As Easy as “ABC” --
Always Be Commercializing:
Cellana’s Multiproduct, Biorefinery-Based Business Model: Today, Tomorrow and in the Future

Valerie Harmon, Senior Director of R&D
Cellana, LLC

© Cellana Inc. 2014
The Promise of Microalgae

- Untapped resource!
- Efficient harvest of the sun’s energy
- Sustainable production
  - Salt water
  - Arid land
  - CO₂ Sequestration
- Simultaneous production of:
  - Essential nutrients
  - Fuels
  - Nutraceuticals
  - Chemicals
  - Pigments
  - Pharmaceuticals
Cellana: Poised for success

- A photosynthetic production system strategy that is proven to work and is sustainable.
- Co-products that are commercially viable.
- A biorefinery business model that will succeed.
- Realizing the promise of microalgae for a sustainable future today.
Kona Demonstration Facility
A photosynthetic production strategy in action!
Intensive, Efficient, Sustainable Algae Production at the Kona Demonstration Facility (KDF) on Hawaii

- 2.5 hectare site in Kona, HI
- >750,000 liter large-scale cultivation capacity
- Produced over 13 tons of microalgae since 2010
- Commercially significant biomass/oil yields (over 15 g/m²/day biomass productivity)
- Consistent, reliable year round production
Cellana’s Analytical Capability

<table>
<thead>
<tr>
<th>Culture monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature, pH, PAR, salinity, DO</td>
</tr>
<tr>
<td>Nutrient analysis (N, P, Si)</td>
</tr>
<tr>
<td>OD/dry weight/AFDW</td>
</tr>
<tr>
<td>Contaminant monitoring-microscopes</td>
</tr>
<tr>
<td>Algae physiology (Fv/Fm, respiration, C/N)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compositional analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total lipids</td>
</tr>
<tr>
<td>Total protein</td>
</tr>
<tr>
<td>Total carbohydrate</td>
</tr>
<tr>
<td>Lipid class (HPLC-CAD, Iatrascan)</td>
</tr>
<tr>
<td>Fatty acids (GC/MS, GC/FID)</td>
</tr>
<tr>
<td>Ash and moisture content</td>
</tr>
</tbody>
</table>
Cellana’s Analytical Capability

![Bar chart showing biochemical composition of two samples, 21985 and 22049.](chart.png)
Cellana’s Culture Collection:

- Diverse collection of non-GMO strains for valuable products
- Over 100 candidate commercial strains
- Strains locally isolated, genetically identified
- Strains characterized as to physiology and biochemistry
- Maintained on both agar slants as well as liquid cultures
Cellana’s ALDUO™ Algae Production Technology: Proprietary, Photosynthetic, & Proven

**Closed System**
Photobioreactors (PBRs)

- Contamination-minimized Monocultures
  - (continuous production; inoculates open ponds)

**Open System**
Open Raceway Ponds

- Consistent Batch Production
  - (fully harvested 3-7 days after inoculation when nutrient deplete)

Covered by US Patents 7,770,322 & 5,541,056. Similar Patents/Patents pending in Europe, Australia, South Africa, Brazil, Japan, Mexico
Cellana’s ALDUO™ Algae Production Technology: Cost Effective Sustainable Commercial Strategy

Covered by US Patents 7,770,322 & 5,541,056. Similar Patents/Patents pending in Europe, Australia, South Africa, Brazil, Japan, Mexico
Cellana’s ALDUO™ Algae Production Technology: Advantages

- Many kinds of algae for many types of products
- Sustainable, cost-effective and reliable generation of quality inoculum / biomass
- Successful demonstration scale cultivation of 11 microalgae strains equating to 7 different species cultivated
Biorefinery Model Products

Commercially viable, sustainable products!
Cellana’s Biorefinery Products

Commercially viable products, today.

ReNew Algae
the planet’s most sustainable™

Nothing goes to waste.

ReNew Fuel

ReNew Omega-3

ReNew Feed
Biorefinery Model Products
Off-Take Agreement for algae oil announced June 2013
Neste Oil is the world’s largest refiner of renewable diesel (NExBTL)
Multi-year off-take agreement
Commercial-scale quantities of algae oil (“up to tens of thousands of tons”)
Commercial-Scale Off-Take Agreement with Neste Oil

- Contingencies for Cellana production capacity, sustainability criteria, and other factors
- Non-Exclusive for both parties
- “Samples have shown that Cellana is able to produce algae oil suitable for renewable fuel production by Neste Oil.”
- “The off-take agreement with Cellana allows us access to commercial-scale volumes of cost-competitive algae oil in the future.”

Neste Oil’s plant in Singapore is the world’s largest renewable diesel plant.
Over 5 MT of Cellana’s ReNew Feed Used in Diverse Feed Trials; All Trials Successful To Date

- Finfish, shellfish, chicken, pigs, cattle – most major sources of meat

- Successful large-scale feed trial for Salmon, Carp, & Shrimp
  - Marine microalgae from biorefinery as a potential feed protein source for Atlantic salmon, common carp and whiteleg shrimp, V. Kiron (Bodo University) et al., published online: Aquaculture Nutrition, 3 APR 2012

- Successful large-scale feed trial for Broiler Chicks
  - 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., published online: J. Agric. Food Chem., 4 JULY 2013
Conclusions from the Successful Feed Trials

• The algal replacements from defatted *Desmodesmos* and *Staurosira* were acceptable for aquaculture feeds
  – Salmon 10%, Carp 40%, Shrimp 40%

• There were negligible differences in growth and hardly any in the biochemical composition during the study period

• 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
Feed Trials Currently Underway

- Feed trials currently being conducted with defatted biomass of *Nannochloropsis* strains
  - Chickens and pigs with Cornell University’s Dr. Xingen Lei
  - Salmon trials with Nordland University’s Dr. V. Kiron
Biorefinery Model Products
Algae are Key to Sustainable Omega-3 Production

Fish Oil / Omega-3 Food Chain

Marine microalgae  Zoo-plankton  Herbivorous/planktivorous fish  Smaller carnivorous fish  Larger carnivorous fish (e.g., Salmon)

Sustainable Omega-3 Production Direct from Algae

Cellana “Cuts Out the Middle-Fish”™

Marine microalgae

Vegetarian, Low-Cost, Sustainable Omega-3s **without** Mercury, Dioxins, or PCBs from Fish

Fish Oil with Omega-3 + Mercury, Dioxins, & PCBs

Algae Oil with Omega-3
Increasing Number of Everyday Products Make Omega-3 Claims
Biorefinery Business Model
A commercially viable, sustainable business strategy!
Omega-3 nutritional oils, foods, high-value aquaculture / animal feed products and fuels are an extension of Cellana's core competency – producing microalgae.
Flexible Biorefinery Production / Revenue Model
Bioproducts Generated from the Use of the Entire Algae Biomass

- 121kg Biocrude Oil
  - @ $100/bbl, $0.68/kg (fossil petroleum px benchmark)
- 62kg Omega-3 Oil (35%)
- 708kg Algae Meal
  - Residual Proteins, Sugars, Minerals, Lipids, & Micronutrients
    - @ $1.00/kg (premium to soymeal px benchmark; discount to fishmeal px benchmark)
- $6,928 per MT (dry weight)
  - $82
  - $6,138
  - $708

* Reflects recovery based on initial whole algae fraction of 6% Omega-3 oils, 25% Biocrude oil, 69% Algae Meal (Protein/Sugars/Minerals/Lipids/Micronutrients), and 11% total yield loss after two separations.
Highly Profitable Production of Algae Bioproducts
Projected Revenue & Costs per MT for 88-ha. US Based Commercial-Scale Facility 2016

Projected Revenue and Costs per MT 88-hectare Biorefinery

Estimated 46% Gross Margin and 62% Cash Margin at current yields / costs
(Higher margins / lower unit costs at larger scale and over time)

- **Revenue**
  - $6,928 per MT
  - $6,138

- **Production Cost**
  - $3,701 per MT
  - $1,046 Depreciation
  - $2,666 Cash Cost

- Omega-3 Oil
  - $100 per kg (35% conc. DHA/EPA)
- Algae Meal
  - $1.00 per kg
- Biocrude Oil
  - $100 per bbl, $0.68 per kg

Break Even
Summary
Marine Algae are Very Diverse and Productive

- Estimated novel species in nature:
  - 100,000 to 1,000,000
  - 10-100x more biomass/acre/year vs. row crops
• Microalgae offer solutions to meeting the demands of our growing populations in a sustainable way.

• Cellana’s state of the art production facility and analytical labs in Kona Hawaii have successfully demonstrated technologies that are capable of commercially viable production of biofuels today.

• Financial viability of the industry today requires a focused biorefinery business strategy such as Cellana’s.
Thank You to the staff of Cellana, our feed partners, our biofuel partner and the agencies that fund our research

For further information please visit www.cellana.com

or contact:

Valerie Harmon
Sr. Director of R & D
valerie.harmon@cellana.com