

GLOBAL ALGAE INNOVATIONS

Algae Solutions to Global Dilemmas

DOE BIO ECONOMY

Conference 2017

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INNOVATIONS

Global Algae Innovations

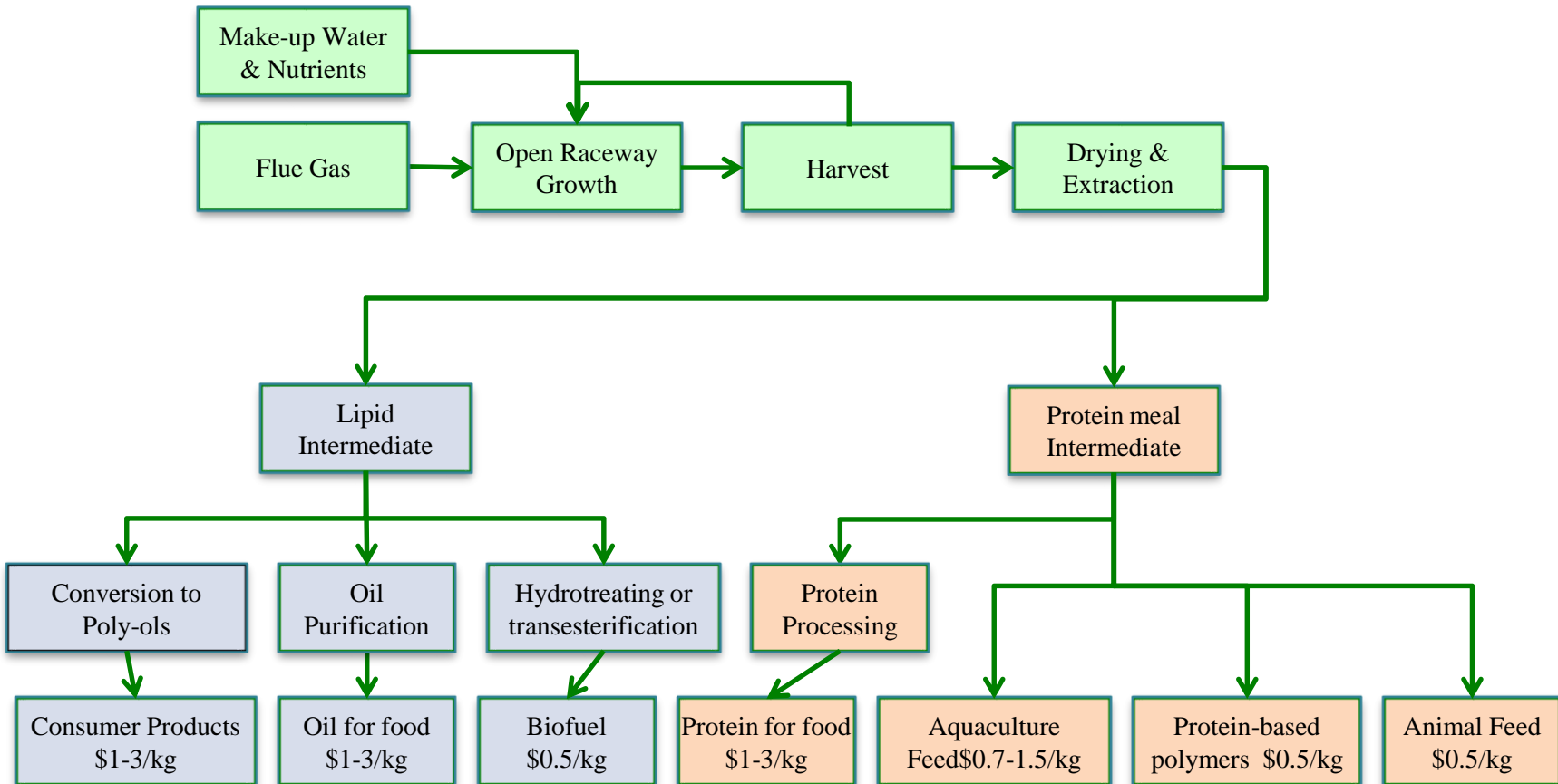
Algae Solutions to Global Dilemmas



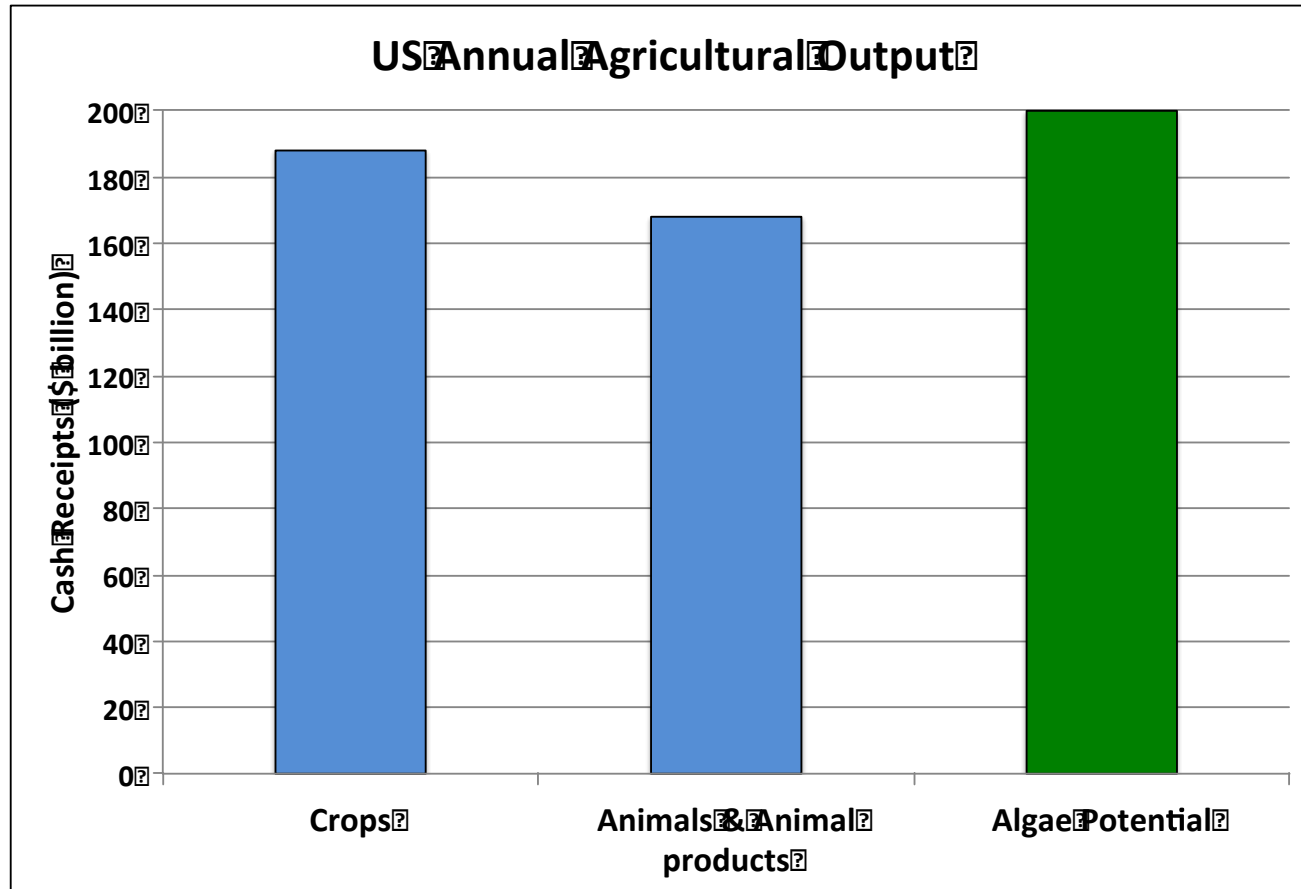
1. Rural rejuvenation & jobs
2. Protein crisis
3. Water, deforestation, climate



Algae Commodities: Protein and Lipids

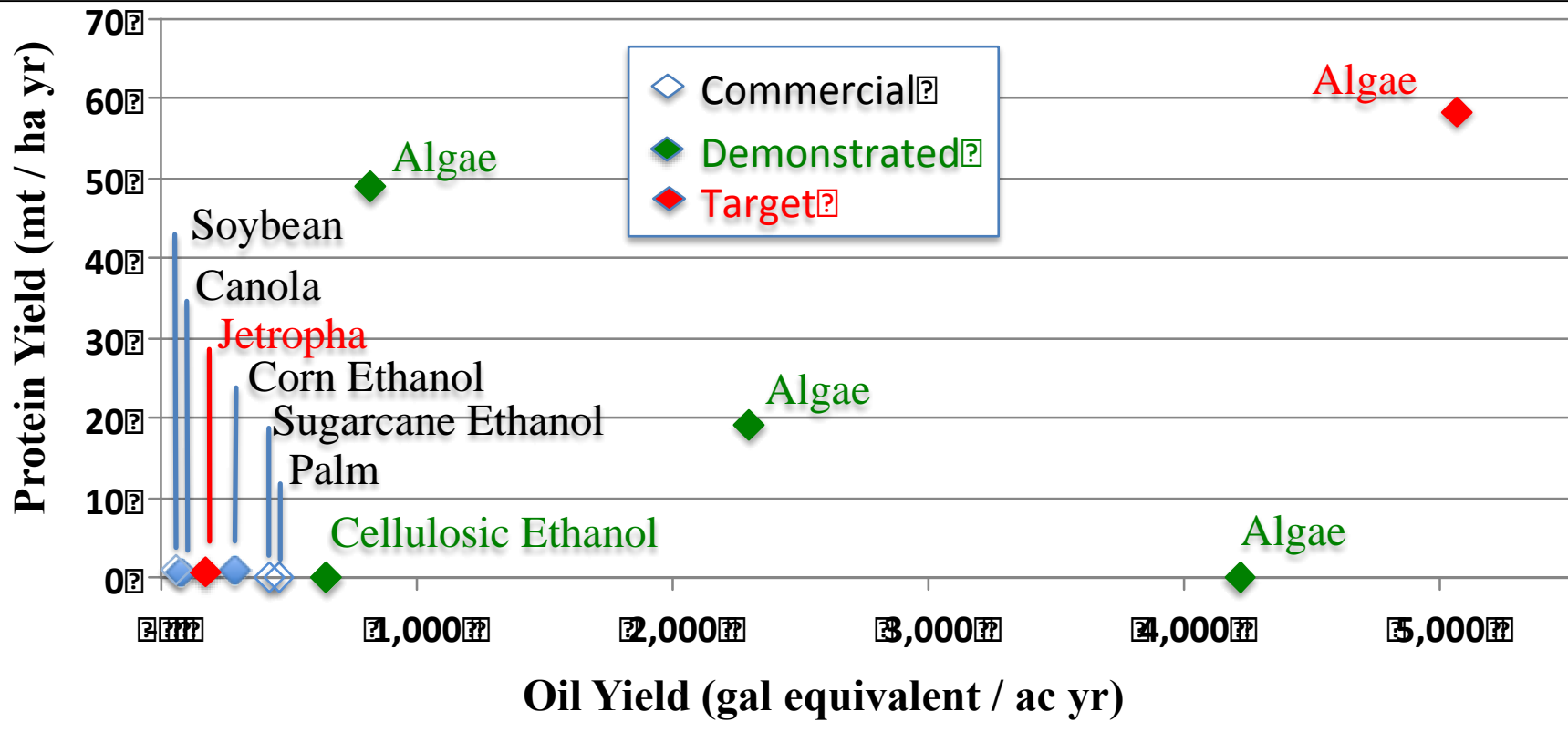


Why is Algae a Big Deal?



**Algae could double US crop output
with 2% of land and 3% of water**

Algae's Transformational



Successfully creating algae industry

Economic Boon --- Higher Standard of Living --- Massive Job Creation

Algae CO₂ Re-use = Lower Electric Rates and More Competitive US Industry



Convert CO₂
waste into a
product

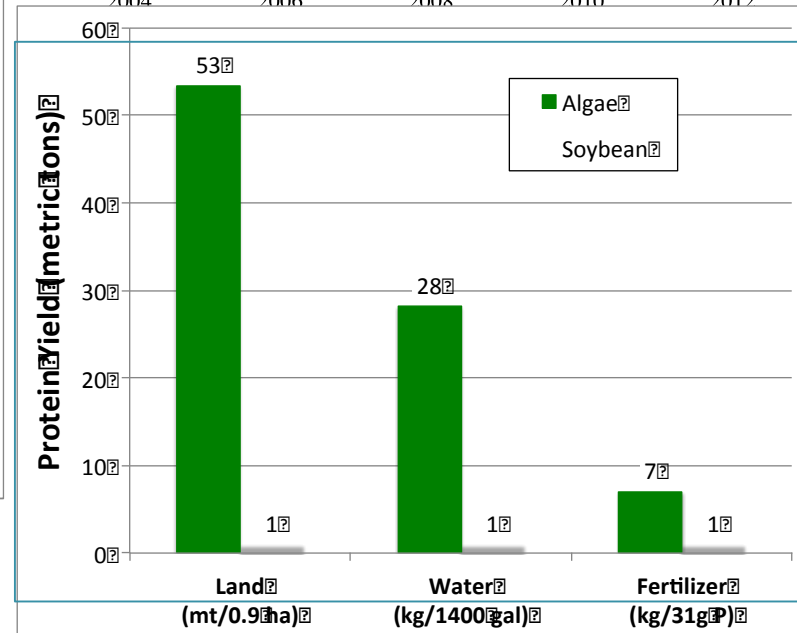
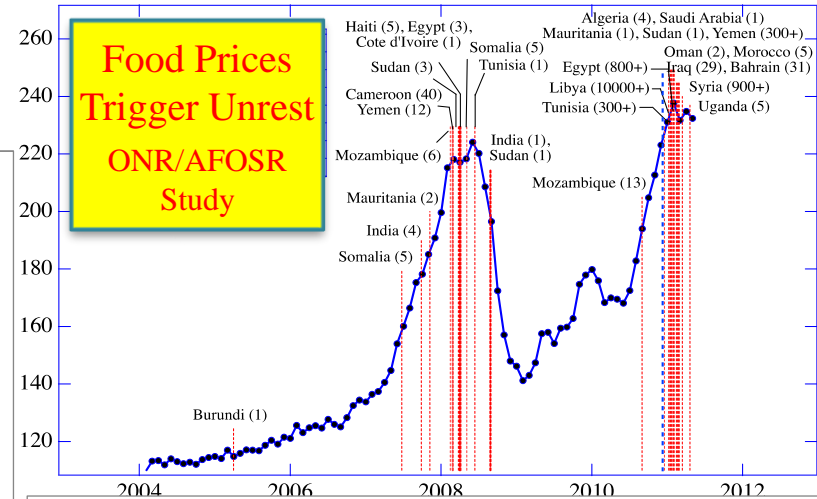
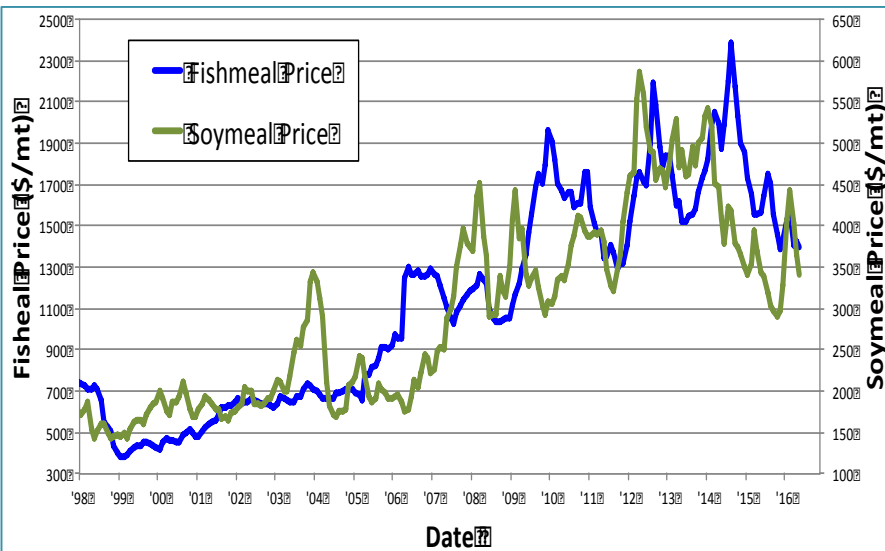


Potential CO₂ re-use
in US is greater than
800 million mt/year

An Algae Industry Would Solve the Protein Crisis

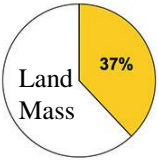
FAO projections

- Need 3x aquaculture protein
- Need 2x other protein
- Crop yield increase ~1.2 %/year

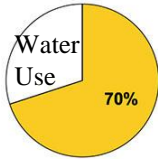


An Algae Industry Would Contribute to Global Environmental Solutions

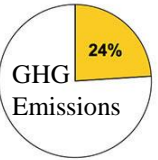
Global Agricultural Footprint



Leading cause of deforestation and habitat loss is for protein production



Leading cause of global water impairment is agricultural run-off



Accounts for 24% of global greenhouse gas emissions



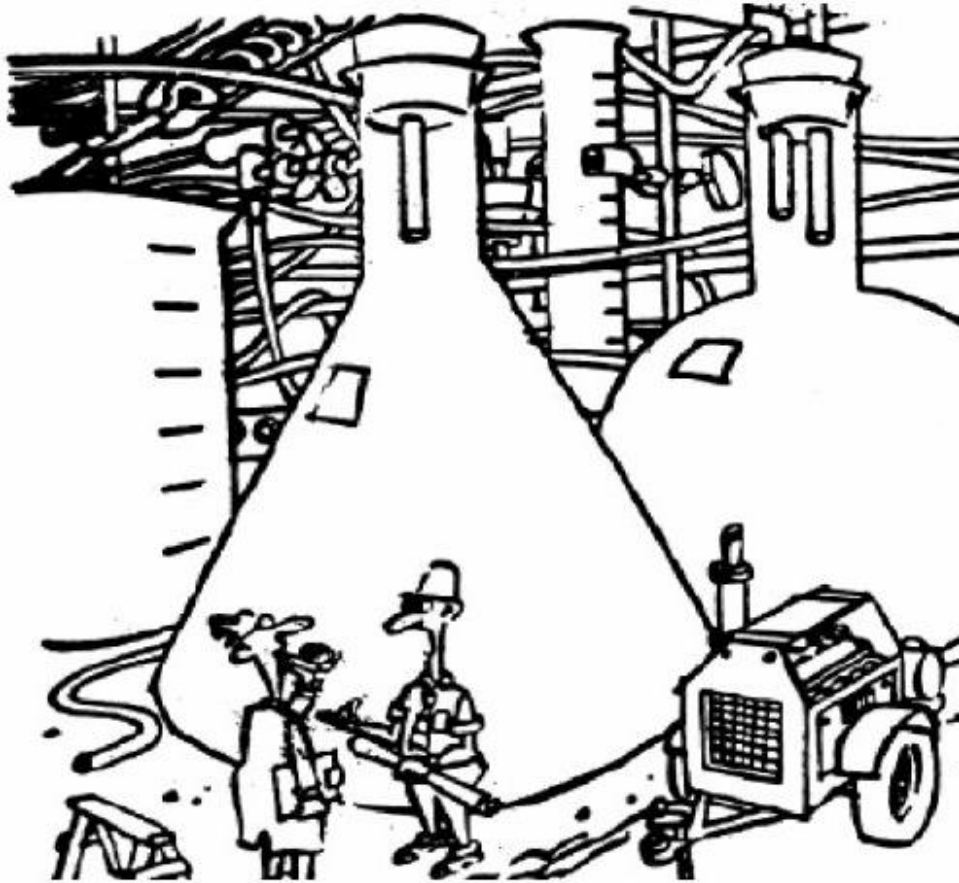
CCS Energy Sector Emissions Mitigation

0% 25% 35% 45% 55% 65% 75%

	0%	25%	35%	45%	55%	65%	75%
BAU	624	563	537	514	491	470	445
BioEnergy	583	525	500	478	456	436	413
Alg-Feed 10%	513	458	435	415	395	376	355
Alg-Feed 20%	496	442	418	398	378	359	337
Alg-Feed 30%	484	429	405	385	364	345	323
Alg-Feed 40%	473	417	393	372	351	332	310

Walsh et al. *Carbon Balance Manage* (2015) 10:26

Presents Multidisciplinary Problems with Multiple Breakthroughs Required



'Show-stoppers'

- CO₂ supply
- Water use
- Mixing energy
- Harvesting energy
- Weed algae & predators
- Open system productivity
- Scalability

We seem to have a few problems going from lab-scale to full-scale production

Demonstrated Solutions to All 'Show-Stopper's'

CO₂ supply

24-hr capture

2.5" water press. drop

Long-term storage

200x less control pts

No ground-level
flue gas release



Cultivation System

Avoids contamination

100x greater scaling

1/4 mixing energy

3x productivity

Rain capture



Zobi Harvester[®]

100% harvest eff.

15-20% solids

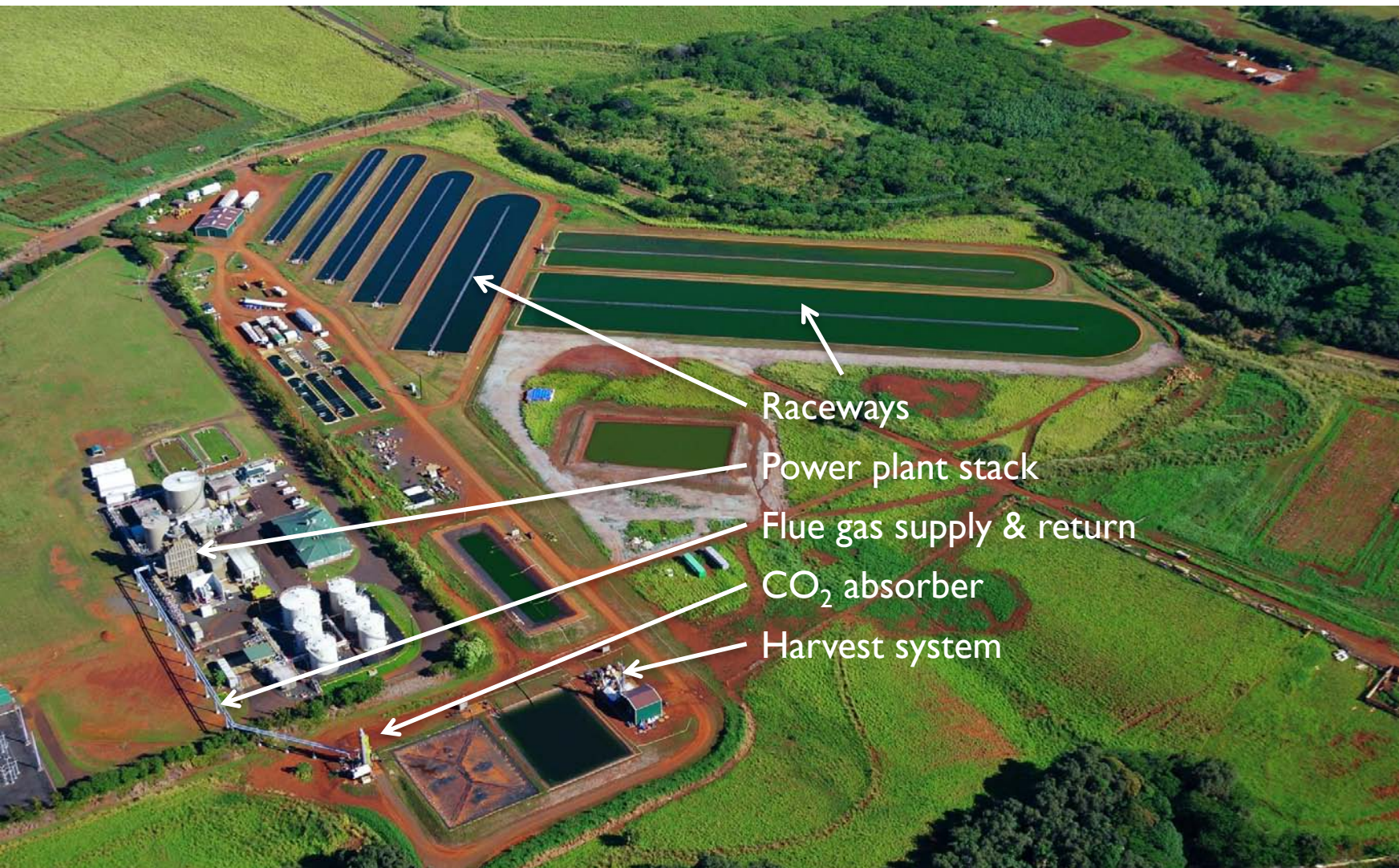
No flocculants

1/100th energy use



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Algae cultivated on CO₂ supplied from power plant flue gas since June 2014



Raceways

Power plant stack

Flue gas supply & return

CO₂ absorber

Harvest system



Summary

- Algae industry offers solutions for many global dilemmas
 - High quality rural jobs and rural rejuvenation
 - Protein crisis
 - Water quality, Deforestation, and Climate change
 - Inequitable distribution of oil - Biofuels
 - Power cost – CO₂ becomes co-product
- Global Algae Innovations has overcome the show-stopper issues for algae production and is working on scale-up
- The algae industry is poised to become a giant multinational industry
 - Productivity and sustainability to meet growing demand
 - Food, Feed, Polymers, and Biofuel
- United States should aggressively support this emerging industry
 - US is currently the world leader
 - Facing large investments by China, India, Korea, Japan, Australia, Europe
 - Need continued and accelerated investment during the emerging stage