



CHANGING WHAT'S POSSIBLE



Innovative Approaches to Ocean Cultivation of Macroalgae for Production of Fuels & Chemicals

ARPA-E Workshop
February 11 & 12, 2016
Capitol Hilton, Washington, DC

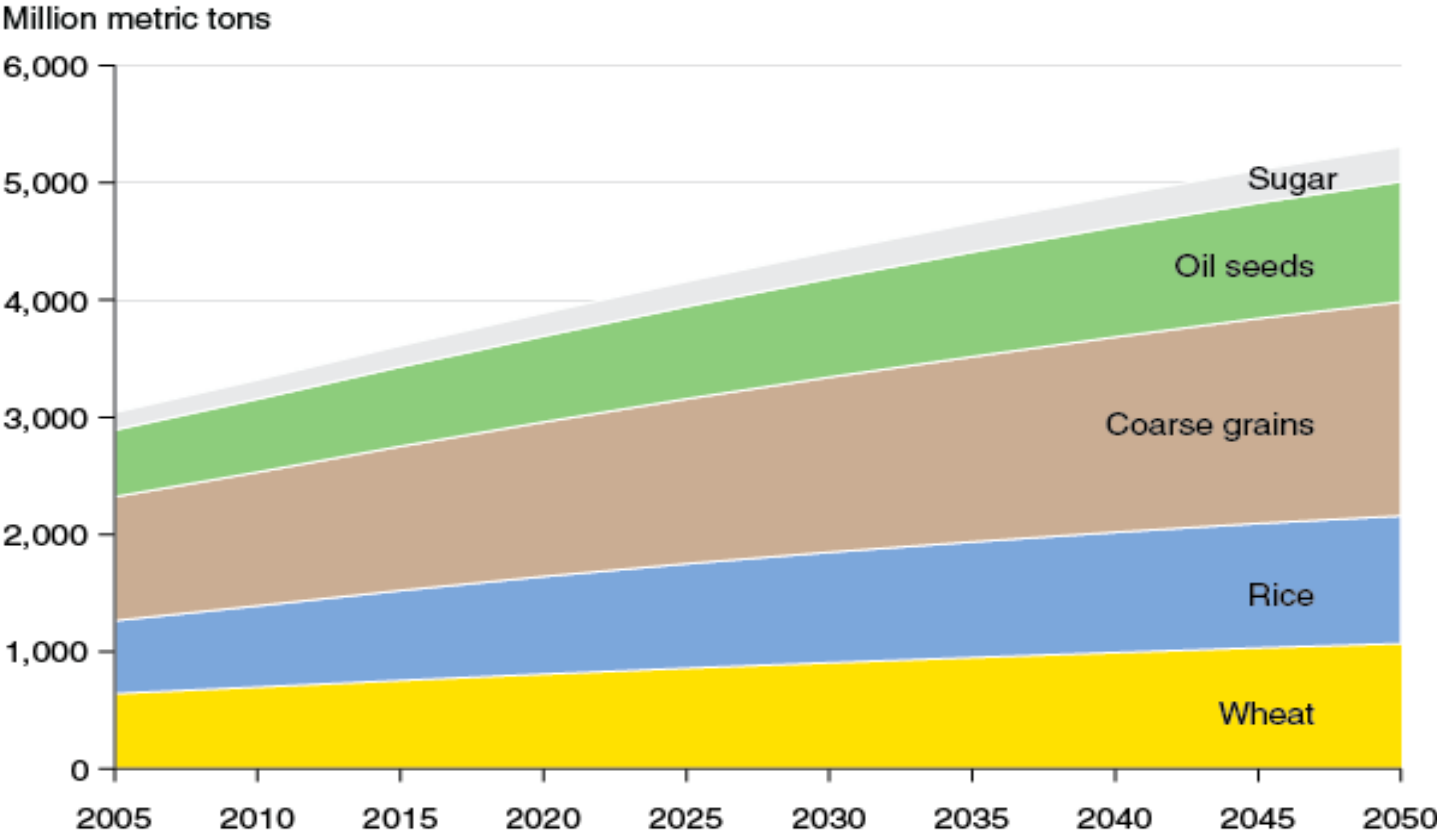


The 3 WHYs?

- ▶ Why Macroalgae?
- ▶ Why now?
- ▶ Why ARPA-E?

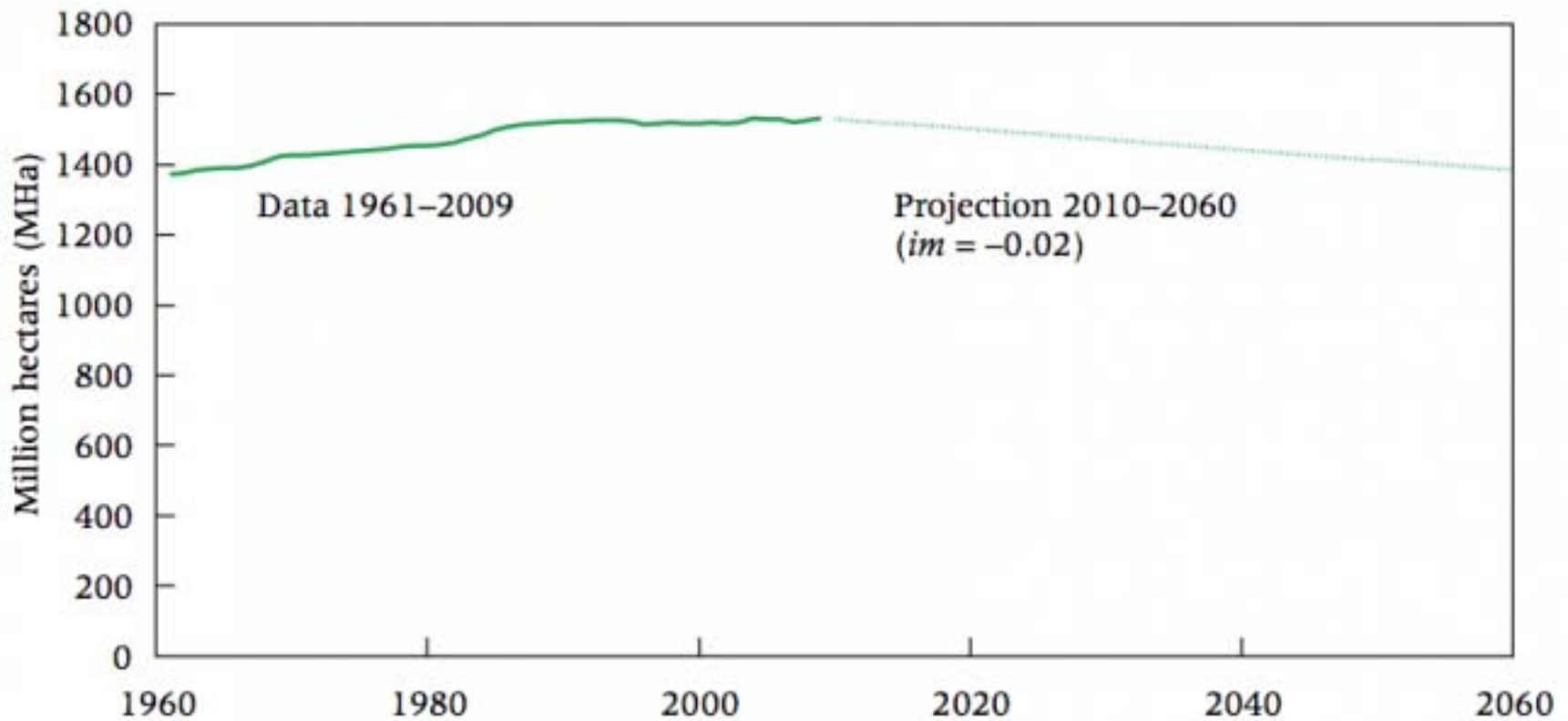
World Food Demand to Increase 70% by 2050

World consumption of major field crops is projected to increase through 2050



Source: USDA, Economic Research Service using Future Agricultural Resources Model reference scenario.

Peak farmland



Extent of global arable land and permanent crops, 1961-2009,
and projection for 2010-2060

Ausubel, Wernick, & Waggoner (2013)

Where do we grow future biomass for fuels?



Oceans as the next frontier

Space

Light

Nutrients

Macroalgae - the crop for the Ocean Farm



Why now? (Why again?)

- ▶ New & better technology tools
- ▶ Rapidly growing aquaculture industry can provide stepping stones

Why ARPA-E?

- ▶ Large Renewable Fuel Opportunity
- ▶ Multi-disciplinary approach needed
- ▶ High risk / high reward project

ARPA-E Goals for Workshop

- ▶ How many technical “miracles” do we need to make happen to achieve energy scale?
- ▶ Can we envision an economically viable path to scale (earn to learn)?
- ▶ How could an ARPA-E funding program best enable path to scale?

Workshop Guidelines

- ▶ GOOD QUESTIONS are more important than answers

- ▶ Consensus is NOT required

Schedule - Morning

| Time | Session/Speaker | Topic/Comments |
|----------|--|--|
| 8:00 am | Registration w/ coffee | |
| 8:30 am | DDT Dr. Eric Rohlfig | Welcome and introduction to ARPA-E |
| 8:45 am | PD Dr. Marc von Keitz | Workshop rationale, description, and operating parameters |
| 9:00 am | Dr. John Benemann | <i>History of DOE macroalgae projects</i> |
| 9:25 am | Dr. Charles Yarish | <i>Open source seaweed culture system technologies in the Northeast US</i> |
| 9:50 am | Dr. Alejandro Buschmann | <i>Macrocystis production and conversion in Chile</i> |
| 10:15 am | MvK | Techno-economic cost considerations & Breakout #1 instructions |
| 10:25 am | Coffee break | Migrate to breakout rooms |
| 10:45 am | Breakout Session #1 | Critical challenges moving to fuel-relevant scale |
| 12:00 pm | Lunch & Breakout Session #1 report out | |

Schedule - Afternoon

| Time | Session/Speaker | Topic/Comments |
|----------|--|---|
| 12:50 pm | Dr. Jang Kim | <i>Macro algae cultivation in Korea/Asia - emerging technology trends</i> |
| 1:15 pm | MvK | ARPA-E perspective of new tech opportunities & Breakout #2 instructions |
| 1:30 pm | Breakout session #2 | Advanced tools & Strategies to approach challenges to scale |
| 2:45 pm | Coffee break | |
| 3:00 pm | Breakout Session #2 read out & Instructions for Breakout Session # 3 | |
| 3:30 pm | Erick Ask | <i>A US Seaweed Industry – View from the largest US market for seaweed</i> |
| 4:00 pm | Bren Smith | <i>Greenwave - Opportunities for distributed, sustainable ocean farming</i> |
| 4:15 pm | Breakout session #3 | Macro Algae Products - revenue, business models & processing |
| 5:15 pm | Breakout Session #3 read out | |
| 5:45 pm | Day 1 closing remarks | |
| 6:30 pm | No host dinner options | Informally coordinated |

