CHANGING WHAT'S POSSIBLE

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Changing What's Possible

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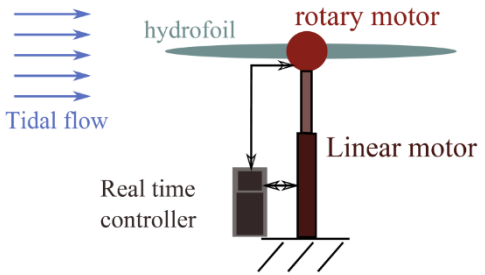
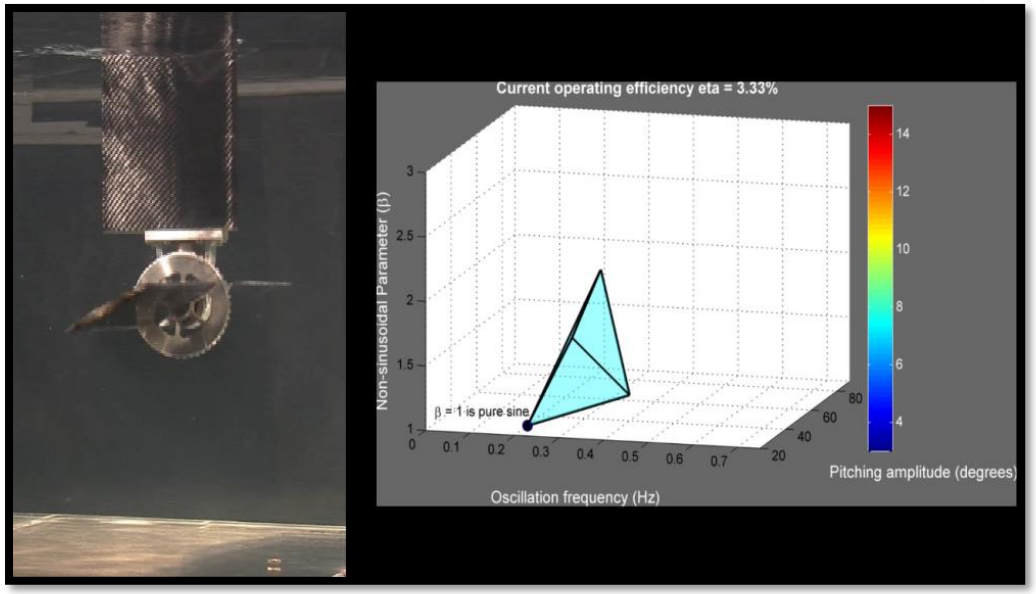
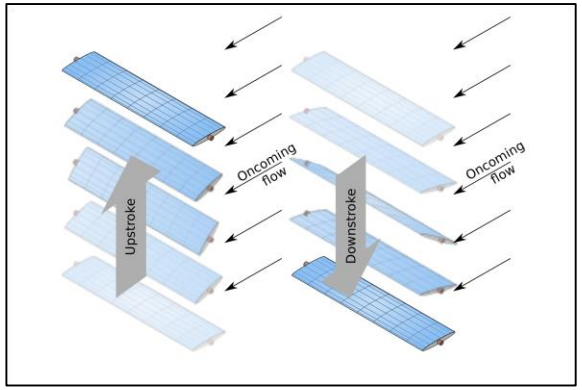
Brown University – Auto-adaptive Tidal Power Conversion



1. Active control of two-degrees of freedom of the hydrofoil.
2. Real-time measurement & optimization of extracted power.
3. Continuously learn and adapt to current environment.

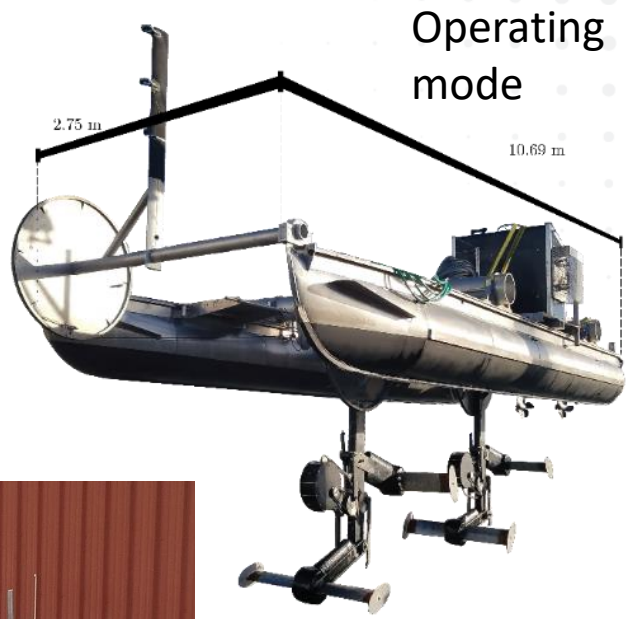


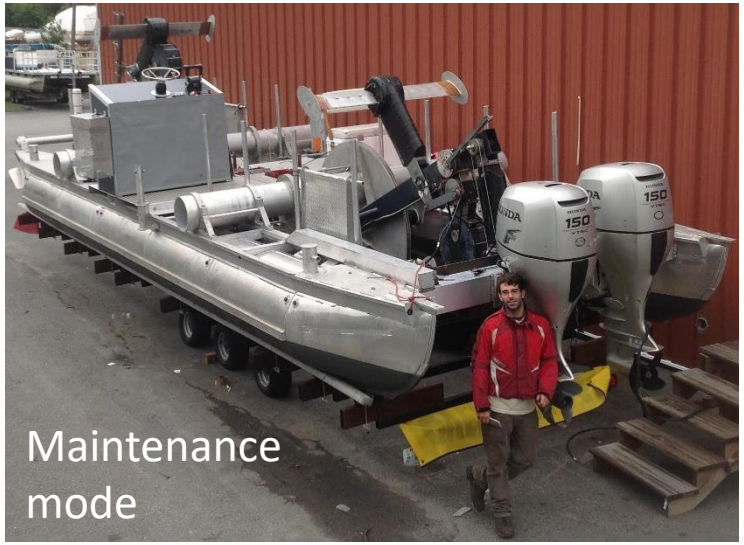


Basic mechanism: Orient hydrofoil so that lift always points in the direction of motion

Portable, Resilient Power

- Install multiple 50 kW units to achieve desired capacity
- Floating design facilitates deployment and accessibility
- Swing arm allows for easy service of wet components
- Electronics and critical components are located above water
- Modular hydrofoil design allows for quick swapping of hydrofoils





ARPA-E Mission

Mission: To overcome long-term and high-risk technological barriers in the development of energy technologies

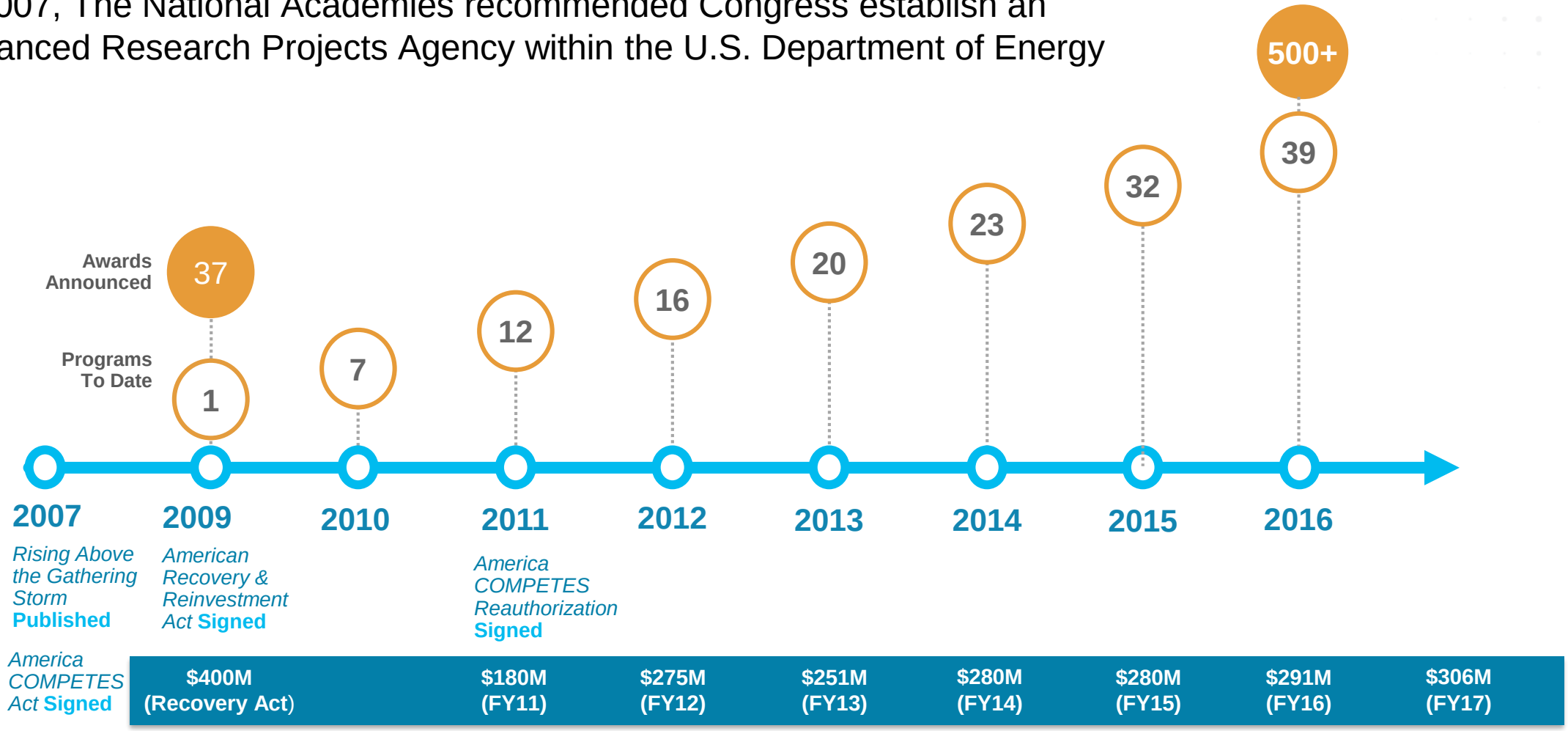
Ensure U.S. Technological Lead & U.S. Economic and Energy Security

Means:

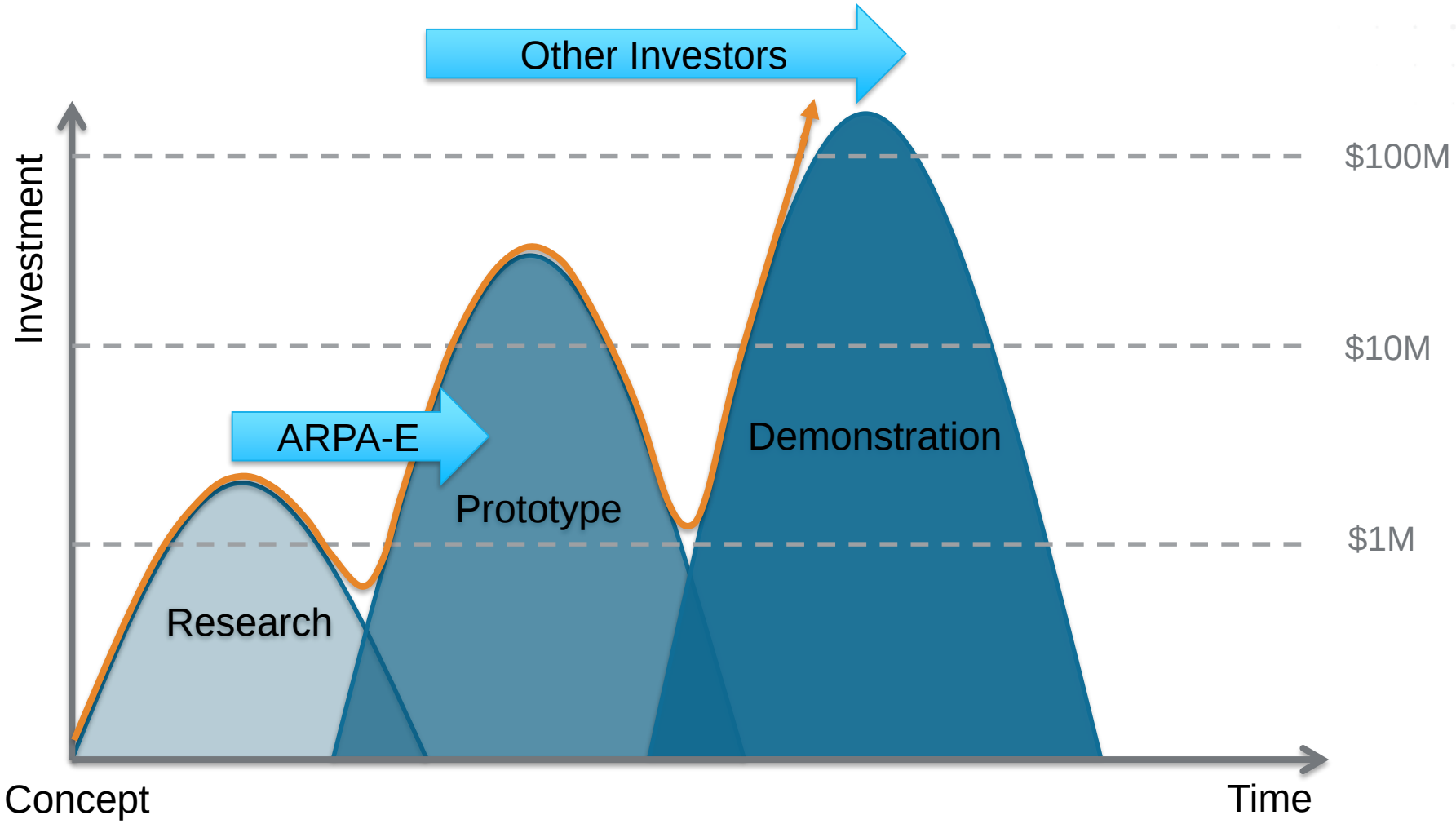
- Identify and promote revolutionary advances in fundamental and applied sciences
- Translate scientific discoveries and cutting-edge inventions into technological innovations
- Accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty

Our History

In 2007, The National Academies recommended Congress establish an Advanced Research Projects Agency within the U.S. Department of Energy

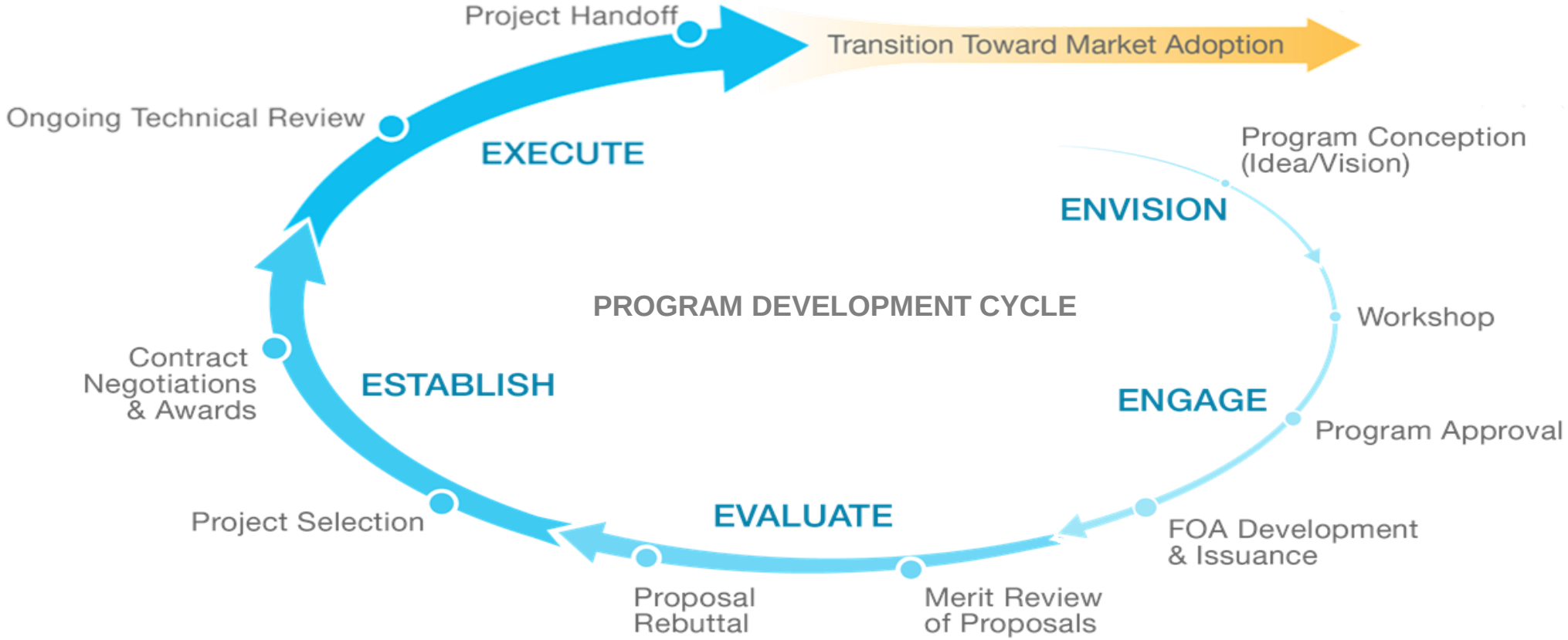


Energy Technology "Mountains of Opportunity"



Developing Our Focused Programs

ARPA-E Program Directors



Program Portfolio

Active

Alumni

ELECTRICITY GENERATION

- MOSAIC
- GENSETS
- ALPHA
- REBELS
- FOCUS
- SOLAR ADEPT
- IMPACCT

EFFICIENCY & EMISSIONS

- CIRCUITS
- PNDIODES
- ENLITENED
- SHIELD
- ROOTS
- MONITOR
- ARID
- DELTA
- SWITCHES
- METALS
- REACT
- BEETIT
- ADEPT

TRANSPORTATION & STORAGE

- NEXTCAR
- REFUEL
- TRANSNET
- TERRA
- RANGE
- REMOTE
- MOVE
- PETRO
- ELECTROFUELS
- AMPED
- BEEST

GRID & GRID STORAGE

- IONICS
- GRID DATA
- CHARGES
- NODES
- HEATS
- GENI
- GRIDS

OPEN 2009, 2012, & 2015 Solicitations Complement Focused Programs

OPEN Solicitations Supplement Portfolio

*Pending FY 2018 appropriations and review

If it works…

will it matter?

Impact Indicators

Since 2009 ARPA-E has provided

$1.5 billion

in R&D funding to more than **580 projects**

56 projects

have formed **new companies**

1,328

peer-reviewed **journal articles** from ARPA-E projects

68 projects

have **partnered with other government agencies** to further development

74 Projects

have attracted more than

$1.8 billion

in private-sector follow-on funding

208 patents

issued by U.S. Patent and Trademark Office

As of February 2017

Impact Requires Work Both In and Out of the Lab

Work in the lab is critical

- Core of innovation
- Discovery
- Ideas are tested and proven to work

+

Beyond the lab work is required for solving big problems

- Provides direction for lab experimentation
- Validates the impact and viability of lab work
- Generates resources needed in the lab

Tech-to-Market: Preparing Teams for Success

Scope

Support creation of highly innovative, commercially-relevant programs

Manage

Manage project teams' T2M efforts through T2M plans and jointly developed milestones

Advise

Support project teams with skills & knowledge to align technology with market needs

Partnerships

Engage third-party investors and partners to support technology development towards the market

An Evidence-based Approach

TEA
(How much does it cost to make and why?)

Customer Discovery
(Who would buy it, why, and for how much?)

Product Hypothesis
(What will you make? What does it do?)

IP Plan
(Can you legally make it? Can others legally make it?)

T2M

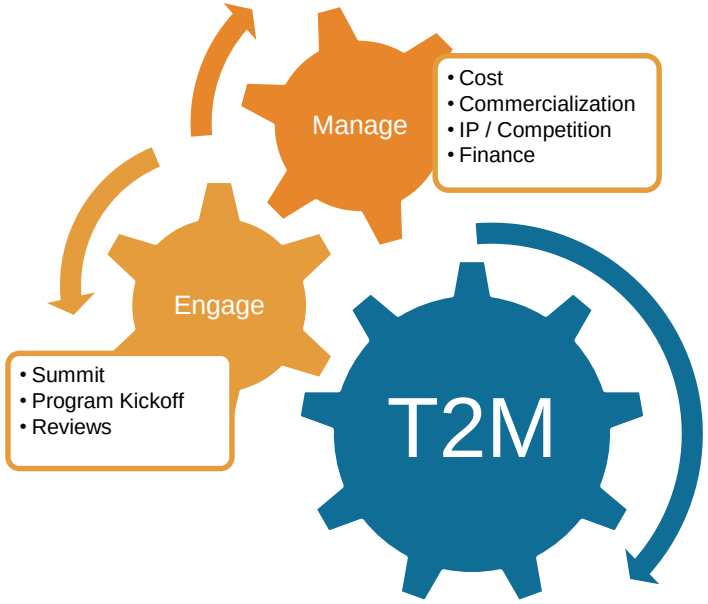
Follow on Funding
(Who will finance it?)

Value Chain Analysis
(Who's involved in it?)

Scaling
(How would you make many?)

Market Analysis
(Who's currently buying and consuming it?)

Our Tech-to-Market Team



Constant feedback between engagement and management efforts brings value to ARPA-E awardees

Tech-to-Market Plan

- Product Hypothesis
- Intellectual Property Strategy
- Manufacturing and Scalability
- Value Chain Analysis

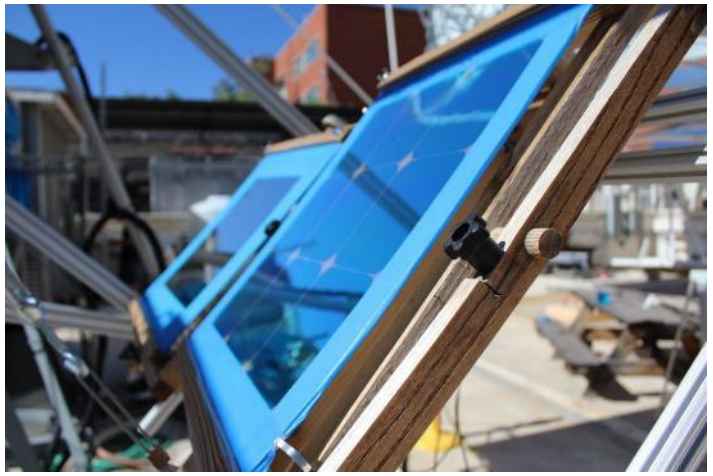

TECHNOLOGY TO MARKET PLAN

Template and Instructions

Rev. 4/30/14

Tech Focus: Solar Energy

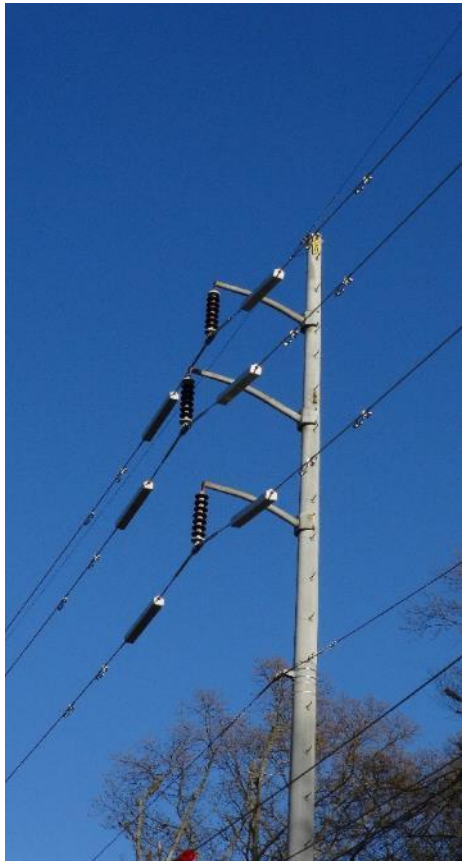
ARPA-E has funded innovative solar energy technologies in specific, targeted areas, including power electronics for solar applications, hybrid conversion systems, and microscale CPV.



Since 2009, ARPA-E has provided over **$142 million** in R&D funding to **59 active projects** in **solar energy**.

Tech Focus: Grid Management

ARPA-E has funded a broad range of technologies including software and hardware solutions designed to build the grid of tomorrow.



Since 2009, ARPA-E has provided over **$135 million** in R&D funding to **50 projects** under several focused programs in **grid management**.

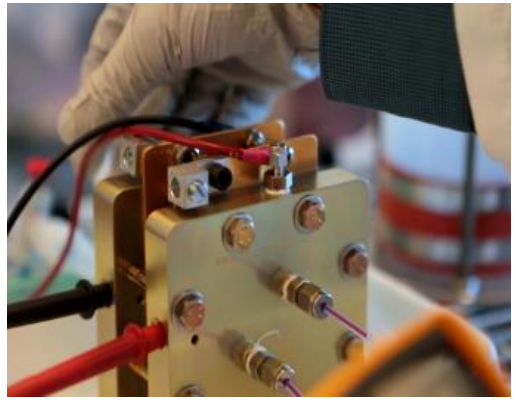
Tech Focus: Natural Gas

ARPA-E has funded a broad range of technologies including conformable compressed natural gas tanks, methane-to-liquid processes, combustion engines and fuel cells to generate on-site electricity, and technologies to monitor costly methane leaks.

Since 2009, ARPA-E has provided over **$222 million** in R&D funding to **82 projects** related to **natural gas** use under several focused programs.

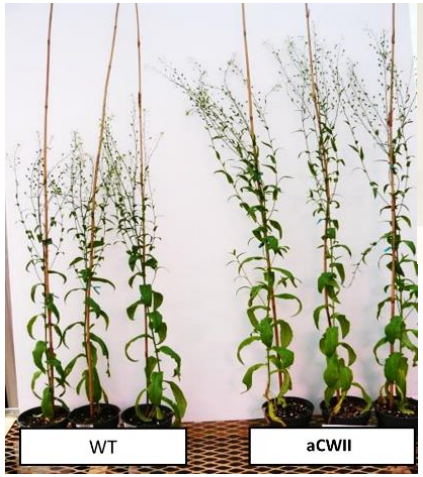
Tech Focus: Energy Storage

ARPA-E has funded a broad range of battery technologies, including flow batteries, metal-air chemistries, and advanced lithium-ion, for both grid-scale storage and transportation.



Since 2009, ARPA-E has provided over **$257 million** in R&D funding to **102 projects** in **energy storage**.

Project Spotlight: NC State



(A) Comparison of vegetative growth between WT and and CWII plants, and (B) per plant seed yield of CWII transgenic camelina lines (L95, L85, L96).

Program	PETRO
Program Director	Dr. Joe Cornelius
Technology	Optimized Biofuel Crops
Location	Raleigh, NC

Summary

- NC State produced economic models demonstrating that increasing oil yield in Camelina seeds by 70%—the level observed in the greenhouse with experimental plants—could more than triple farmers' profits

Highlights

- The team engineered the gene to increase sugar available for biomass production and seed yield, which led to Camelina with higher vegetative biomass (greater than 20%), higher rates of photosynthesis and increased seed yield (40-80%)
- ARPA-E encouraged NC State to work with PETRO team UMass. The two then worked with commercial partner, Metabolix, in field trials.

Project Spotlight: RTI International

RTI's bench-scale solvent testing unit

Program	IMPACCT
Program Director	Dr. Ping Liu
Technology	CO_2 Capture
Location	Research Triangle Park, NC

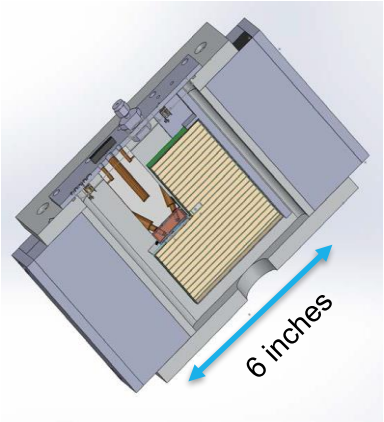
Summary

- The RTI International team has demonstrated significant potential to lower the cost of carbon capture in coal-fired power plants compared with the incumbent amine treatment process

Highlights

- RTI developed a non-aqueous solvent (NAS) that could potentially reduce the energy required for carbon capture by 20-30%
- RTI received additional federal funding from NETL to scale the RTI NAS process up to a 60 kW facility in collaboration with SINTEF, a Norwegian research company
- The SINTEF facility is being outfitted with a multiburner that allows, for the first time, testing of NAS in coal-derived flue gas

Project Spotlight: Duke University



Program	MONITOR
Program Director	Dr. Joe King
Technology	Coded Aperture Miniature Mass Spectrometer for Methane
Location	Durham, NC

Summary

- Duke University is developing a coded aperture miniature mass spectrometer environmental sensor (CAMMS-ES) for use in a methane monitoring system.

Highlights

- Miniaturizing a mass spectrometer utilizing microfabrication and aperture coding
- High selectivity measurements at short detection times for methane as well as VOCs (such as benzene, C2-C7)
- Capable of thermogenic vs. biogenic differentiation
- Developing advanced search/location algorithms for optimum sampling

Why Work at ARPA-E?

CONTRIBUTE TO A BETTER ENERGY FUTURE

Work towards creating a more efficient, more secure energy future

WORK IN DIVERSE TECH AREAS

At ARPA-E you'll have the opportunity to work with a diversity of energy issues and explore new fields

JOIN OUR INNOVATIVE STARTUP-LIKE CULTURE

ARPA-E is a fast-paced, action-oriented Agency

COLLABORATE WITH OTHER EXPERTS

Work with other experts from many different disciplines who are devoted to creating a better energy future

If you are interested in applying or learning more, please email ***arpa-e-jobs@hq.doe.gov****.*

https://arpa-e.energy.gov

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