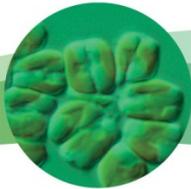


# cellana™

algae-based products  
for a sustainable future™



## Algae as the new Feedstock for the Advanced Bioeconomy

David Anton, COO  
June 2016

**ABLCCFeedstocks**  
Advanced Bioeconomy Leadership Conference - Feedstocks & Supply Chain

# Global issues for feedstocks: hunger, nutrition, climate change, and water

## Hunger

**“Some 795 million people** in the world do not have enough food to lead a healthy, active life. That's about one in nine people on earth.”  
*State of Food Insecurity in the World*, FAO, 2015

## Nutrition

“Poor nutrition causes **nearly half (45%) of deaths** in children under five - 3.1 million children each year.”  
*Series on Maternal and Child Nutrition*, *The Lancet*, 2013

## Climate Change

“For governments looking for shortcuts to sustainable development, **algal feedstock manages to satisfy the competing imperatives of food security and climate mitigation** by reducing resource burdens while commodifying CO<sub>2</sub>. On large scales, this establishes the conditions for cascading greenhouse emissions savings and a return to preindustrial atmospheric carbon concentrations.”  
*New feed sources key to ambitious climate targets*, Walsh et al., *Carbon Balance and Management* (2015)



# Algae – superior advantages

- **Rapid Growth**

Microalgae are the earth's most productive plants — 10 to 15 times more prolific in biomass than the fastest growing land plant.

- **Lower land footprint**

Compared to growing sugar or starch crops (sugar cane, sugar beets, corn, wheat, grains), or oilseed crops (soybeans, rapeseed and canola, mustard, camelina, safflower, sunflower, and jatropha).

- **Lower carbon footprint**

Compared to petroleum, fish-based feeds, fish-based Omega-3s, or fermentation-based fuels and nutrition products. Consumes CO<sub>2</sub>, so it is one of the best carbon capture and use solutions.

- **Lower fresh water footprint**

Compared to growing terrestrial crops or producing fermentation-based products.

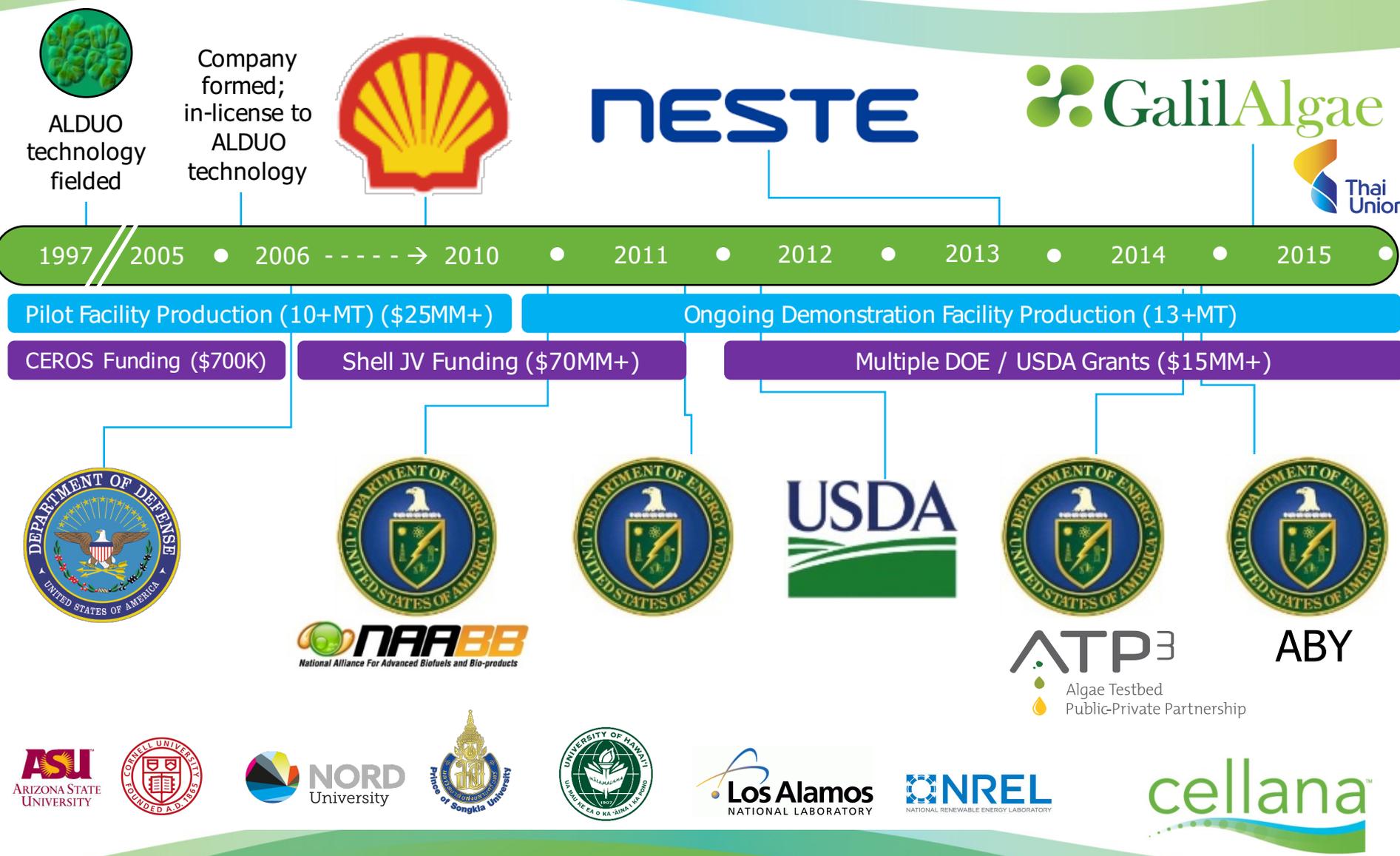
- **Processing of microalgae is less complicated**

Due to algae's small cell size and lack of lignocellulose.



# Cellana's World-Class Partners Since Inception

~ \$100MM invested in R&D, facilities, production, product trials



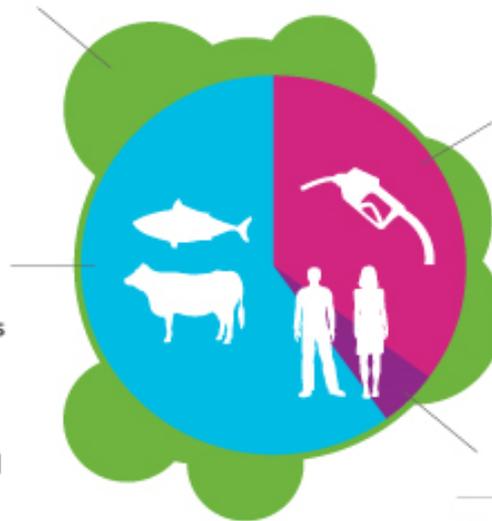
# Cellana - sustainable nutrition, energy as a by-product



**Product:** Whole algae enriched with Omega-3 fatty acids, such as DHA and EPA, and pigments and other antioxidants, such as astaxanthin, beta-carotene, lutein, and zeaxanthin, for food and aquaculture/animal feed applications  
**Market Size:** \$1T+ food and feed



**Product:** High-protein algae biomass to replace fishmeal for farmed fish and soymeal for livestock feed  
**Market Size:** \$9B+ aquaculture feed/fishmeal; \$300B+ livestock feed



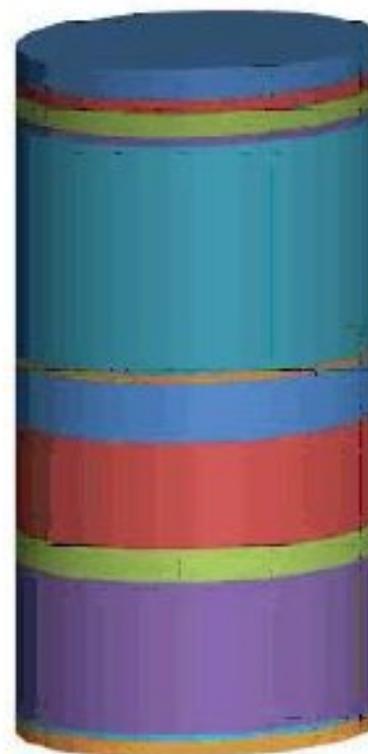
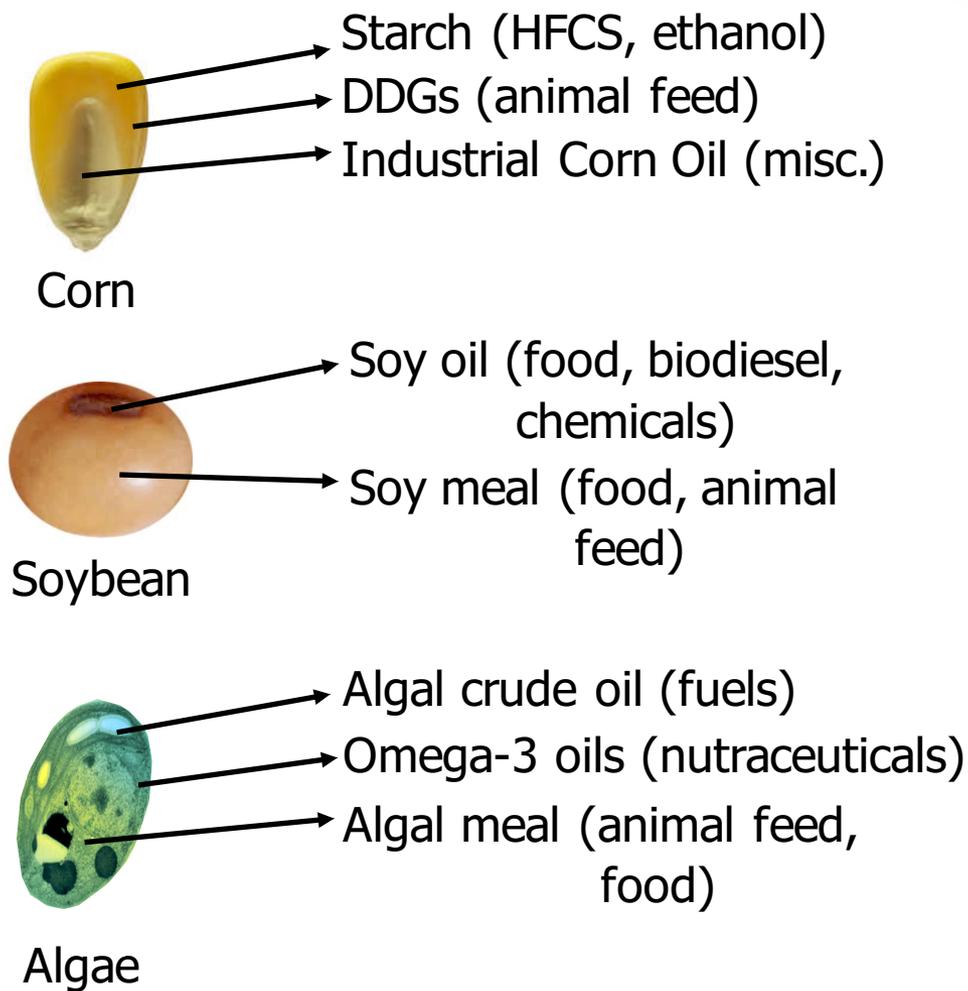
**Product:** Residual bulk oil for biofuel applications  
**Market Size:** \$1T+ fuels and energy



**Product:** High-value oils for human nutrition such as the polyunsaturated fatty acids DHA and EPA (Omega-3 fatty acids)— sold either as nutraceuticals, pharmaceuticals, or feed / food additives



# Multi-product feedstocks are the rule – not the exception – for both biofuels and fossil fuels....

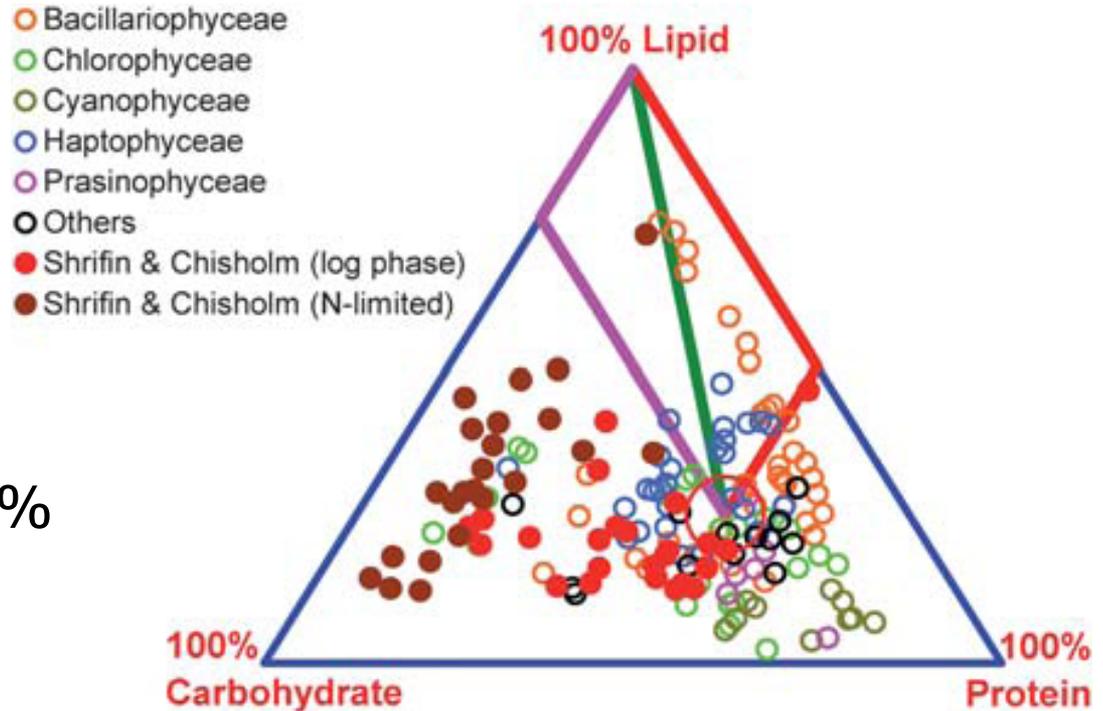


- Gases 4-5.5%
- LPGs 2-3%
- Naptha 2-5%
- Solvents 1.5-1.5%
- Gasoline 25-50%
- Kerosene 1-1.5%
- Jet Kerosene 7-12%
- Diesel 10-25%
- Gas Oil 5-5%
- Fuel Oil 10-40%
- Lubes 1-1%

# Algal Diversity & Composition

- The biochemical composition of microalgae is highly variable, and dependent upon species and environmental parameters (growth irradiance and nutrient concentrations)

Proteins: 20-60 Wt %  
Lipids: 15-60 Wt %  
Nucleic acids: 2-3 Wt %  
Carbohydrates: 10-50 Wt%



# Intensive, Efficient Algae Production at the Kona Demonstration Facility (KDF) in Hawaii

Aerial View of KDF



- 6-acre (2.5 ha site in Kona, Hawaii)
- ~\$20MM facility
- ~1MM liter cultivation capacity
- Produced over 15,000 kg of microalgae since 2010 for testing / feed trials
- 10+ novel strains grown at industrial scale to date; focus on high-Omega-3 strains
- Commercial yields achieved with Omega-3 producing strains in 2014/2015



- Whole algae
- Protein-rich algal meal (w/ some Omega-3s)



Omega-3 oil

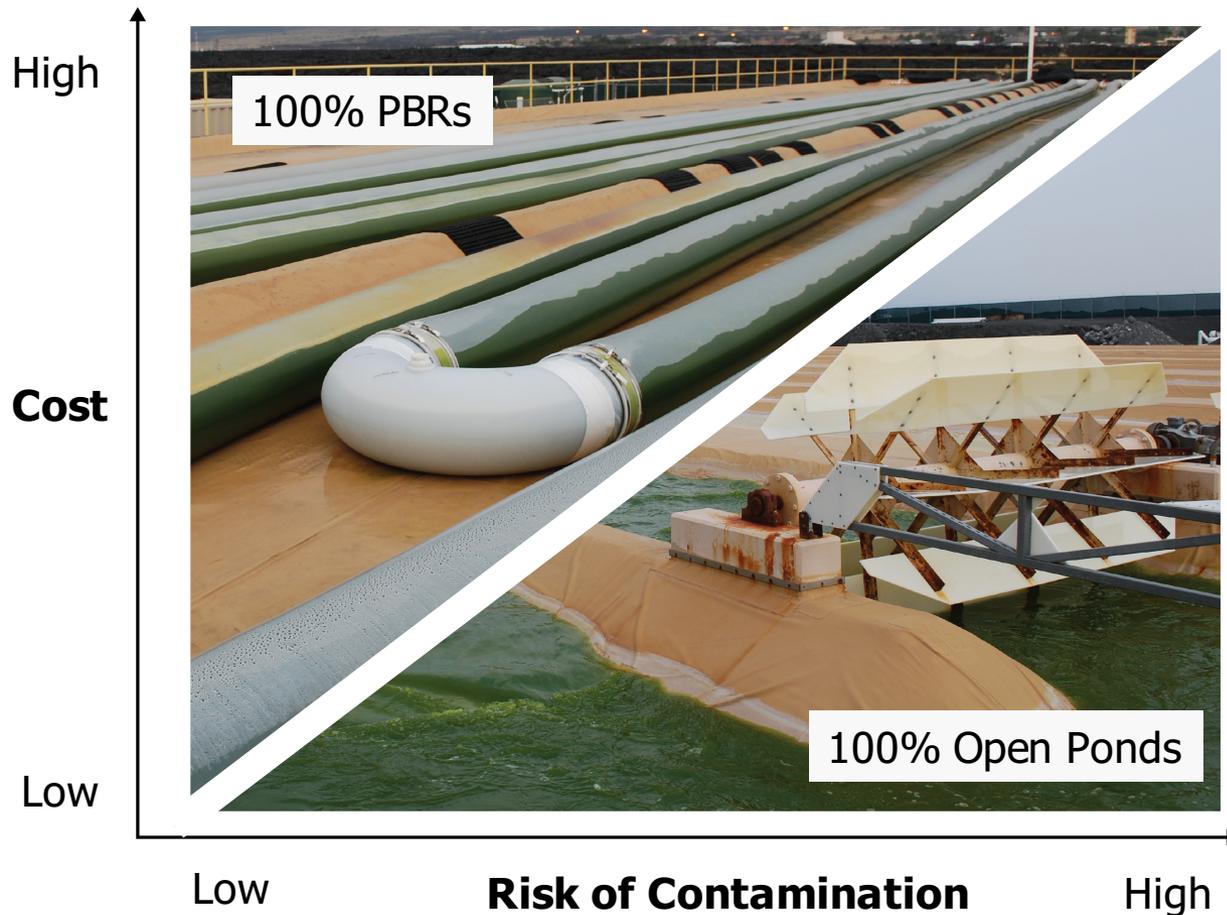


Biocrude oil



# Proprietary ALDUO™ Technology Enables Cost Effective Productivity :

Semi-sterile PBRs (in continuous mode) Inoculate Open Ponds (operated in batch mode)

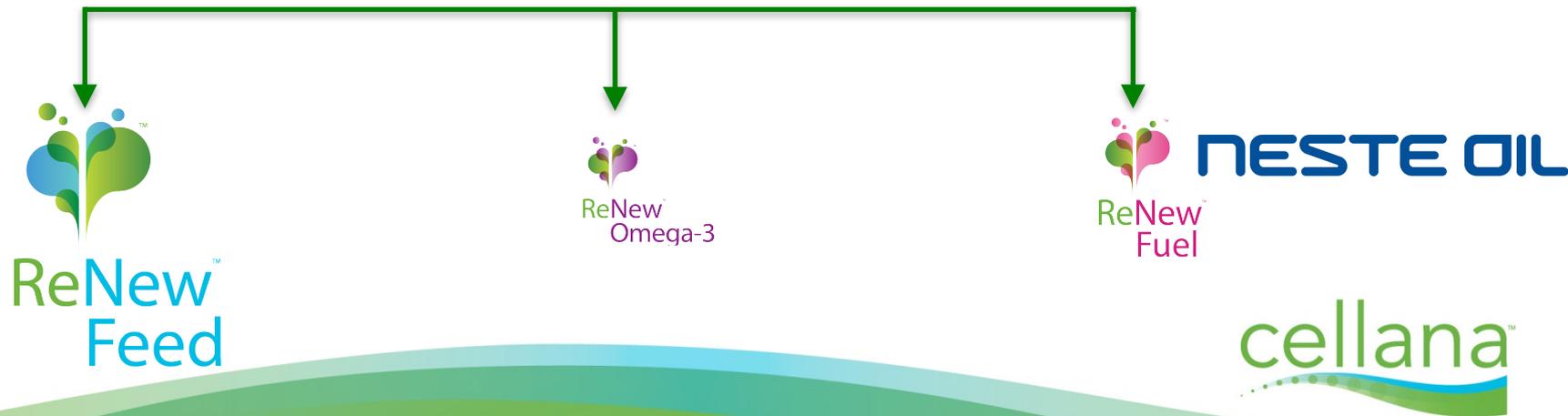


Covered by US Patents 7,770,322 & 5,541,056; similar Patents/Patents pending in RoW

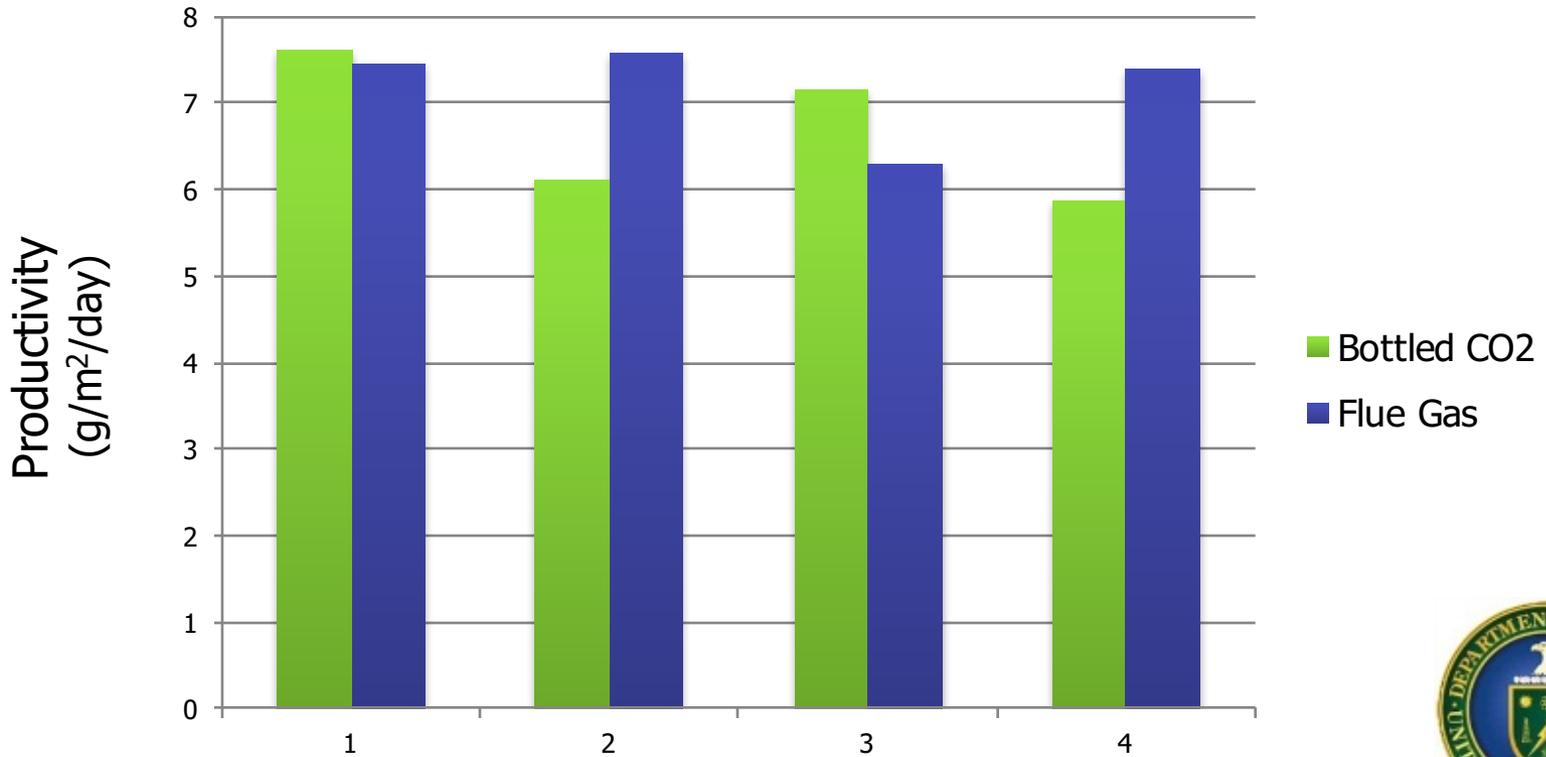


# Multi-Product Business Model: up to 4 Products From Each Strain Via ALDUO™ + “Conventional” Upstream/Downstream Processes

- “Off-the-shelf” ag inputs + sunlight + CO<sub>2</sub> + ALDUO™ = 
- Existing or new & improved separation/extraction techniques =  +  +  + 



# Cellana Uses Industrial Flue Gas Without Compromise as a CO<sub>2</sub> Source



*Nannochloropsis maritima*  
60,000L binary ponds



ABY



# ReNew™ Fuel – crude oil feedstock for biofuels



- Crude algae oil prior to refining
- \$270 per metric ton for biocrude at ~\$40 Bbl crude. Biomass fraction / ton: 25+%
- \$1+ trillion oils, fuels, and energy markets
- Samples generated from first commercial facility with commercial products sold from second and follow-on commercial facilities located worldwide, under a signed offtake agreement with Neste (Finland).



# Successful, large-scale feed trials

- **Salmon, Carp, and Shrimp:** Cellana's ReNew Feed was acceptable for the three animals at the maximum levels tested (Salmon 10%, Carp 40%, Shrimp 40%)  
*Marine microalgae from biorefinery as a potential feed protein source for Atlantic salmon, common carp and whiteleg shrimp*, V. Kiron (Bodo Univ.) *et al.*, *Aquaculture Nutrition*, Vol. 18, Issue 5, pp. 521-531, Oct. 2012
- **Broiler Chicks:** Cellana's ReNew™ Feed could substitute for 7.5% of soybean meal alone, or in combination with corn, in diets for broiler chicks when appropriate amino acids are added  
*Potential and Limitation of a New Defatted Diatom Microalgal Biomass in Replacing Soybean Meal and Corn in Diets for Broiler Chickens*, Xin Gen Lei (Cornell) *et al.*, *J. of Agricultural & Food Chemistry*, 61(30), pp. 7341-8, July 2013
- **Broiler Chicks and Weaning Pigs:** Broilers fed 15% Cellana's ReNew™ Feed had 16% greater gain/feed efficiency than the control diet over the 42-day period.  
*Nutritional and Metabolic Impacts of a Defatted Green Marine Microalgal (Desmodesmus sp.) Biomass in Diets for Weaning Pigs and Broiler Chickens*, Xin Gen Lei (Cornell) *et al.*, *J. of Agricultural & Food Chemistry*, 62(40), pp. 9783–91, Sept. 2014
- **Broiler Chicks:** Broilers fed 16% Cellana's ReNew™ Feed had up to 60x greater Omega-3 content than those fed the control diet.  
*Dose-dependent effect of a defatted green microalgal biomass on enriching Omega-3 fatty acids in broiler chicken*, Xin Gen Lei (Cornell) *et al.*, 2014 ADSA-ASAS-CSAS Joint Annual Meeting (Conference Paper)
- **Salmon and Shrimp:** Cellana's high-Omega-3 ReNew Feed was acceptable for salmon and shrimp, showing improved pigmentation compared to existing feeds  
*Publication pending, 2016*



# Validation in salmon and shrimp pigmentation visuals

Enhanced pigmentation of salmon fillet with Cellana algae meal (Omega-3 strain, 2015)

Feed without algae

Feed with 12.5% Cellana algae

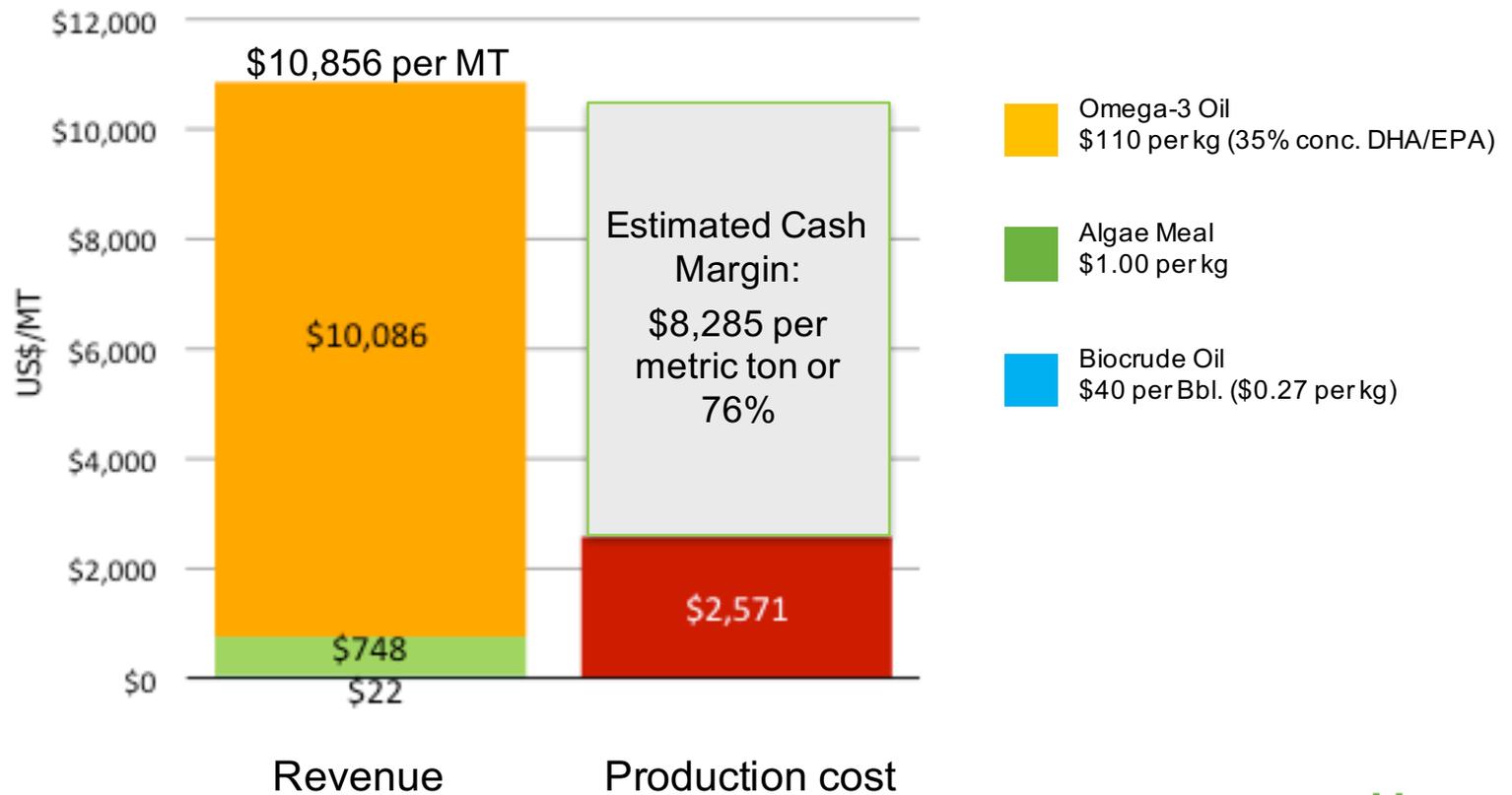


Improved pigmentation with algae feeding based on *SalmoFan*<sup>TM</sup> values (visual analysis) below.

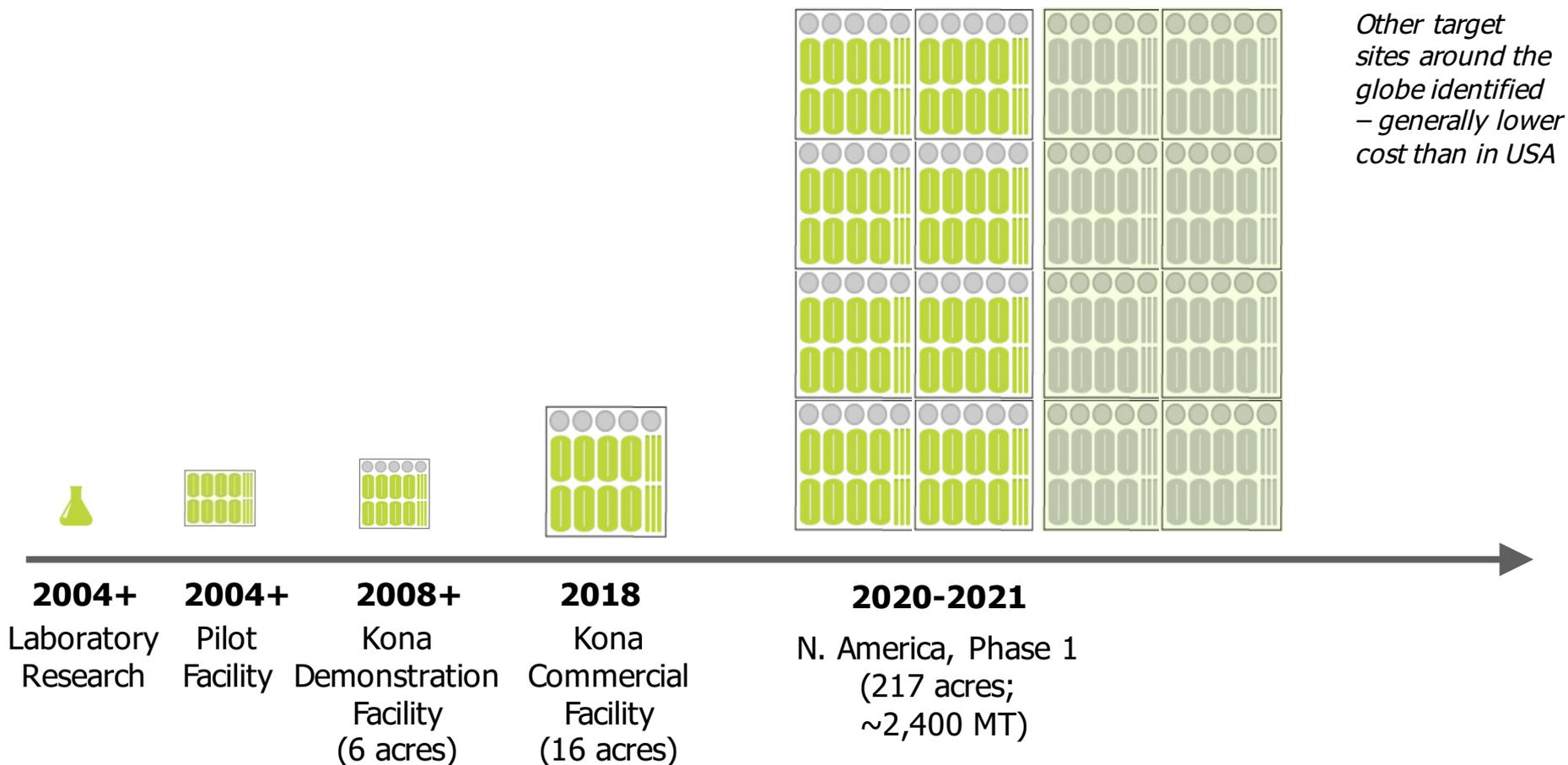


# Key financials

## Estimated Gross Margin from Cellana's Large-Scale Commercial Facilities

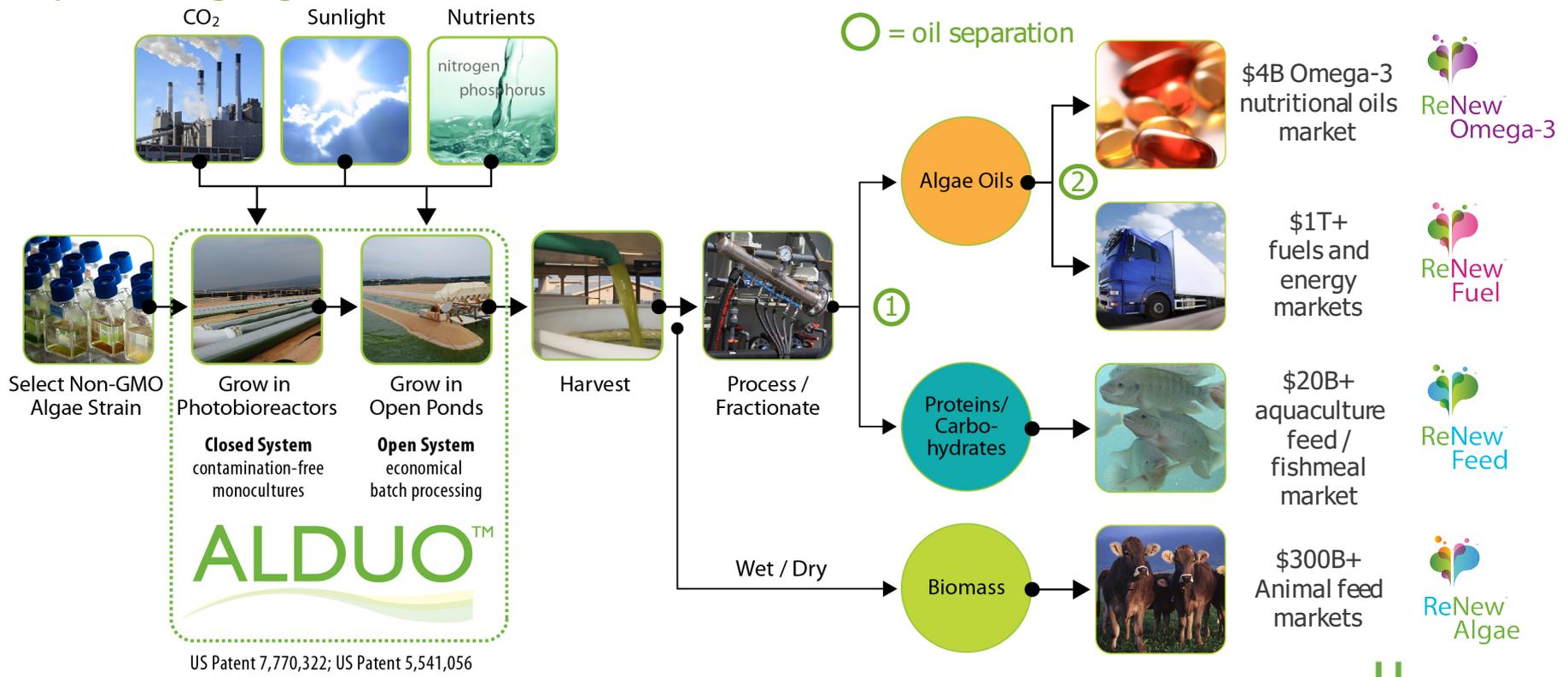


# Modular Growth Enables Scale-Up of Technology to Commercial Facilities



# Cellana's Biorefinery Business Model Builds on a Foundation of Biofuel Research to Address Additional Valuable Products

Omega-3 nutritional oils and high-value aquaculture / animal feed products are an extension of Cellana's core competency - screening, developing, and producing algae biofuel feedstock.



# Lowest Carbon, Land, Water Footprints Compared to Other Sources of Protein/Feed and Fuels

Lower Carbon Footprint

Lower Arable Land Footprint

Lower Fresh Water Footprint



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for a sustainable future™



## Thank You

For further information please visit [www.cellana.com](http://www.cellana.com)

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