GLOBAL ALGAE INNOVATIONS

Algae Solutions to Global Dilemmas

DOE BIO ECONOMY Conference 2017

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Global Algae Innovations
Algae Solutions to Global Dilemmas

1. Rural rejuvenation & jobs
2. Protein crisis
3. Water, deforestation, climate
Algae Commodities: Protein and Lipids

Make-up Water & Nutrients → Flue Gas → Open Raceway Growth → Harvest → Drying & Extraction

Lipid Intermediate → Conversion to Poly-ols → Consumer Products $1-3/kg

Oil Purification → Oil for food $1-3/kg

Hydrotreating or transesterification → Biofuel $0.5/kg

Protein Processing

Protein meal Intermediate

Protein for food $1-3/kg

Aquaculture Feed $0.7-1.5/kg

Protein-based polymers $0.5/kg

Animal Feed $0.5/kg

Biofuel $1-3/kg
Why is Algae a Big Deal?

Algae could double US crop output with 2% of land and 3% of water
Productivity is a Key Driver of Economic Growth and High Quality Jobs

Algae is Transformational

Successfully creating algae industry

Economic Boon --- Higher Standard of Living --- Massive Job Creation
Algae CO$_2$ Re-use = Lower Electric Rates and More Competitive US Industry

Convert CO$_2$ waste into a product

Potential CO$_2$ 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

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

‘Show-stoppers’
- CO₂ supply
- Water use
- Mixing energy
- Harvesting energy
- Weed algae & predators
- Open system productivity
- Scalability
Demonstrated Solutions to All ‘Show-Stoppers’

**CO₂ supply**
- 24-hr capture
- 2.5” water press. drop
- Long-term storage
- 200x less control pts
- No ground-level flue gas release

**Zobi Harvester®**
- 100% harvest eff.
- 15-20% solids
- No flocculants
- 1/100th energy use

**Cultivation System**
- Avoids contamination
- 100x greater scaling
- ¼ mixing energy
- 3x productivity
- Rain capture

**Global Algae Innovations**
Algae cultivated on CO$_2$ supplied from power plant flue gas since June 2014
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