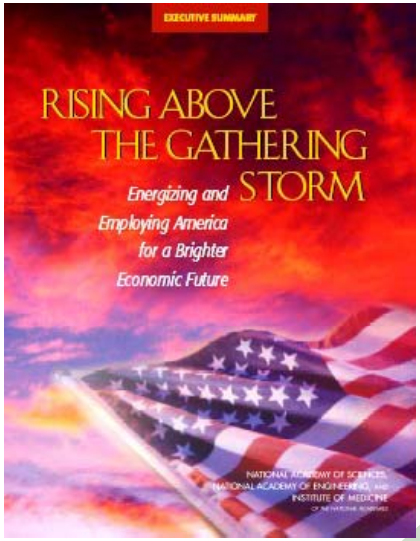
ARPA-E: A New Paradigm in Energy Research

www.arpa-e.energy.gov

ARPA-E: APPLYING THE ARPA MODEL TO ENERGY



2006
Rising Above the Gathering Storm
(National Academies)

2007
America COMPETES Act

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

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

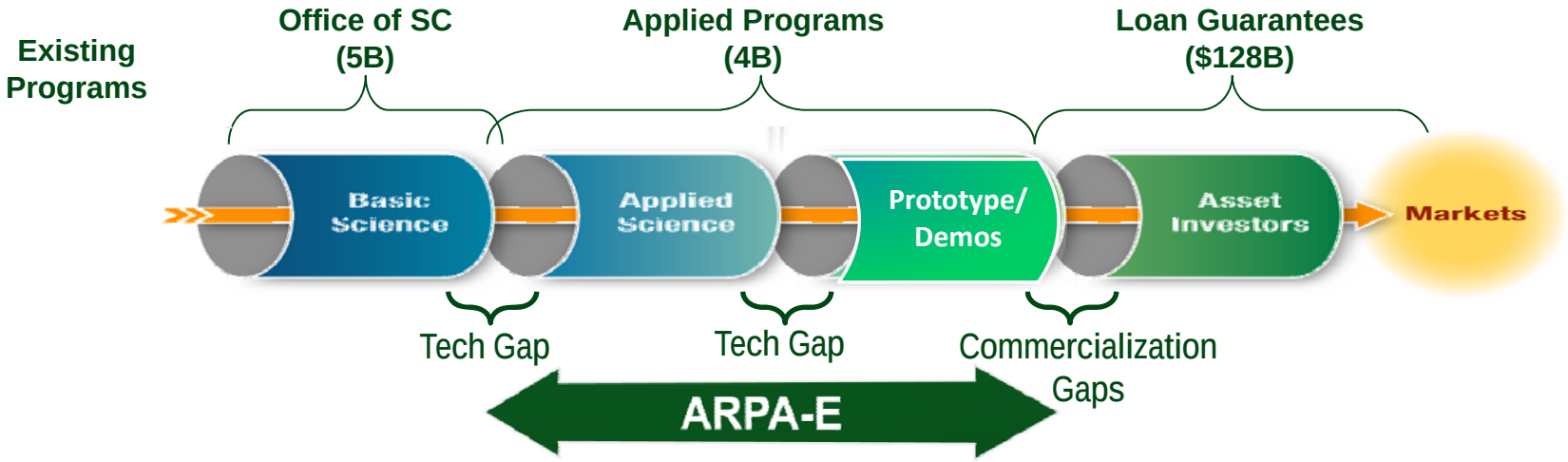
Stealth Technology

arpa·e

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

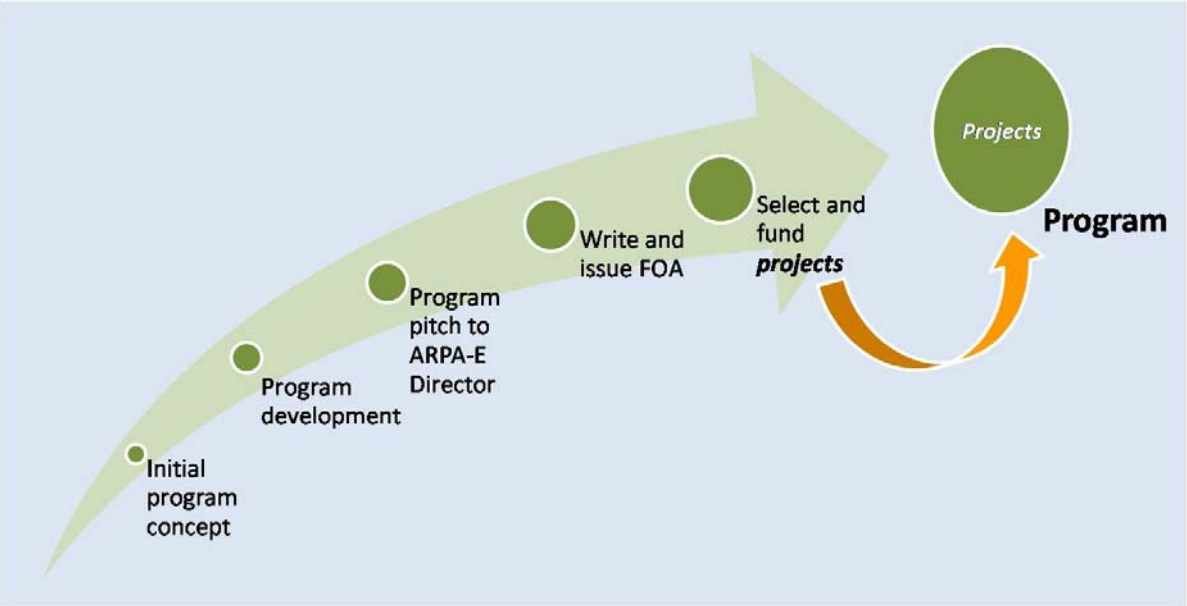
what ARPA-E *NOT* will do

- 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



Innovation Pace And Scale Needed In Energy Technologies…

20TH CENTURY GAME-CHANGERS

100 years

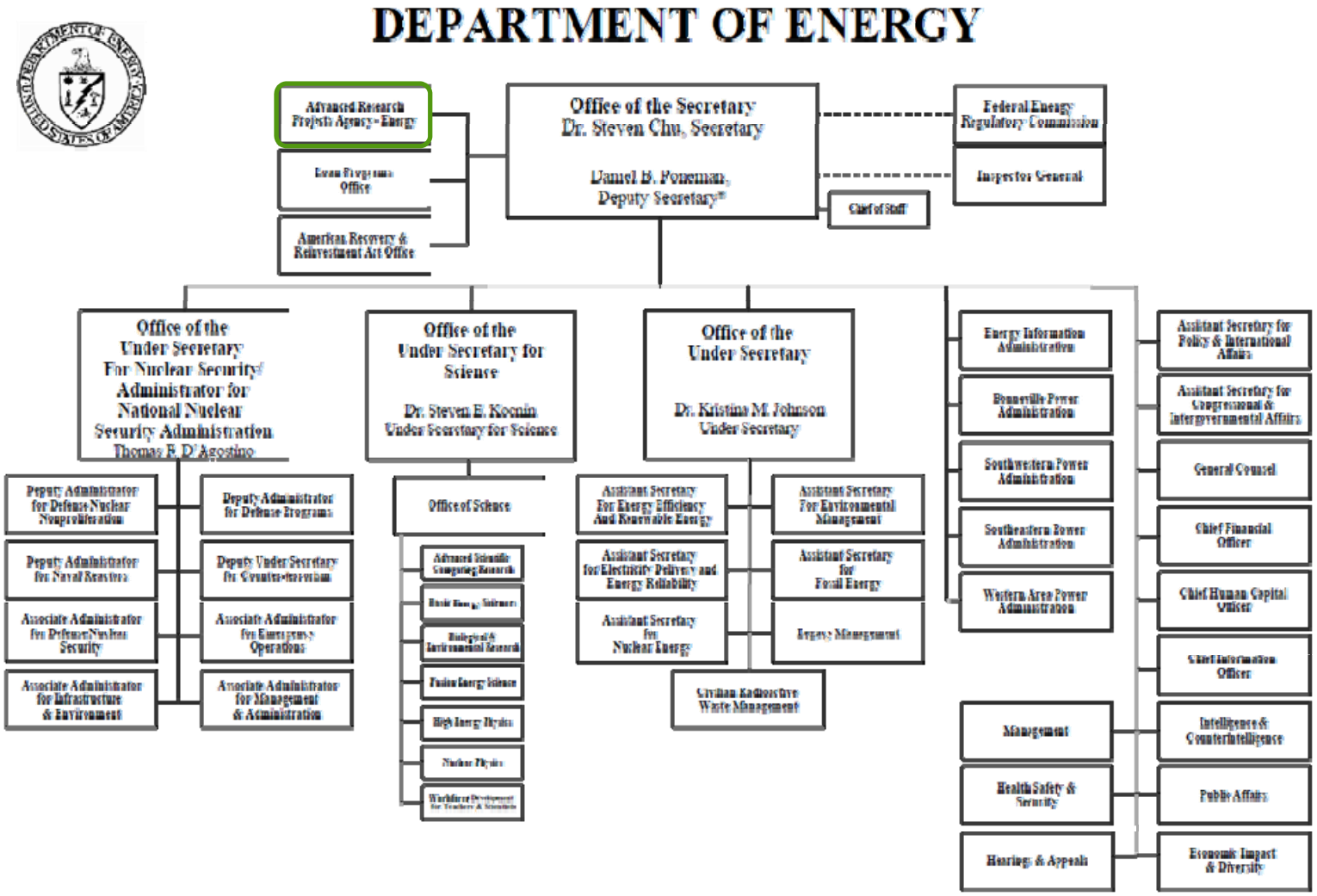
- Artificial Fertilizers
- Green Revolution
- Transistor
- Airplanes
- Electrification
- Polio Vaccination
- Antibiotics
- Nuclear Energy
- Integrated Circuits
- Fiber Optic Communication
- Wireless Communication
- Internet

20 years

Imagine all of this happening in the next 20 years…

Identify and support today's Haber, Bosch, Borlaug, Bardeen, Shockley, Brattain, Salk, Wright brothers, Kilby, Noyce, Gates, Jobs, Page, Brin of the energy field

ARPA-E's director reports directly to the Secretary of Energy



* The Deputy Secretary also serves as the Chief Operating Officer

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What is an ARPA-E Project?

High impact on ARPA-E mission areas

Disruptive, innovative technical approaches & new learning curves

- Best-in-class people & teams containing scientists and engineers;
- Attract the US intellectual horsepower to energy R&D

Strong impact of ARPA-E funding relative to private sector

ARPA-E PROGRAMS

FOA1

Electrofuels

BEEST

IMPACCT

ADEPT

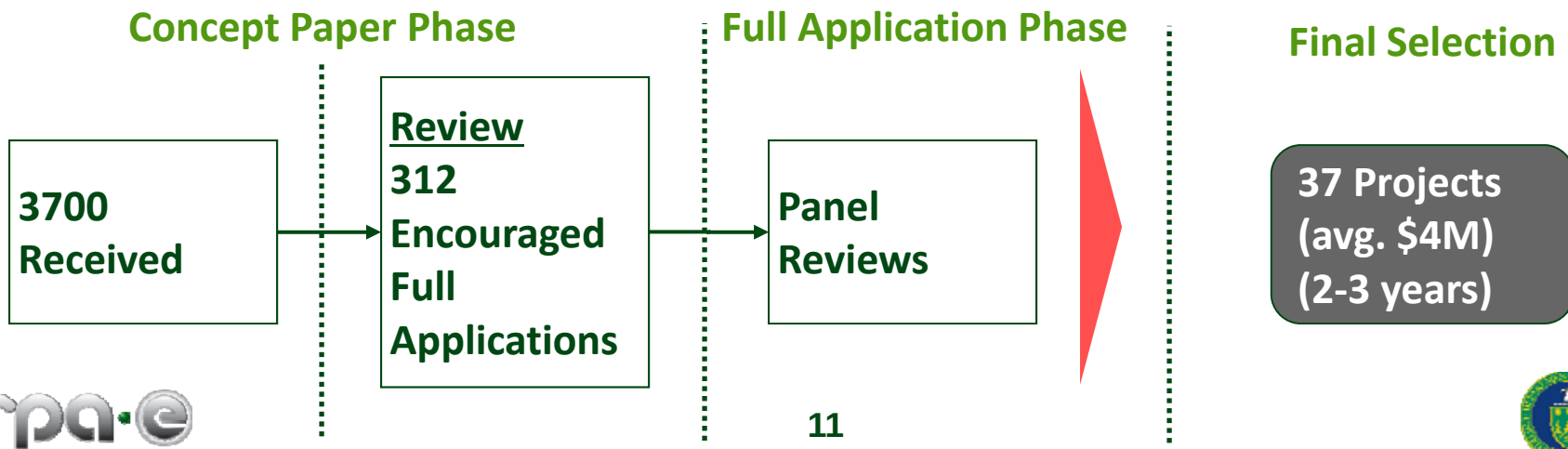
BEETIT

GRIDS

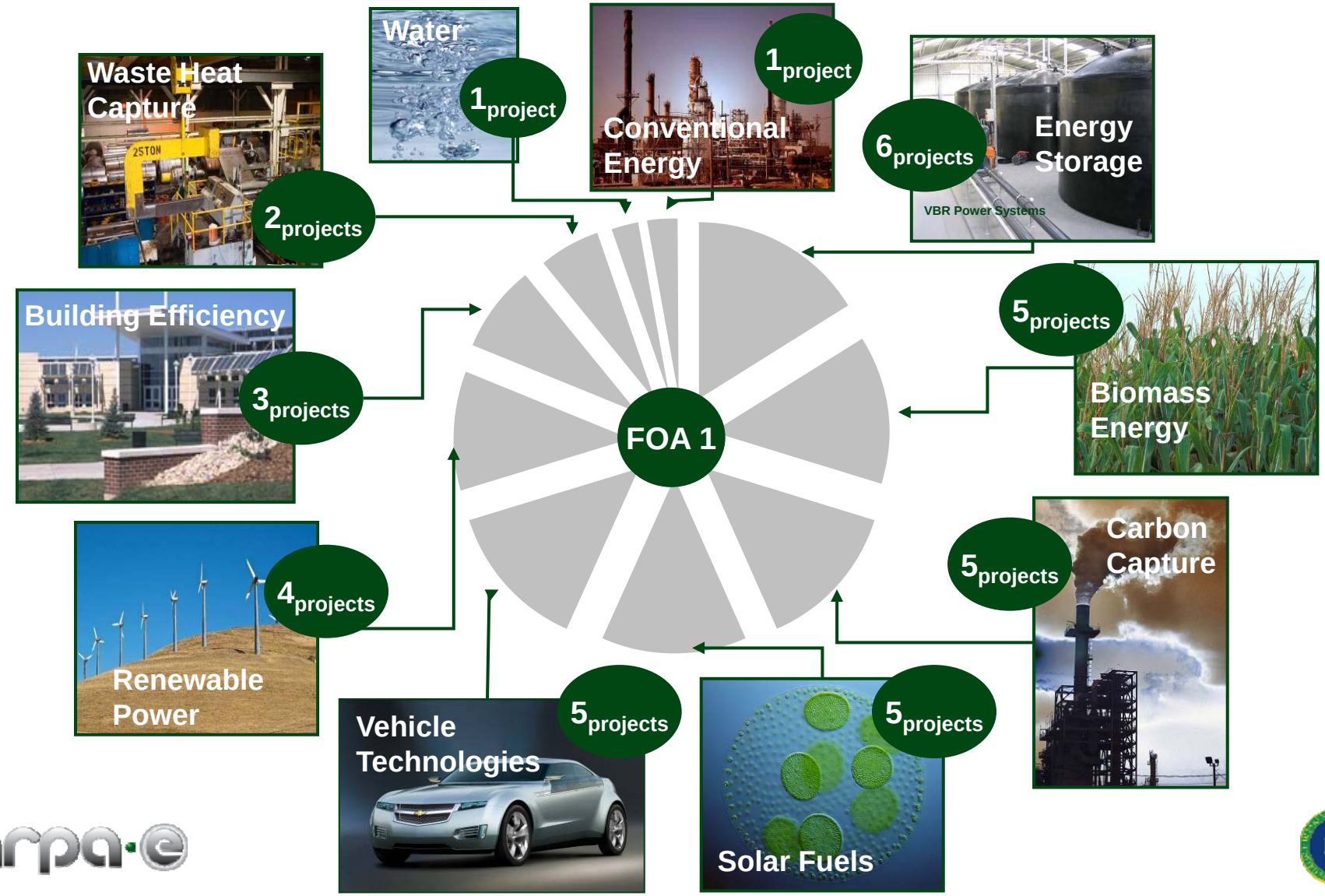
FOA ROUND 1

- ARPA-E's First Funding Opportunity
  - Announced April 2009, Selections Oct 2009
  - 3,700 proposals to 37 project selections ($151M)

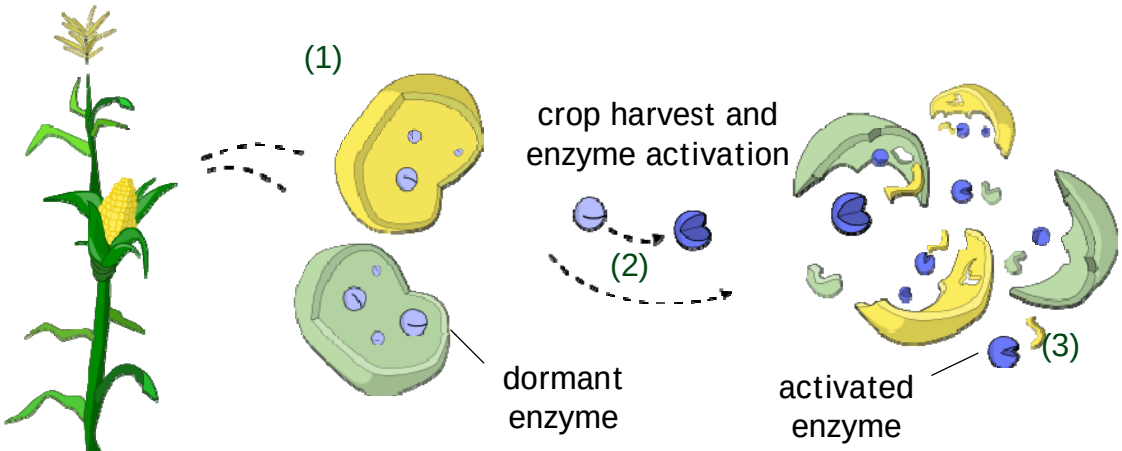
- As ARPA-E's inaugural program, this funding opportunity was open to all energy ideas and technologies, but focused on applicants who already had well-formed research and development plans for potentially high-impact concepts or new technologies



ARPA-E FOA 1 projects can be categorized into one of ten energy technology areas

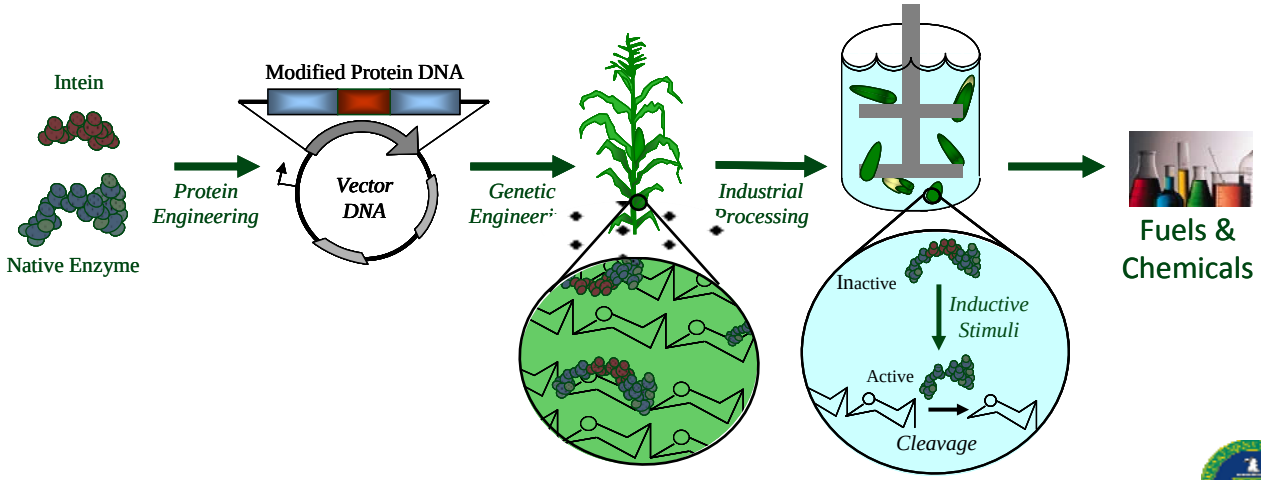


Agrivida is developing intein-modified pro-enzymes which can be conditionally activated within plant biomass



1. Agrivida™ crops produce dormant enzymes within the plant.
2. The dormant enzymes are activated after harvest.
3. The activated enzymes degrade the cell wall.

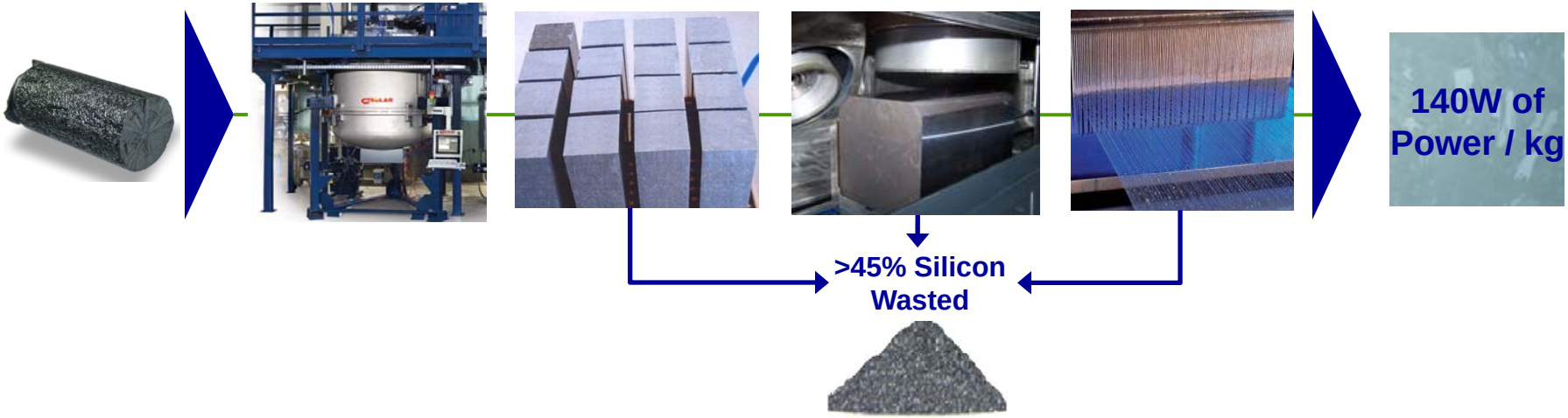
Molecular biology discovery platform



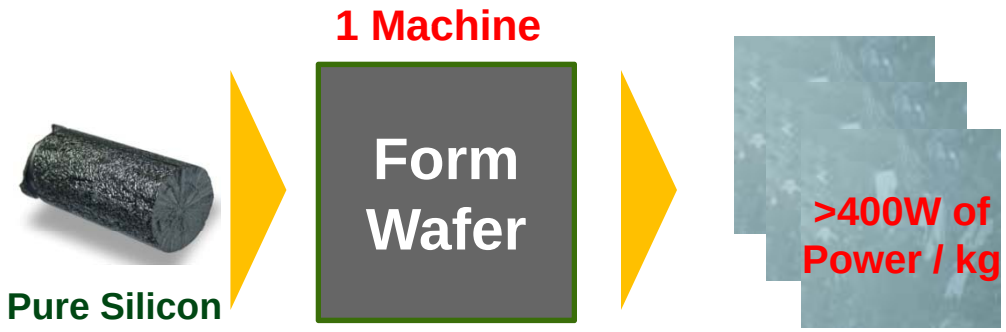
1366: Solar at the cost of coal

Old Process

1. Cast Ingot
2. Cut Brick
3. Grind & Polish Brick
4. Saw Wafers



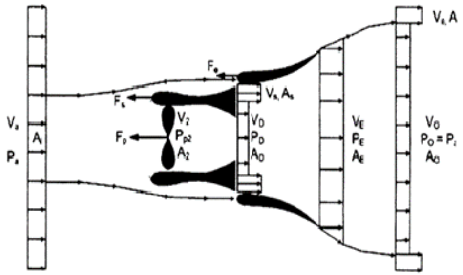
1366 Direct Wafer



Non-conventional Wind Power Generation Projects

Mixer/Ejector Wind Turbine

PI: Robert Dold; ARPA-E funding: $8.3M

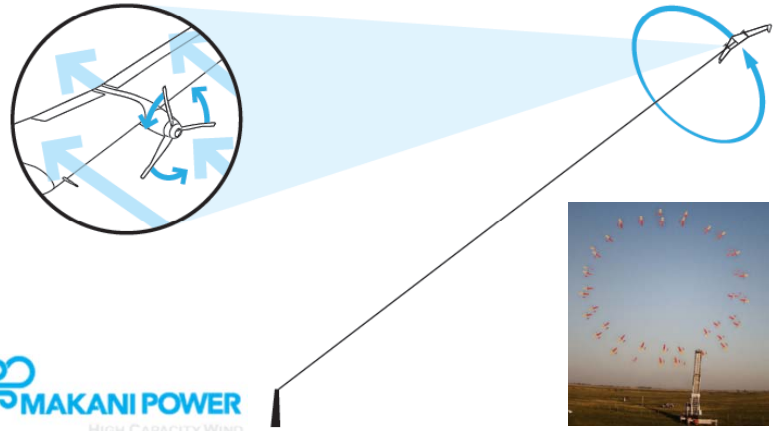


FloDesign Wind Turbine
there's change in the wind

Power output is 3x that predicted by the Betz Limit

Airborne Wind Turbine

PI: Corwin Hardham; ARPA-E funding: $3M



MAKANI POWER
HIGH CAPACITY WIND

Capacity Factor is 2x that of conventional HAWTs, at same wind speed

Potential Areas for coordination

- Field testing
- Drive train testing
- Modeling (onshore and offshore)
- Utility grid integration

National Wind Technology Center (NREL) as well as EERE

ARPA-E PROGRAMS

FOA1

Electrofuels

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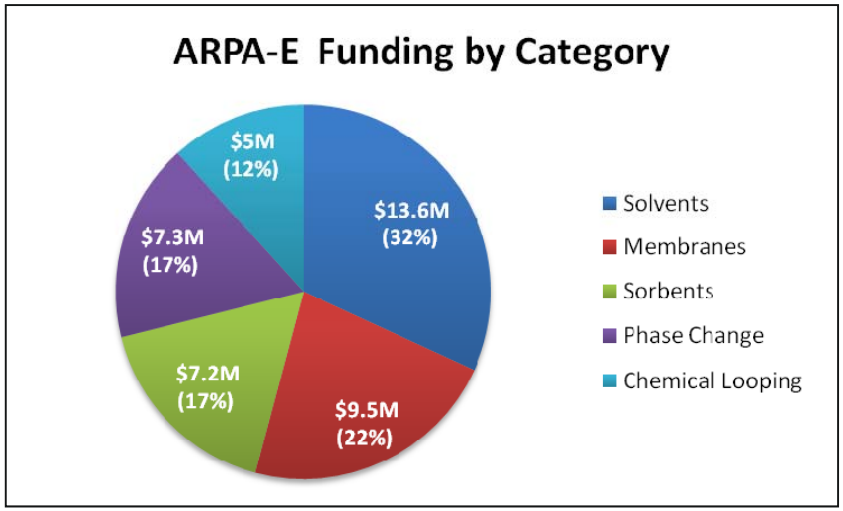
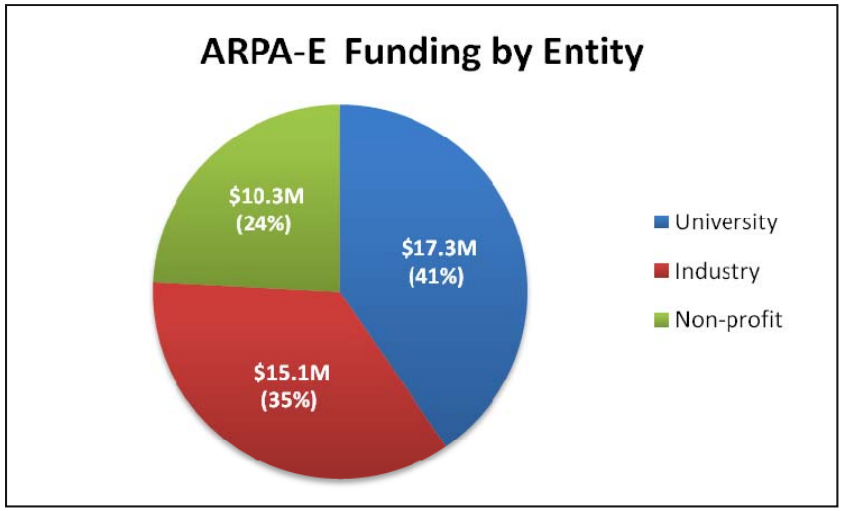
ARPA-E's Carbon Capture Projects
$42.7M of funding

	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		

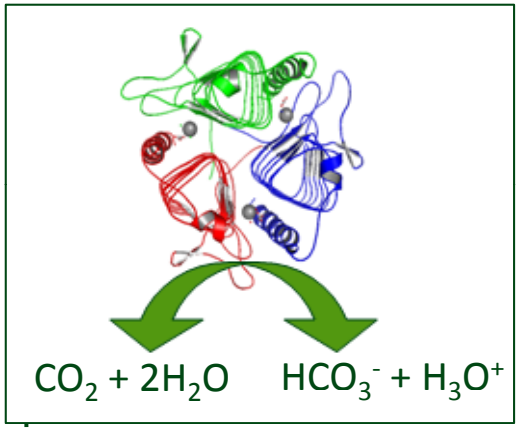


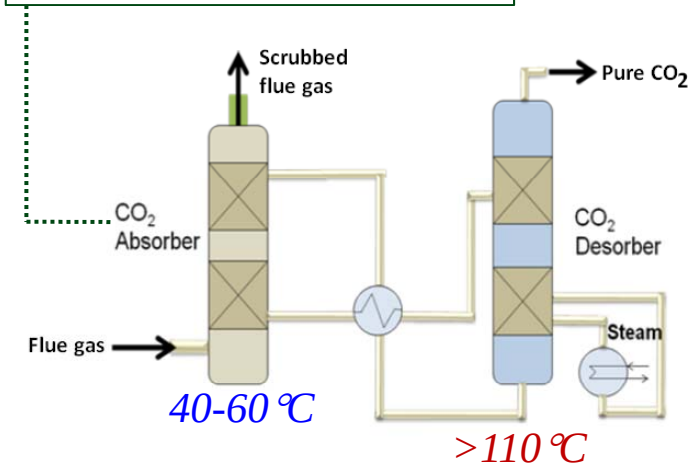


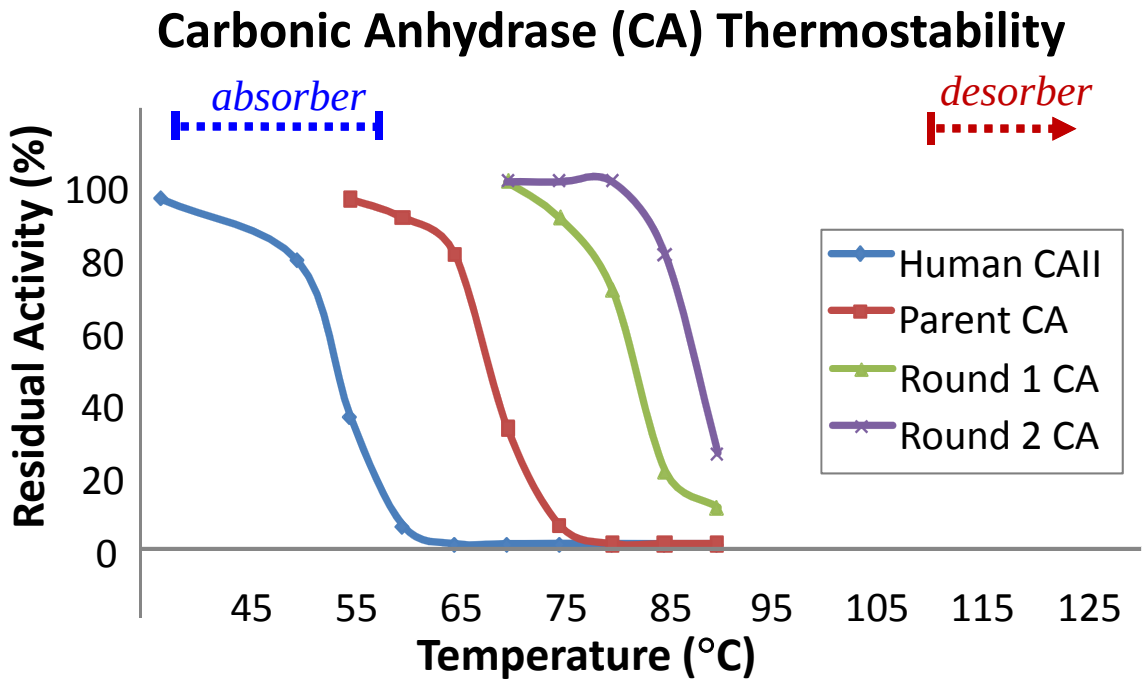
Solvents: Codexis

Low-Cost Biocatalyst for Acceleration for Energy Efficient Capture Solvents

PI: Dr. James Lalonde ; ARPA-E Funding: $4.7M





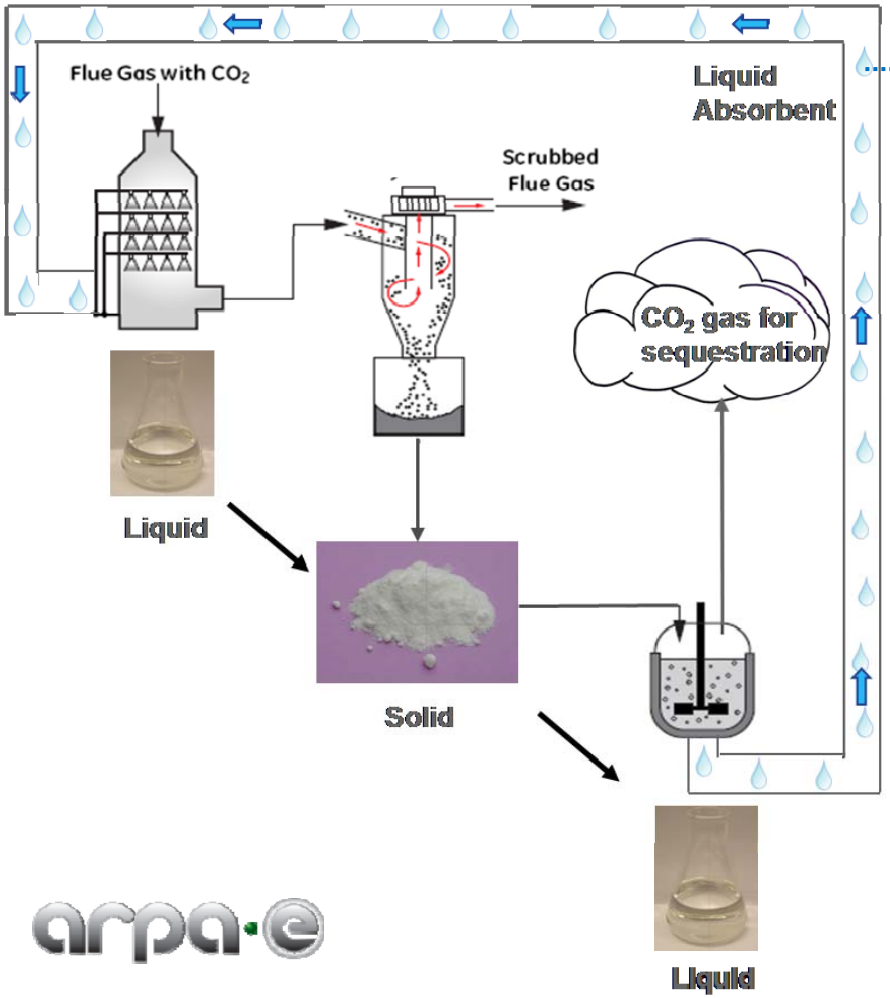


CA variants are evolved to be scalable and stable in tertiary amine solutions

Phase Change: GE

CO_2 Capture Process Using Phase-Changing Absorbents

PI: Dr. Teresa Grocela-Rocha ; ARPA-E funding: $3M



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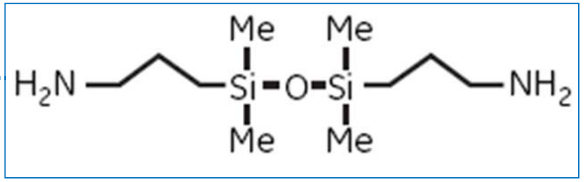

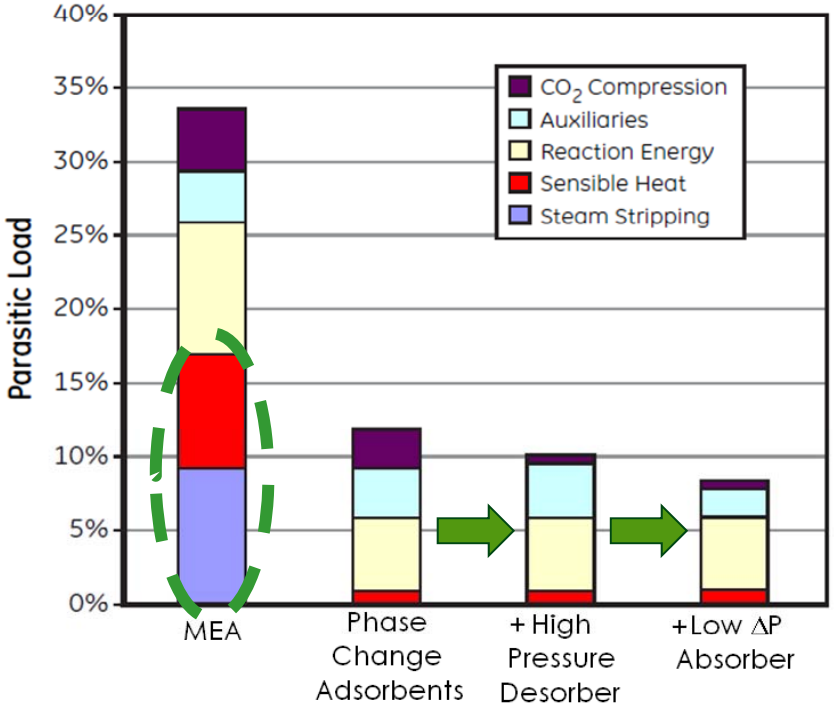

Target: $24 per ton CO_2 avoided

Current and Upcoming Activities

- Workshops
- Hiring new Program Directors
- Hiring Fellows (Junior and Senior)
  - Goal: to bring best and brightest scientist, engineers, and technical entrepreneurs in to ARPA-E and create a think tank to identify gaps, challenges, opportunities and new ways of creating energy technologies
  - Junior Fellows are recent PhDs
  - Senior Fellows are experienced PhDs and/or faculty on sabbatical
- 2011 ARPA-E Summit
  - February 28 – March 2, 2011
  - Gaylord Convention Center in Washington, DC