

Breakout Session  
Co-Products (Day 1)

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# Market Size

EISA goal by 2022:

36 billion gal biofuel /year = ca.100 million tons biofuel/year  
= ca. 300 million tons biomass/year (@ 33% lipid content)

Future outlook:

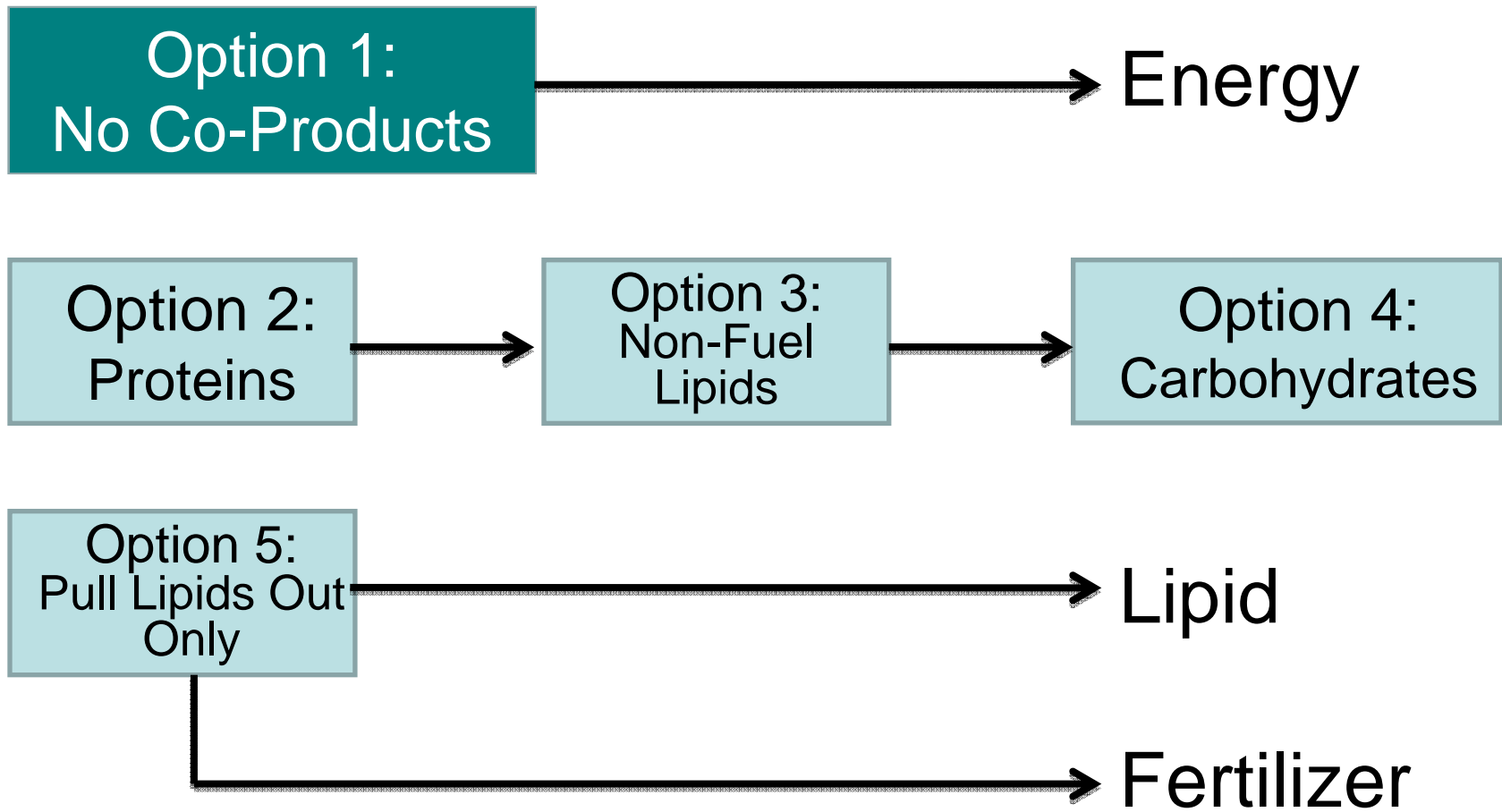
- Biofuels drive co-products (not the other way around)
- Market size has to be large (generally low value)
- Boutique production of wide variety of co-product is in principle possible.

Not covered in this section:

- Energy recovery technologies (biorefinery)



# Overall Concept





# Option 1

## Option 1: Complete Energy Recovery, No Co-Products Recycling of all Nutrients (N, Si, etc.)

### R&D Needs

- Maximize biomass productivities
- Understand microalgal physiology
- Understand nutrient recycling and recovery
- Maximize efficiency of biomass conversion to energy
- Use ash as soil fertilizer?



## Option 2

### Option 2: Remove N-Containing Compounds

(High volume, low cost: Food+ Feed,  
Cellulases)

(Low volume, high cost: Indust. Enzymes)

### R&D Needs

- Quality of feed protein, species dependence, shelf-life
- Effect of CO<sub>2</sub> quality on feed (toxicity?)
- Build molecular genetic tools for optimizing protein synthesis (enzymes, therapeutics)



## Option 3+4

### Option 3: Remove Non-Fuel Lipids

(High volume, low cost: surfactant, bioplastics)

(Low volume, high cost: specialty chemicals from cracking of triglycerides)

### Option 4: Remove Carbohydrates

(High volume, low cost: ethanol fermentation,  
recycling for pulp and paper)

(Low volume, high cost: polysaccharides,  
emulsifiers, nutraceuticals)



# R&D Needs for Options 3+4

## R&D Needs

- Understand metabolic profile of algae
- Develop high throughput technologies for metabolites
- Develop metabolic engineering tools
- Bioresource support services: Strain collections, data resources, and ready access



## Option 5

Option 5: Remove lipids only and use residual biomass  
(High volume, low cost: soil fertilizer)

### R&D Needs

- Quality of soil fertilizer
- Is there any pre-treatment needed?



# Interfaces

- What areas of interest need to be discussed between your session and other breakout areas?

Wastewater treatment as co-service.

CO<sub>2</sub> mitigation as co-service.



## Contentious/Controversial Topics

- What were the topics that sparked the most heated exchanges and/or differences of opinion.

How to address the organization of co-products.