CHANGING WHAT'S POSSIBLE

SEAS
Scalable Energy from Aquatic Sources

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Juneau, Alaska
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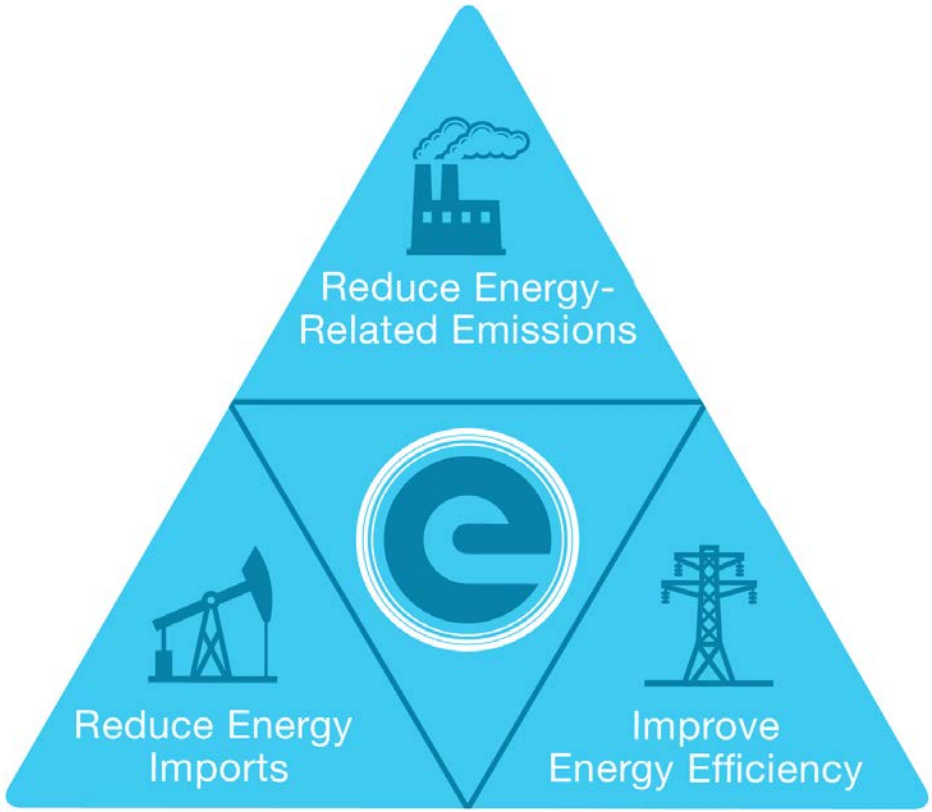
ARPA-E Mission

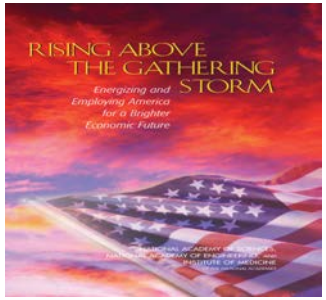
Catalyze the development of transformational, high-impact energy technologies



Ensure the U.S. maintains a lead in the development and deployment of advanced energy technologies

ARPA-E's History

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



…"The new agency proposed herein [ARPA-E] is patterned after that model [of DARPA] and would sponsor creative, out-of-the-box, transformational, generic energy research in those areas where industry by itself cannot or will not undertake such sponsorship, where risks and potential payoffs are high, and where success could provide dramatic benefits for the nation."…

	2007	2009	2010	2011	2012	2013	2014	2015	2016
Awards Announced		37							500+
Programs To Date		1	7	12	16	20	23	32	39
	Rising Above the Gathering Storm Published *America COMPETES Act* Signed	*American Recovery & Reinvestment Act* Signed		*America COMPETES Reauthorization* Signed					*Anticipated*
	$400 Million (Recovery Act)	$180 Million (FY2011)	$275 Million (FY2012)	$251 Million (FY2013)	$280 Million (FY2014)	$280 Million (FY2015)	$291 Million (FY2016)		

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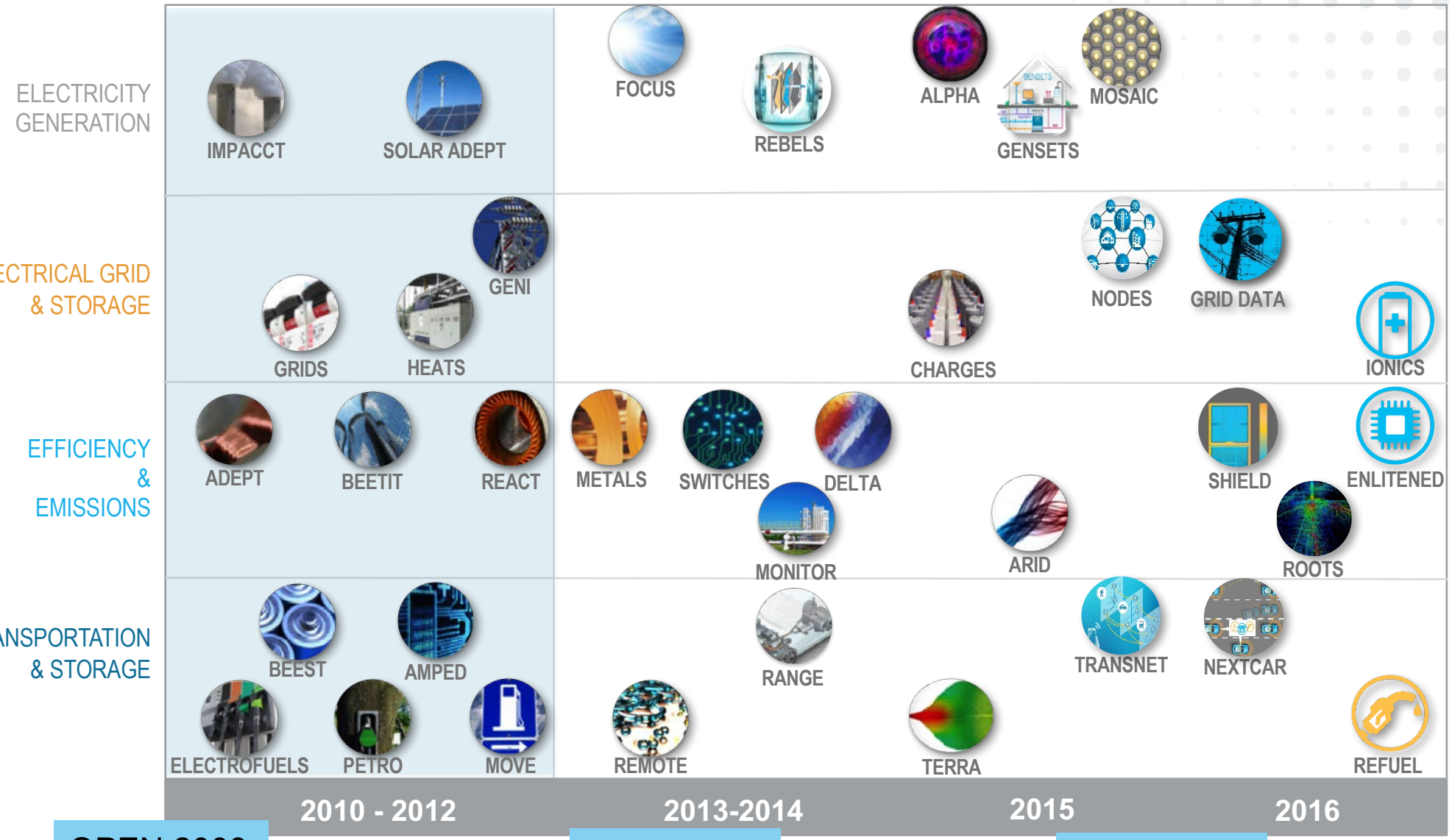
ARPA-E Programs and OPENs



OPEN 2009
36 projects

OPEN 2012
66 projects

OPEN 2015
41 projects

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If it works…

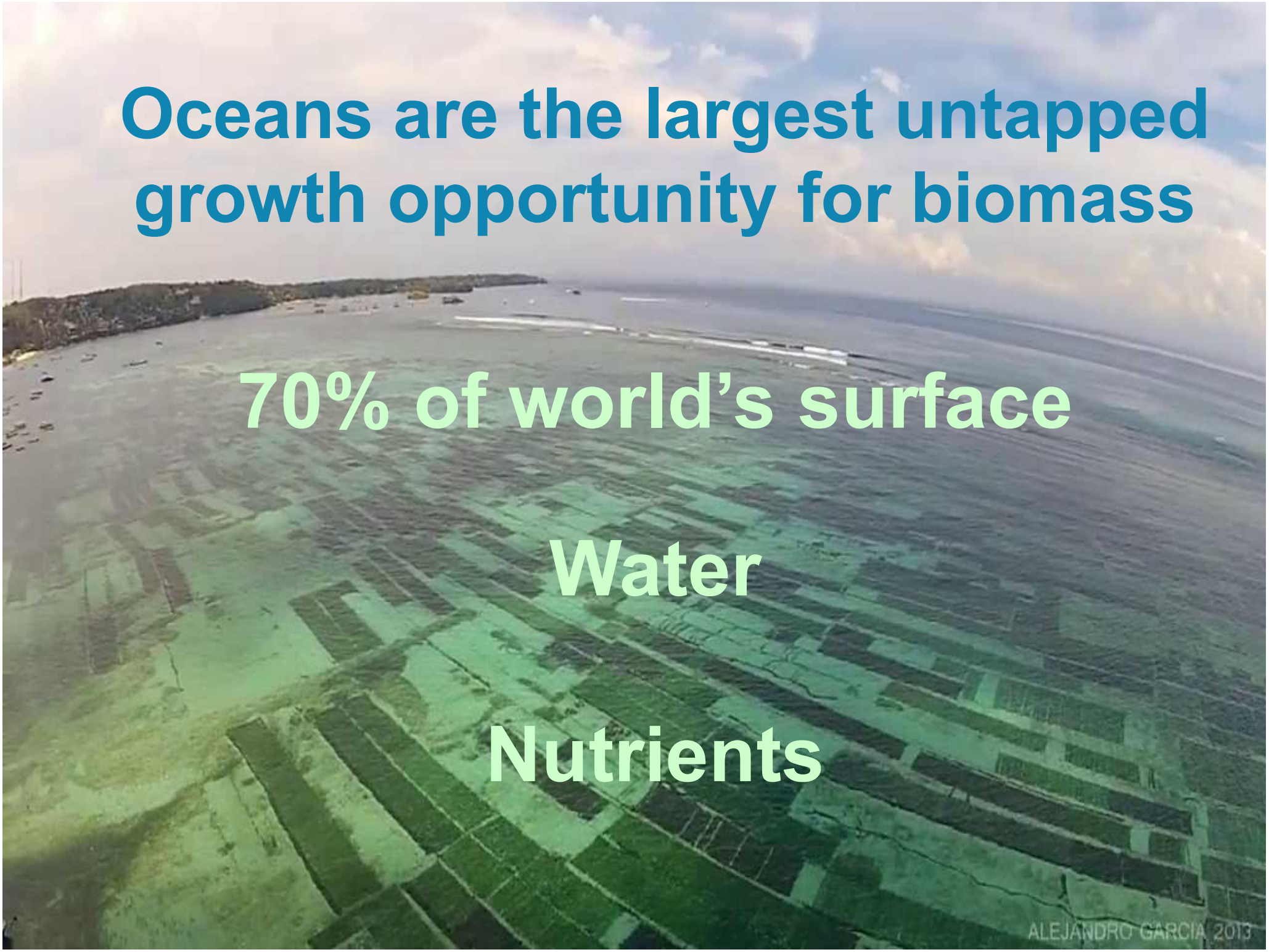
will it matter?

Measuring ARPA-E's Success

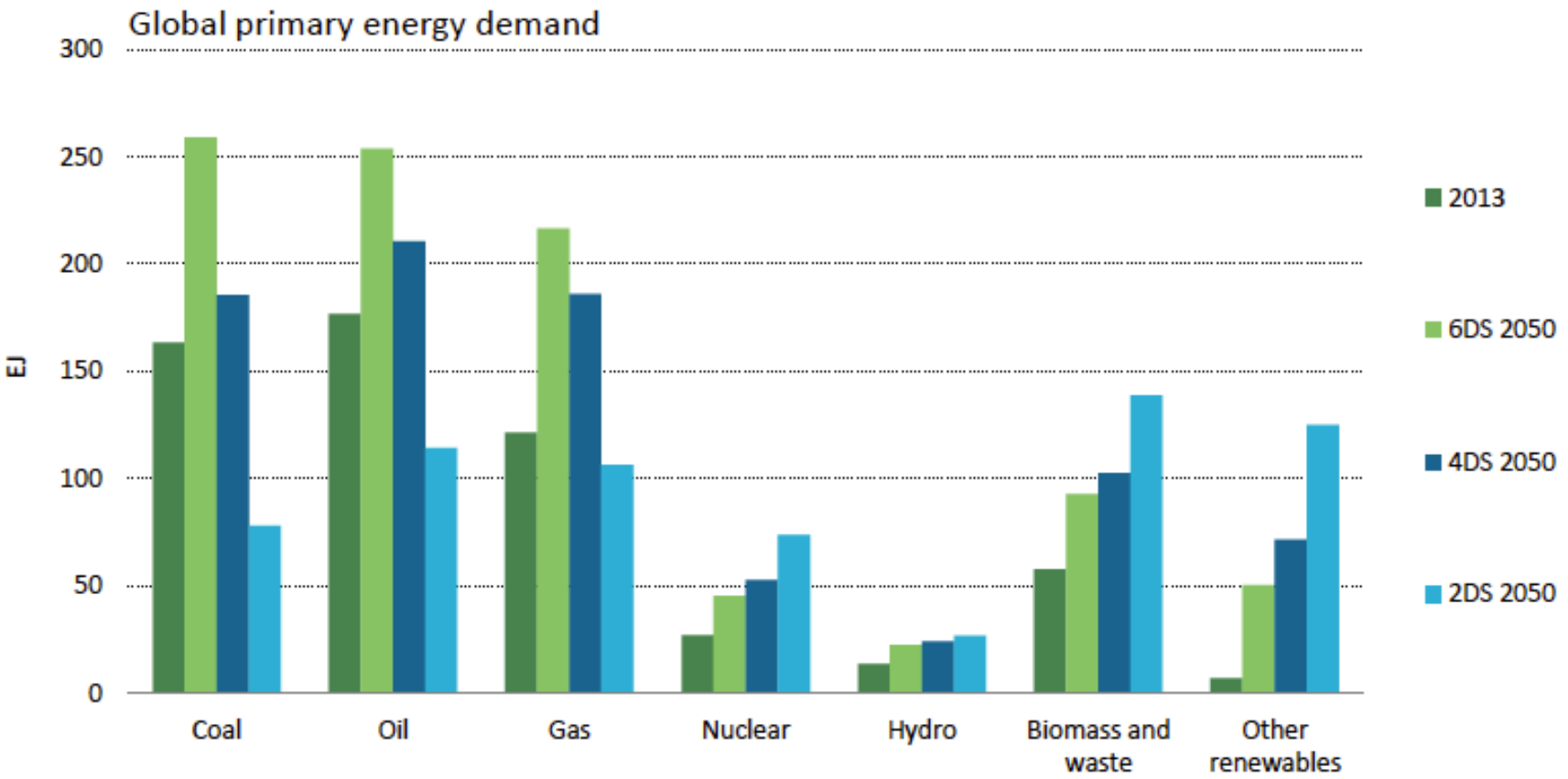
Since 2009 ARPA-E has invested approximately $1.3 billion across over 500 projects, through 32 focused programs and 3 open funding solicitations.

For all alumni and current projects:

- Follow-on Funding
  - 45 projects have attracted more than $1.25 billion from the private sector
- Partnerships with other government agencies
  - 60 government projects
- New company formation
  - 36 new companies formed


Oceans are the largest untapped growth opportunity for biomass
70% of world's surface
Water
Nutrients
ALEJANDRO GARCIA 2013

Biomass critical for reducing GHG emissions



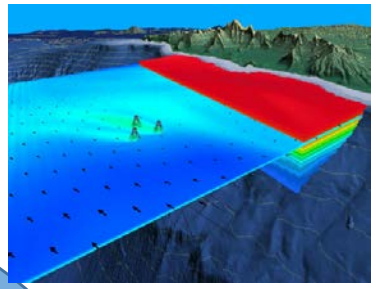
Share of fossil fuels in primary energy is in the 2DS with 45% almost halved by 2050 compared to today (81%), biomass becomes the largest energy source in 2050 in the 2DS.

Source: ETP 2016, IEA

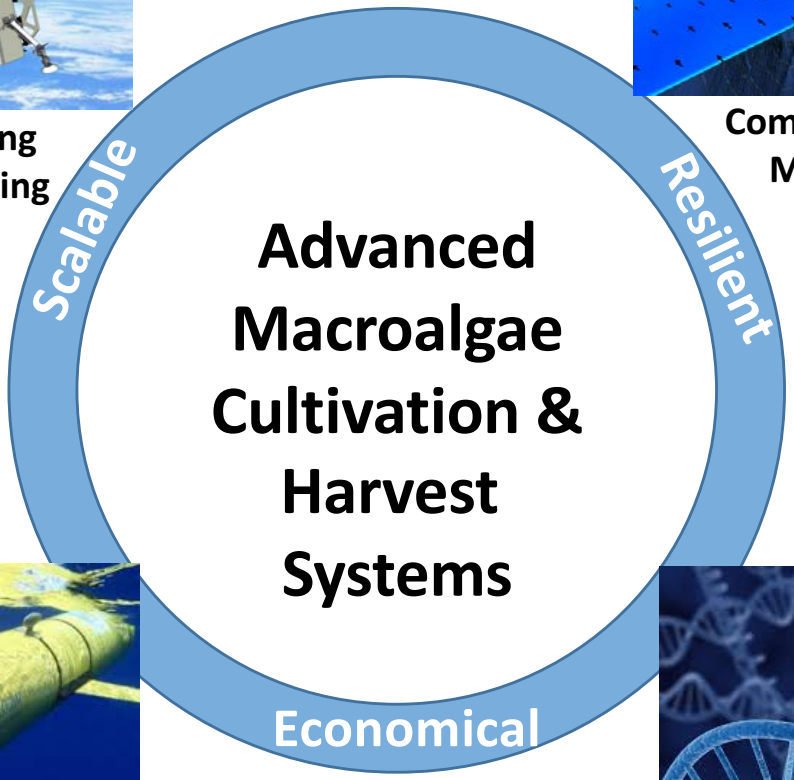
SEAS
Macroalgae Production

Scalable Energy from Aquatic Sources

Satellite Imaging & Remote Sensing



Computational Modeling



Robotics & Automation

Breeding & Genetics

Mariculture Biomass:

- No Land
- No Freshwater
- No Fertilizer

FOA to be release in Dec. 2016

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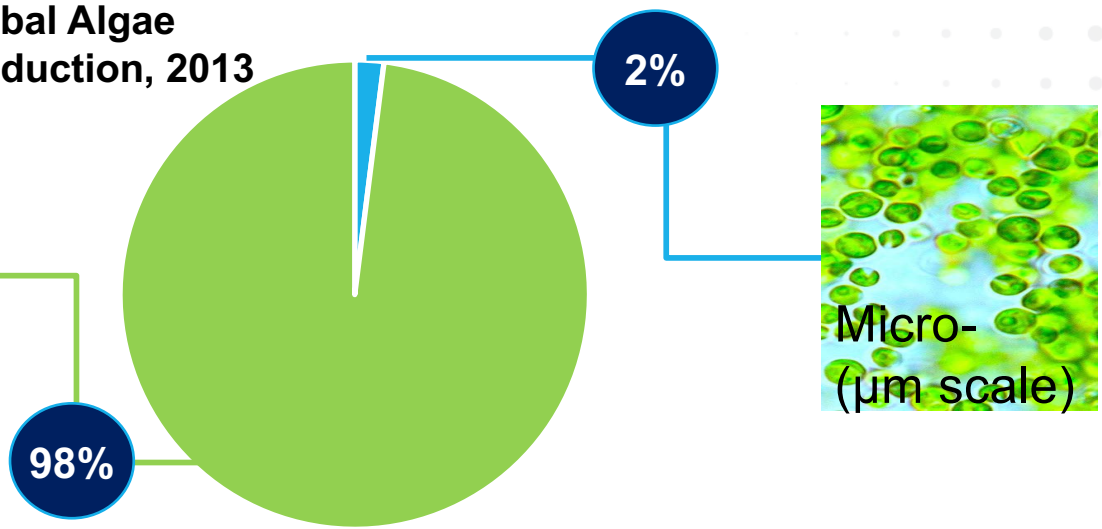
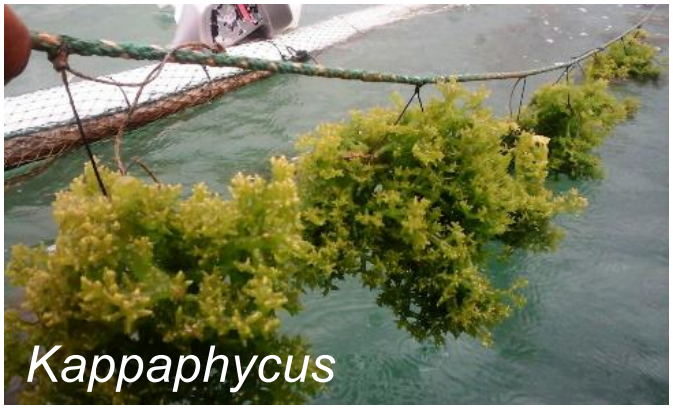
SEAS creates new biomass production opportunities for the vast ocean resources of the United States

Macroalgae (aka seaweed) – the quintessential ocean crop





- **Amenable to cultivation & harvest**
- **Mostly carbohydrate & protein**
- **Many different species**
- **Fast growth rate**

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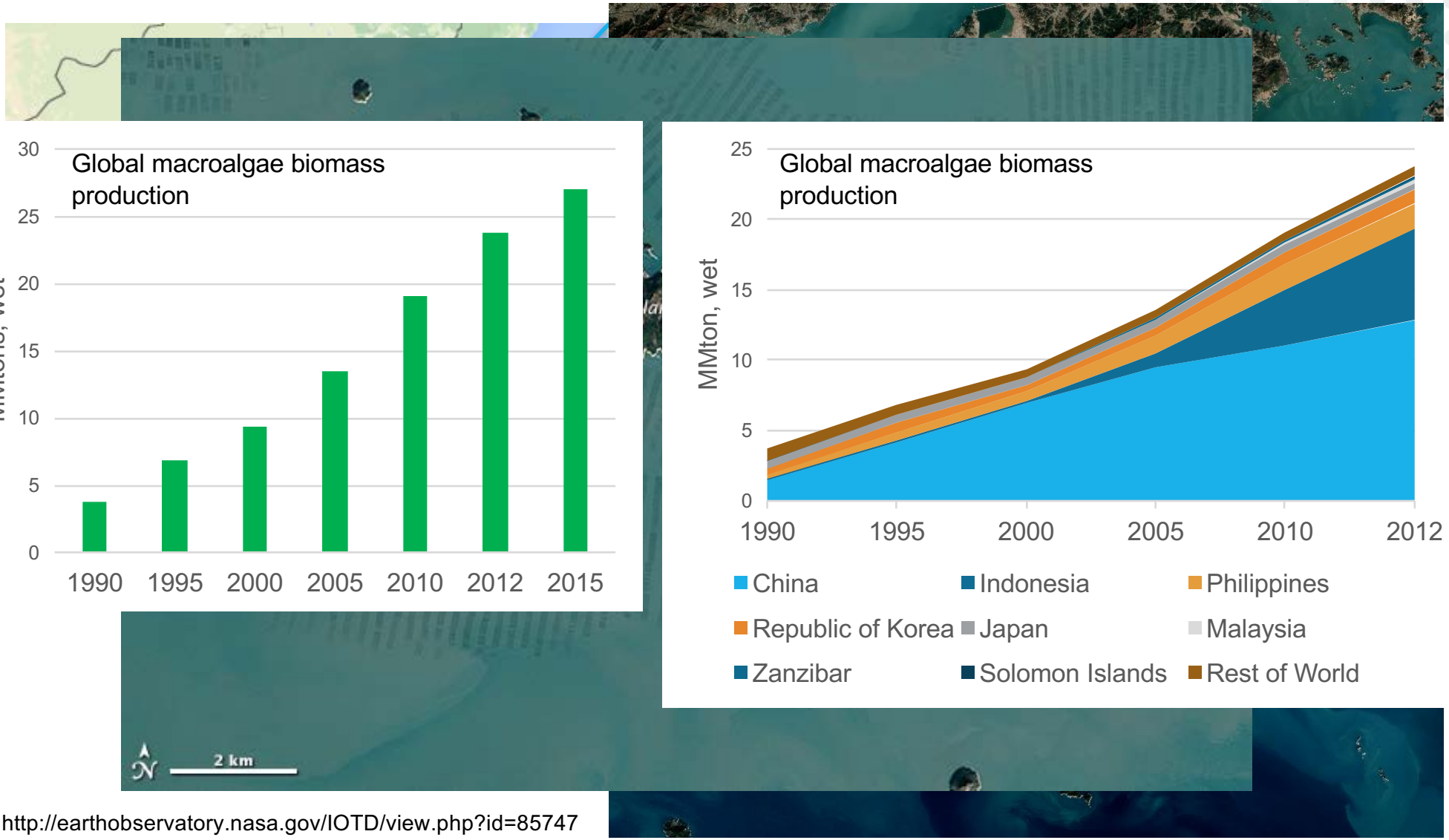
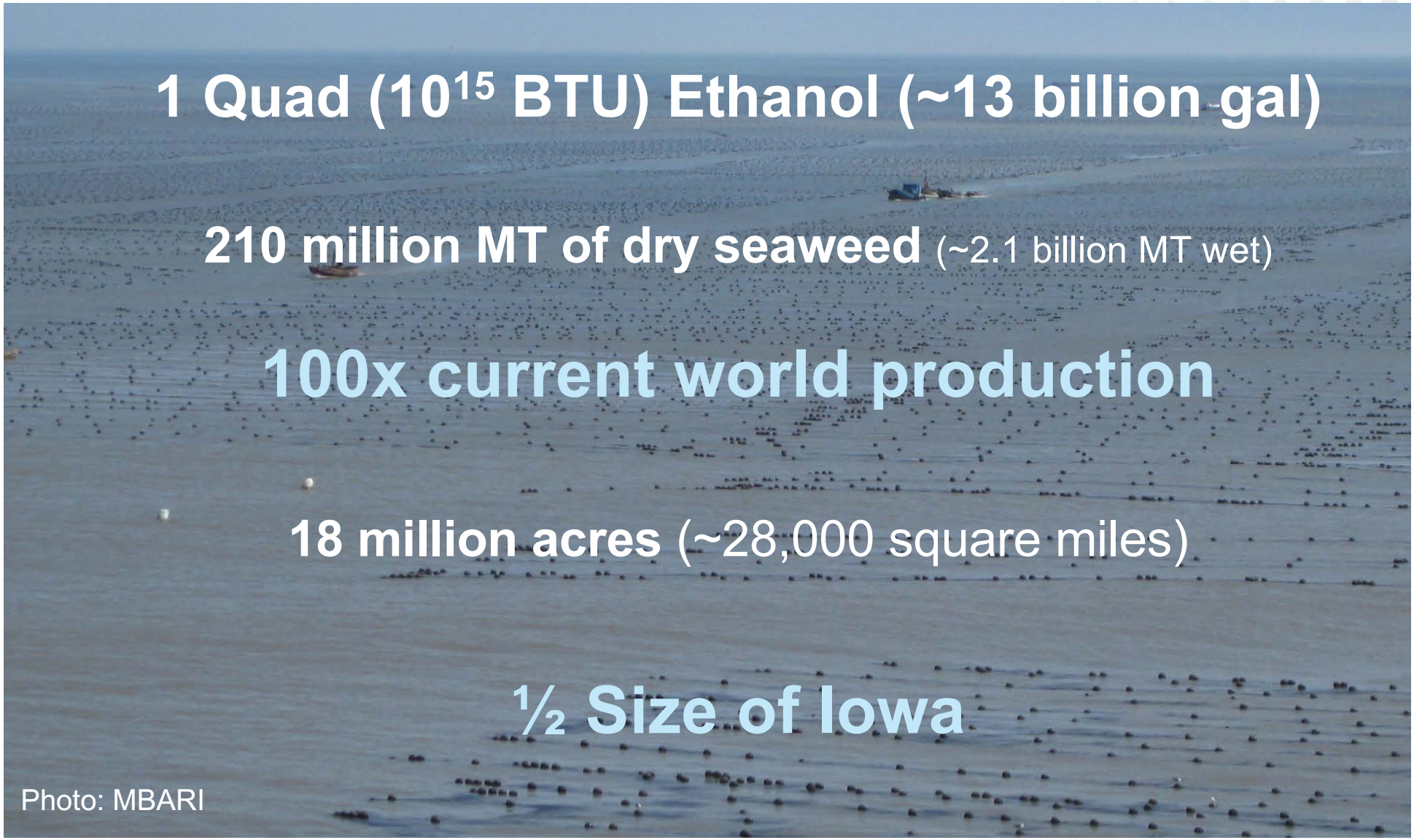
An existing & growing industry



http://earthobservatory.nasa.gov/IOTD/view.php?id=85747

Key Questions for ARPA-E:

How much is enough?

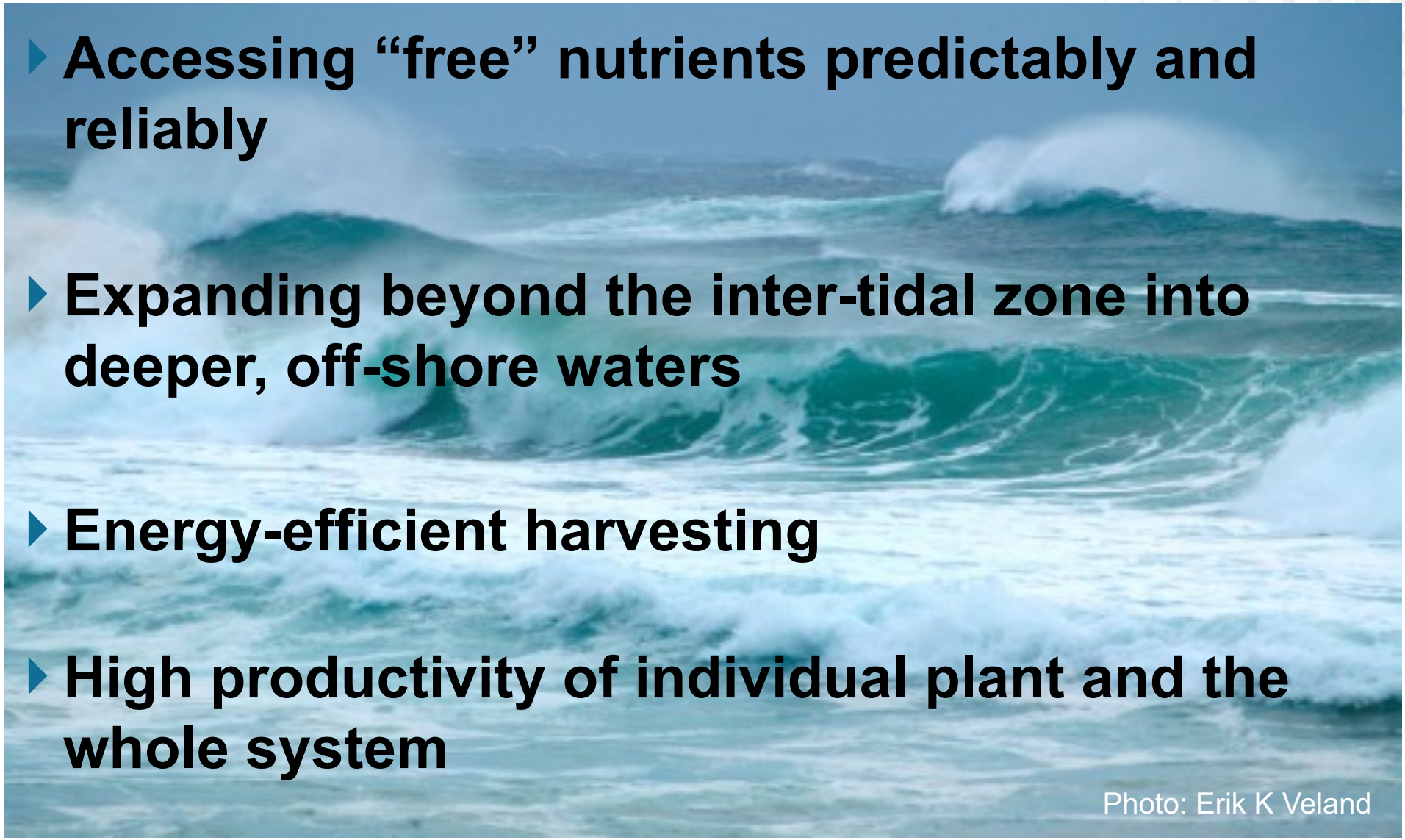


Where should we focus our effort?

Focus on scalable, cost-competitive, and sustainable biomass production

- Production system should be scalable to millions of tons of dry biomass
- Target to be cost competitive with terrestrially produced biomass (at “ocean” farm gate)
- Energy input requirement should not be higher than for cellulosic biomass crops

Key requirements for macroalgae energy farms



- Accessing “free” nutrients predictably and reliably
- Expanding beyond the inter-tidal zone into deeper, off-shore waters
- Energy-efficient harvesting
- High productivity of individual plant and the whole system

Photo: Erik K Veland

Program Structure Overview

Core Program Area

Cultivation & Harvesting System – Design & Demonstration

Tools Program Areas

Modeling
Current & Hydrodynamics
Spatial Planning
Nutrient distribution
Macroalgae growth

Monitoring
Biomass growth/health
Biomass composition
In situ nutrients

Breeding
Hybridization Technologies
Sequencing
Genetic marker identification

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Thank you !

Questions?

Teaming List – Building the Community

- https://arpa-e-foa.energy.gov (RFI-0000027)
- Opportunity to connect with interested parties in the field
- Tell people what your capabilities and relevant resources are
- Spell out areas of expertise you are looking for, if you are trying to form a team
- Link to enter your profile: https://arpa-e-foa.energy.gov/Applicantprofile.aspx

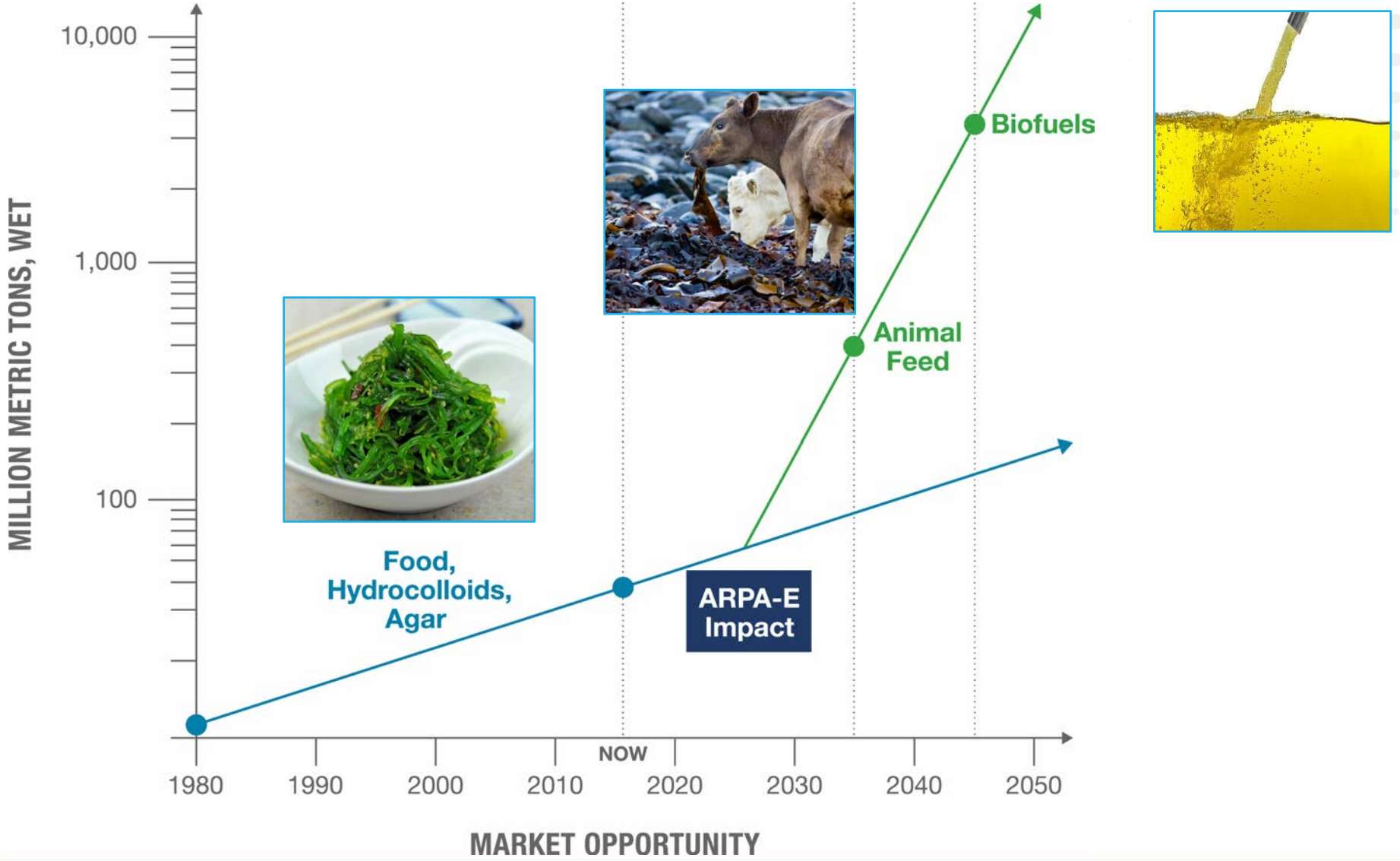
ARPA-E Macroalgae Workshop

ARPA-E Macroalgae Workshop Agenda
February 11-12, 2016
Capital Hilton, 1001 16th St NW, Washington, DC 20036

Webpage

http://arpa-e.energy.gov/?q=workshop/macroalgae-workshop

The path to fuels will likely go through the animal feed market



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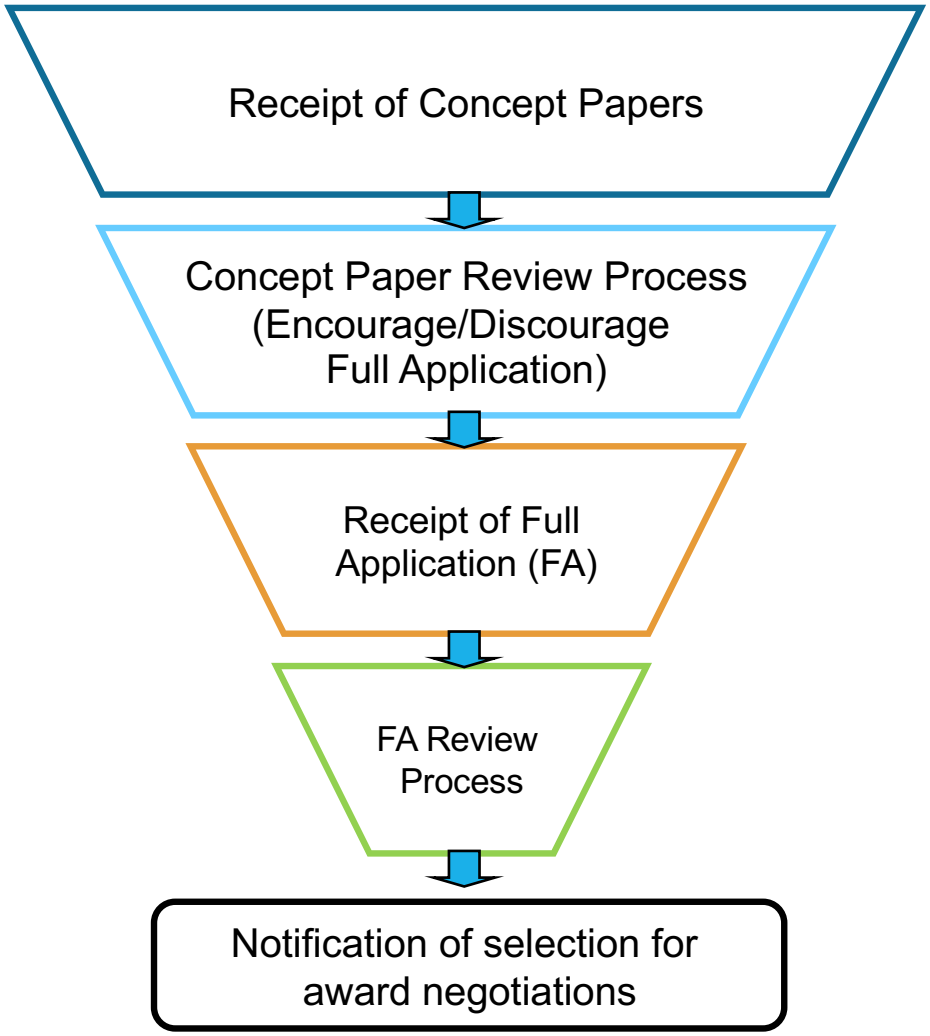
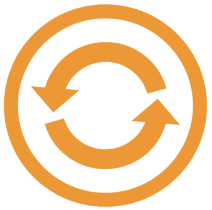
Proposal Review Process (High-level view)



What Makes an ARPA-E Project?

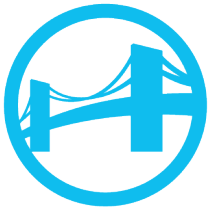
IMPACT

- High impact on ARPA-E mission areas
- Credible path to market
- Large commercial application



TRANSFORM

- Challenges what is possible
- Disrupts existing learning curves
- Leaps beyond today's technologies



BRIDGE

- Translates science into breakthrough technology
- Not researched or funded elsewhere
- Catalyzes new interest and investment

TEAM

- Comprised of best-in-class people
- Cross-disciplinary skill sets
- Translation oriented