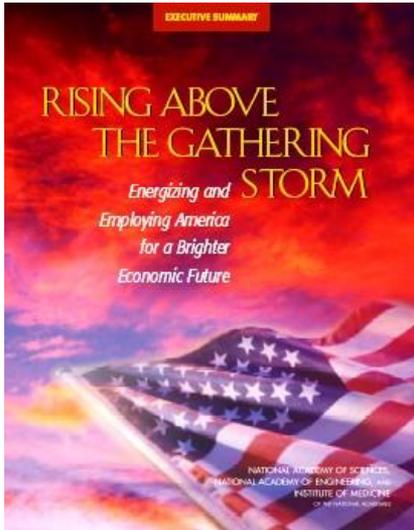
ADVANCED RESEARCH PROJECTS AGENCY (ARPA-E)

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PROGRAM DIRECTOR

2010 NETL CO₂ CAPTURE TECHNOLOGY MEETING
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www.arpa-e.energy.gov

ARPA-E: Applying The ARPA Model To Energy



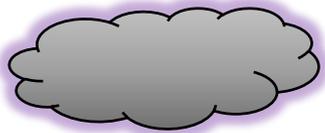
2006 ●
Rising Above the Gathering Storm
(National Academies)

American Recovery and Reinvestment Act of 2009 (Recovery Act)

\$400M appropriated for ARPA-E
President Obama launches ARPA-E
in a speech at NAS on April 27, 2009



2007 ●
America COMPETES Act



ARPA-E's Distinct Culture

- Excellence
- Openness
- Integrity
- Speed
- Metrics Driven
- Flat and Nimble



The ARPA Model: Different By Design



- ARPA-E is modeled after the first Advanced Research Projects Agency (ARPA), now known as DARPA, at the Department of Defense
- DARPA was explicitly chartered to be different, so it could do fundamentally different things than had been done by other military service research and development organizations
 - Did not have labs
 - Did not focus on existing military requirements
 - Separate from any other operational or organizational elements
- Using this model, DARPA has enjoyed 50 years of success

Revolutionary Ideas Developed By DARPA



The Internet



GPS



Stealth Technology

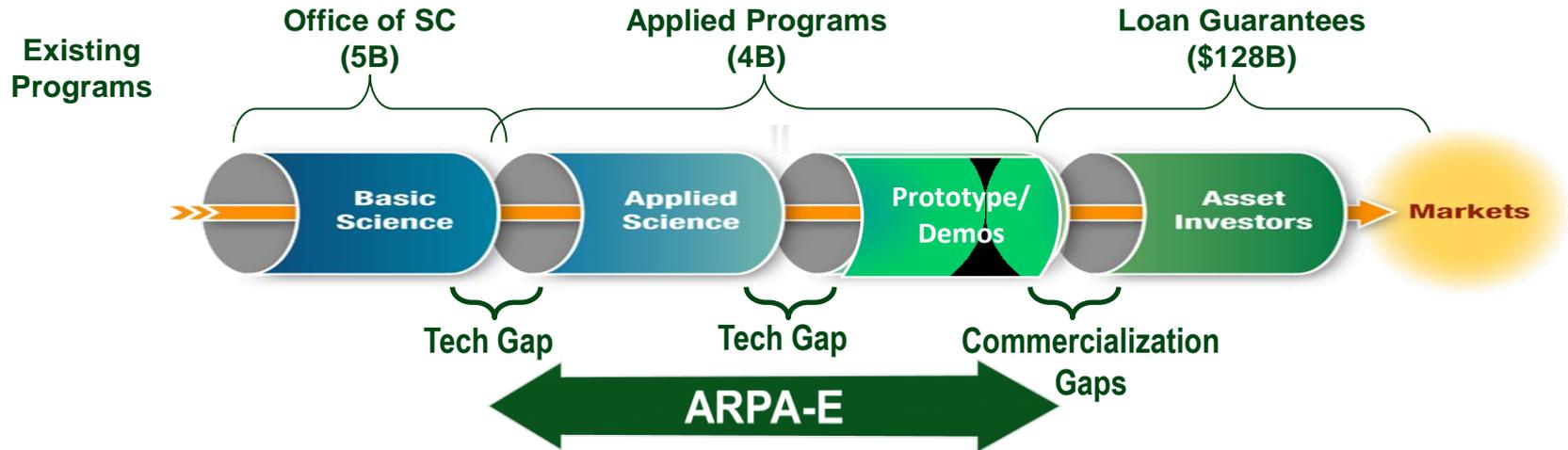


Fulfilling ARPA-E's Mission



- Find and fund high-risk, high-impact projects
- Identify and promote revolutionary advances in fundamental sciences
- Accelerate transformational technologies or create new technologies where none currently exist
- Translate scientific discoveries and cutting-edge inventions into technological innovations
- Bridge gaps in the energy innovation pipeline

ARPA-E was created with a vision to bridge gaps in the energy innovation pipeline



what ARPA-E will do

- Seek high impact science and engineering projects
- Invest in the best ideas and teams
- Will tolerate and manage high technical risk
- Accelerate translation from science to markets
- Proof of concept and prototyping

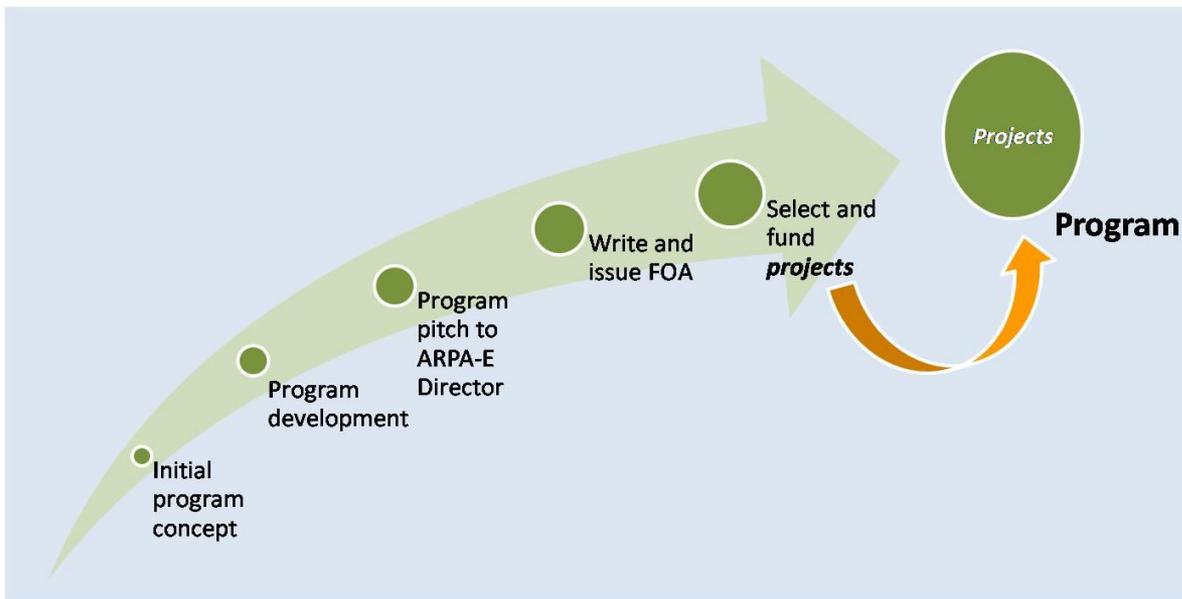
what ARPA-E NOT will do

- Incremental improvements
- Basic research
- Long term projects or block grants
- Large-scale demonstration projects

Program And Project Selection



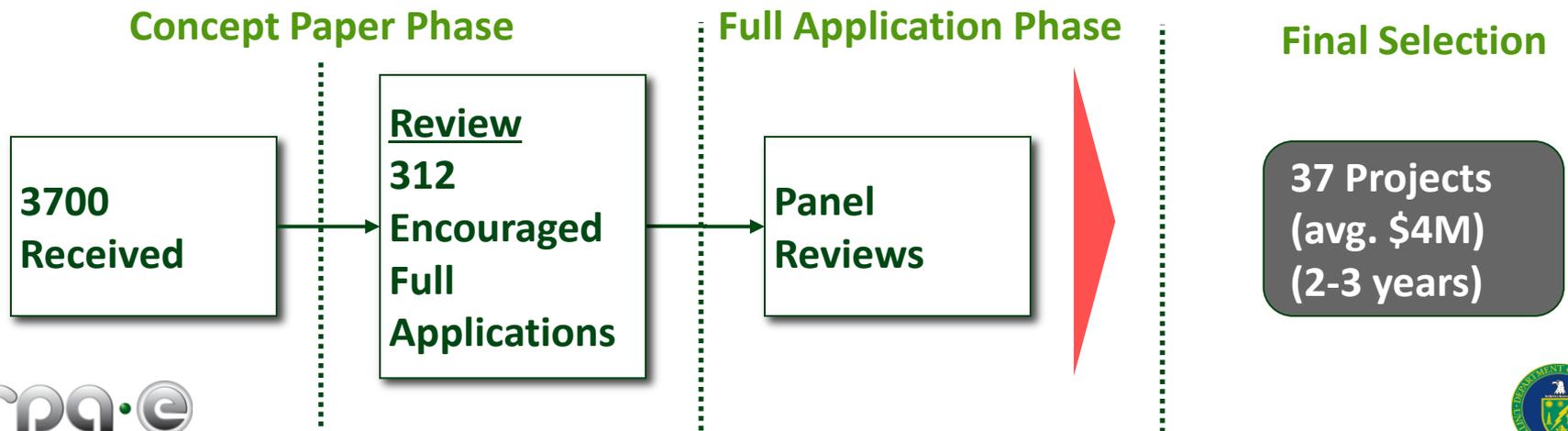
- ARPA-E itself does not have labs or perform research; instead, it funds work conducted by universities, startups, established firms, and others
- ARPA-E solicits projects to fund by issuing a competitive funding opportunity announcement (FOA) for each future program area



FOA Round 1



- **ARPA-E's First Funding Opportunity**
 - Announced April 2009, Selections Oct 2009
 - 3,700 proposals to 37 project selections (\$151M)
- As ARPA-E's inaugural program, this funding opportunity was open to all energy ideas and technologies, but focused on applicants who already had well-formed research and development plans for potentially high-impact concepts or new technologies



FOA-1 Projects Span 10 Areas



Energy Storage 6 projects



Biomass Energy 5 projects



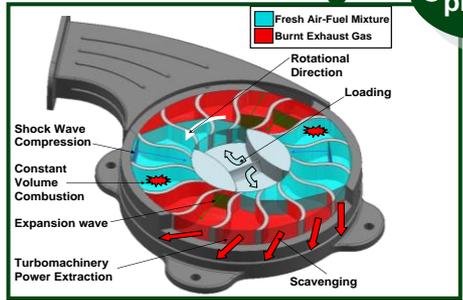
Carbon Capture 5 projects



Solar Fuels 5 projects



Vehicle Technologies 5 projects



Renewable Power 4 projects



Building Efficiency 3 projects



Waste Heat Capture 2 projects



Conventional Energy 1 project



Water 1 project



FOA-2: Funding for 3 Program Areas



Batteries for Electrical Energy Storage in Transportation (BEEST)



10 projects

Electrofuels



13 projects

Innovative Materials & Processes for Advanced Carbon Capture Technologies (IMPAACT)



15 projects

Developing a new generation of energy-dense, low-cost battery technologies for plug-in and hybrid electric vehicles

Could give electric vehicles the range, performance, lifetime, and cost required to shift transportation energy from oil to the U.S. electric grid

Exploring using microorganisms to harness energy and convert carbon dioxide into liquid fuels

Theoretically, this could be 10 times more efficient than current approaches

Revolutionizing technologies that prevent carbon dioxide produced by coal-fired power plants from entering the atmosphere

Could dramatically reduce the amount of carbon dioxide emissions that contribute to global warming

FOA-3: Funding for 3 Program Areas



Agile Delivery of Electrical Power Technology (ADEPT)



14 projects

Building Energy Efficiency Through Innovative Thermodevices (BEETIT)



17 projects

Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS)



12 projects

Exploring materials that will increase performance and lower costs of computers and other electronics

Could reduce energy consumption by up to 30 percent – or 12 percent of total U.S. energy consumption

Developing efficient air conditioners and building-cooling technologies that use less energy and release less greenhouse gases

Could reduce emissions and significantly increase the U.S. technological lead in rapidly emerging clean energy industries

Developing affordable, large-scale energy storage that enables the widespread use of two key renewable energy sources: wind and solar power

These technologies will position the U.S. to lead the technology and manufacturing of stationary electricity storage infrastructure in the emerging global market

Attributes Of ARPA-E Projects



High Impact on ARPA-E Mission Areas –

- Reduction in energy imports
- Improvement in energy efficiency
- Reduction in energy-related emissions, including greenhouse gases
- To “ensure” U.S. “technological lead in developing and deploying advanced energy technologies

Disruptive, Innovative Technical Approach –

- ARPA-E is focused on high risk/high reward R&D
- Interested in –
 - New technical approaches that move to entirely new learning curves
 - Fundamentally new areas of research with uncharted white space

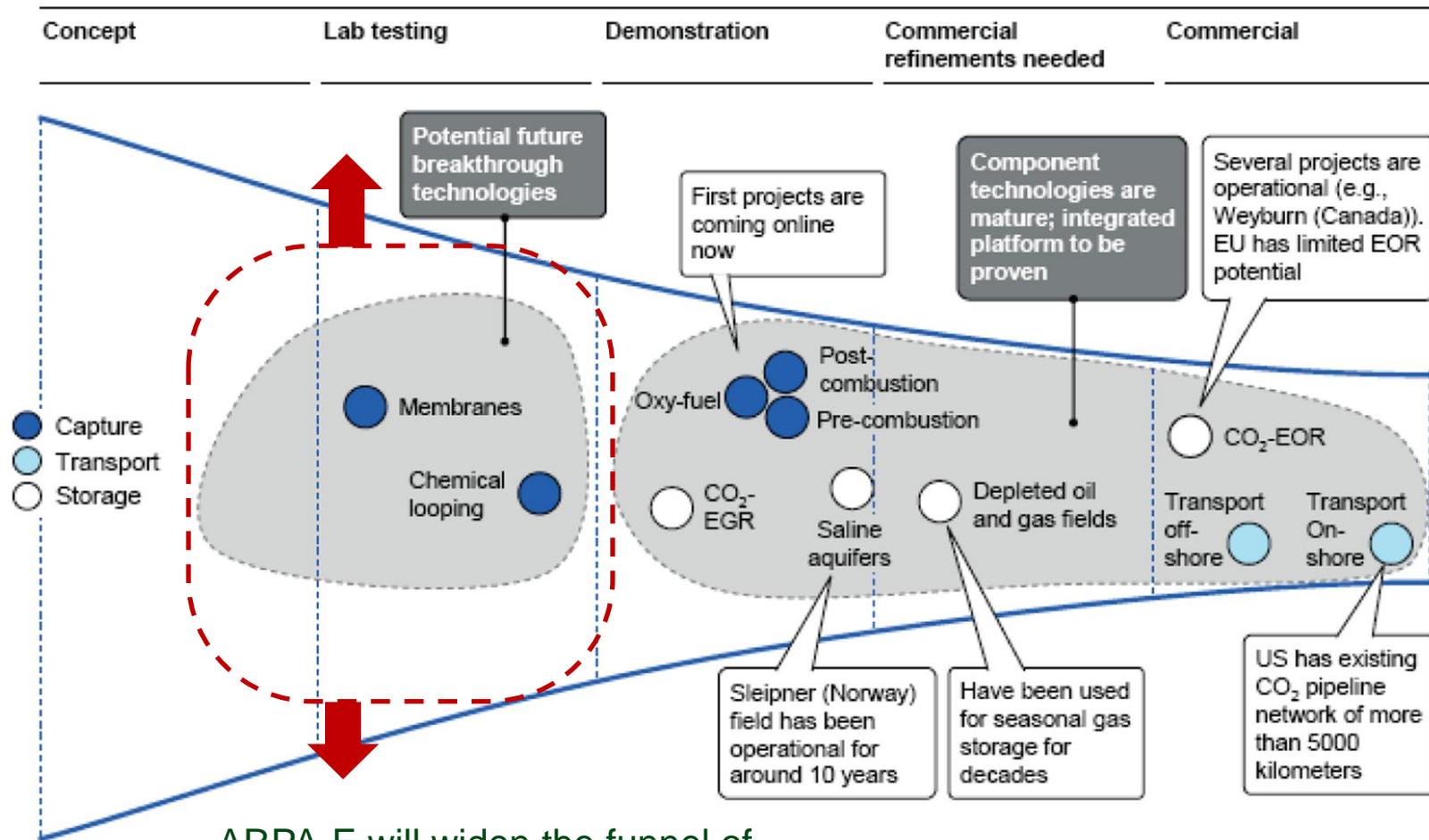
Best-in-class People & Teams

- Complementary, cross-discipline skill sets
- Strong interest to bring in new, talented scientists and engineers to energy technology research
- Break down barriers between science and engineering

Strong Impact of ARPA-E Funding Relative to Private Sector –

- Invest in areas too risky for the private sector
- ARPA-E investments de-risk technologies and catalyze follow-on private sector investments

CCS Technology Maturity can be Visualized as a Pipeline



ARPA-E will widen the funnel of promising concepts and accelerate towards demonstration and commercialization

Source: McKinsey & Company

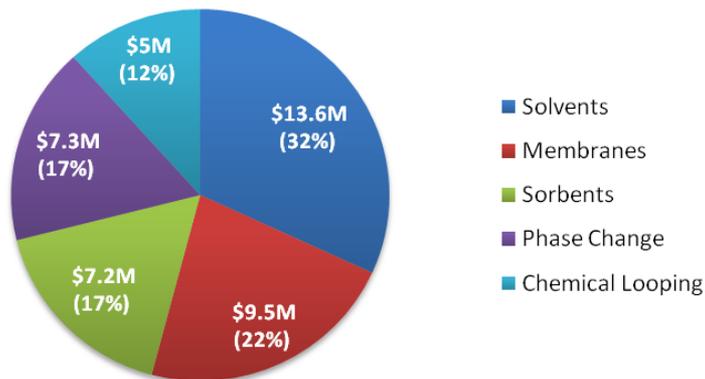
ARPA-E's Carbon Capture Projects

\$42.7M of funding

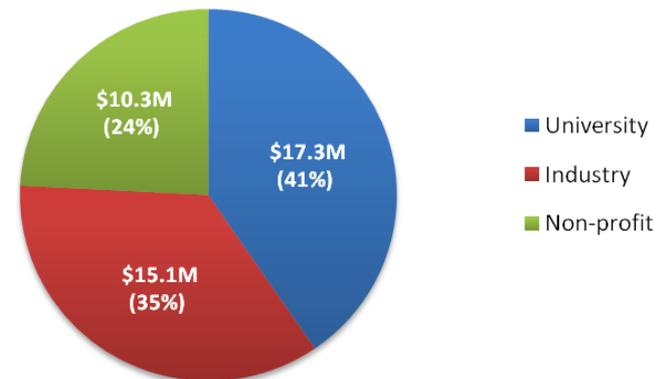


	Solvent	Membranes	Sorbents	Phase Change	Chemical Looping
University	Columbia	Univ. Colorado, Georgia Tech, Univ. Kentucky	Texas A&M, MIT, Lehigh Univ.	Notre Dame	Ohio State
Industry	Codexis, Nalco	UTRC, Porifera		GE, Sustainable Energy Solutions, ATK	
National Labs / Non-Profits	LLNL, RTI		LBL, ORNL		

ARPA-E Funding by Category



ARPA-E Funding by Entity



Technology Pipeline and Program Coordination



Basic Research

Applied Research

Development

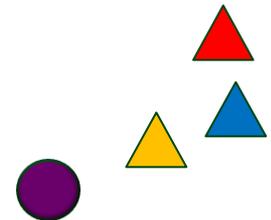
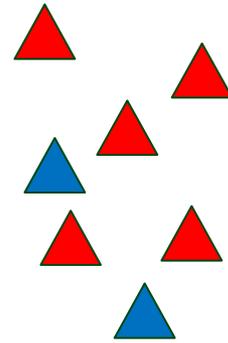
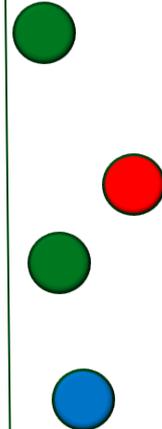
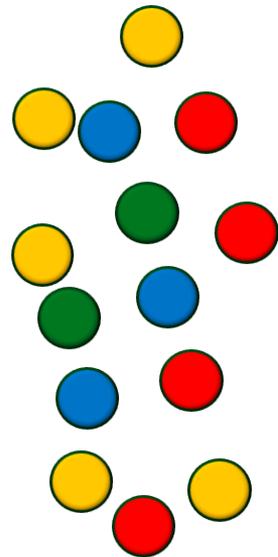
Pilot/Demonstration

BES ☆

ARPA-E FOAs ○

NETL FOA Bench-Scale △

NETL FOA Slipstream △



● Solvents

● Membranes

● Sorbents

● Chemical Looping

● Phase-Change

Poster Session to follow:



- 20 Performer Teams from FOA 1 and FOA 2 on CCS
- Each Performer will give a 1 slide / 2 minute presentation over the next 40 minutes
 - Legal disclaimer....
- Posters are next door in the refreshment area and will be attended for the discussion session.
- Interaction is the goal of this meeting!

Questions??



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