

OriginOil[®]

Scaling Up – from the Lab to the Field

Algae World Australia, 16-17 August 2011

Townsville, Queensland

A BREAKTHROUGH TECHNOLOGY TO EXTRACT OIL FROM ALGAE

Safe Harbor Statement



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CASE STUDY

ALGAE FOR CARBON CAPTURE

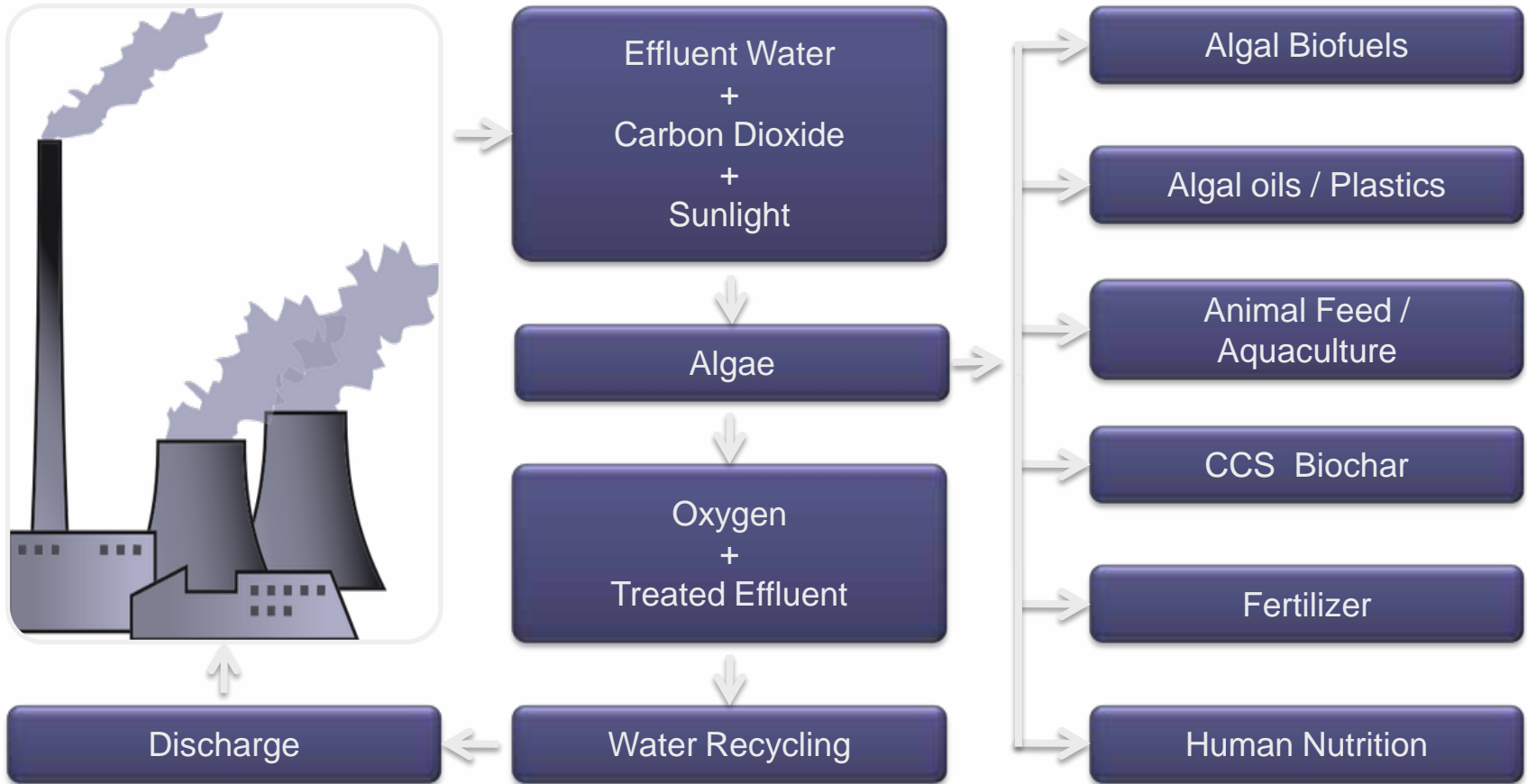
A BREAKTHROUGH TECHNOLOGY TO EXTRACT OIL FROM ALGAE

The Vision



A BREAKTHROUGH TECHNOLOGY TO EXTRACT OIL FROM ALGAE

CO₂ for Value Added Products



A BREAKTHROUGH TECHNOLOGY TO EXTRACT OIL FROM ALGAE

4-Stage Process to Scale



JCU Research Facility
(5,000 m²)



Tarong Energy Display Plant
(1-Hectare)



Pilot Plant
(30-90 Hectare)

Demonstration Plant
(500-Hectare +)

A BREAKTHROUGH TECHNOLOGY TO EXTRACT OIL FROM ALGAE

A Fast-Growing Partnership



q Technology To Date:

1. Quantum Fracturing™ (QF) technology to inject CO₂ and nutrients into algae culture.
2. Single Step Extraction™ (SSE) for continuous, highly-scalable, chemical-free dewatering and cell lysing.

q Timeline:

- q June 2010: MBD orders research-scale QF & SSE systems. Strategic agreement.
- q December 2010: Research systems operating successfully at James Cook Univ.
- q January 2011: MBD orders construction-phase SSE for Tarong Power Station.
- q April-May 2011: Scale and integration trials at MBD.
- q May 2011: MBD orders full-size SSE for Tarong Power Station 1ha Display Plant.
- q Looking Ahead: *"...a growing pipeline of large-scale CO₂ to Energy Algal Synthesizer installation projects at power stations and other emitters in Australia and around the world."* Andrew Lawson, Managing Director, MBD Energy, 23 May 2011.

The Big Picture

MANAGING THE NEXT PHASE

A BREAKTHROUGH TECHNOLOGY TO EXTRACT OIL FROM ALGAE

The New Phase of Algae Scale-Up

- q MBD and other producers (e.g. Aurora Biofuels) have now exited the test phase.
- q New stage: Industrial Demonstration
- q Challenges:
 - q Managing real-world inputs (e.g. CO2 emissions, waste water)
 - q Consistent health and yields of algae fields (many factors)
 - q Process management for quality and automation
 - q Managing very large harvest inflows (up to 300GPM continuous for 1ha cultivation)
 - q Development of offtake arrangements, carbon tax mitigation, etc.
 - q Managing expectations in media, government, investors, the public.

**Completion of this stage =
Key industry inflection point.**

Lessons Learned: Vendor Integration



- q Early customer message: don't make us manage multiple vendors!
- q Current integration projects:
 - q Real-time control network (SCADA*) with hooks into growth control systems
 - q Process integration with 3rd party equipment:
 - § Dissolved Air Flotation
 - § 3-Phase Separation
 - § Fractionation systems (multiple approaches)
- q Biggest challenge: low-energy, reliable, chemical-free systems.
- q Biggest opportunity: cross-leveraging vendor distribution networks.
- q One year outlook: lots of test sales as producers experiment widely.
- q Three year outlook: vendor shakeout as best-of-breed solutions emerge.
- q **Multi-way vendor alliances will be key to long-term survival.**

* SCADA: Supervisory Control and Data Acquisition

Innovation vs. Product Management



- q OriginOil's challenges:
 - q “too much good stuff” – innovations in all areas of algae production
 - q Lots of diffuse demand from potential customers
 - q Fast-moving technology development
- q Solutions:
 - q Focus: Single Step Extraction™ the only product offered
(Additional process, service offerings only for existing SSE clients)
 - q Product Management:
 - § Standardization on two capacities – entry-level and full-scale modular
 - § Process Engineering and Design
 - § Version and Build management
 - q Evergreen support contracts:
 - § Customer guaranteed our best offering
 - § Beneficial standardization of product fleet

Process Engineering vs. Live Algae?

- q Existing algae production is like farming or brewing.
- q Large-scale algae production is like waste water treatment:
 - q Large volumes of water and dynamic input variables
 - q Potential for crash events
 - q Load balancing is critical
 - q Integrated real-time controls required from growth through offtake.

Process engineering best practices are essential to achieve very large scale production.

Intermediate Feedstock Standardization



- q For scale, growers need a defined output standard.
- q Requirements:
 - q Compact for transportation (minimum 10% solids)
 - q Achieved without toxic chemicals (local permits issue)
 - q Minimal biomass degradation
 - q Cell disruption achieved for downstream processing
- q Suggested labels:
 - q Formal: Uniform Intermediate Feedstock
 - q Informal: Algae Crude
- q OriginOil wants to work with growers, process partners, standard-setting bodies to develop a standard.

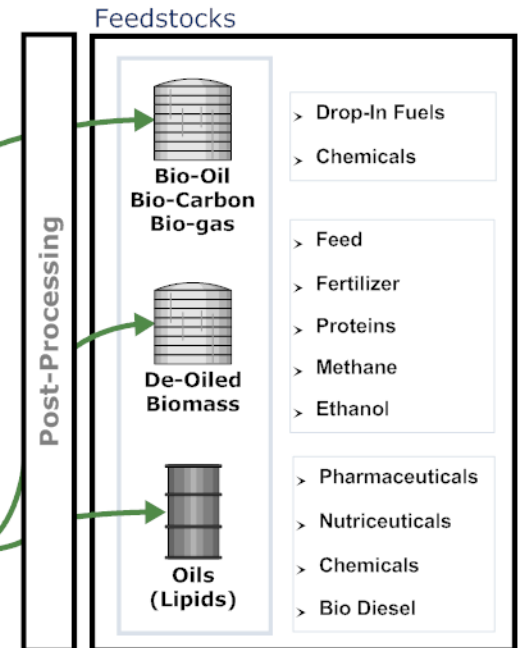
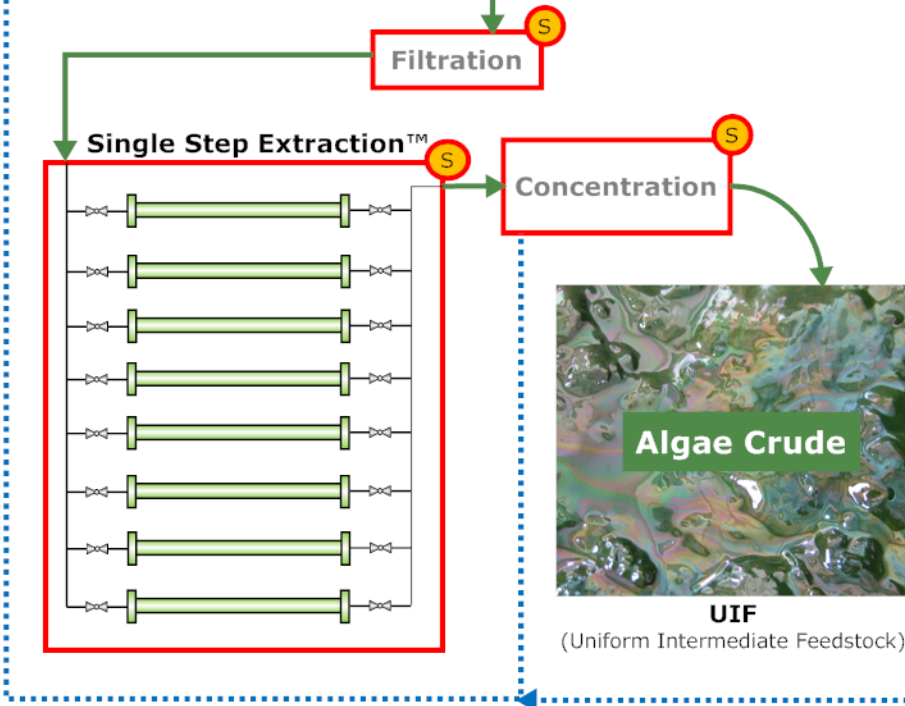
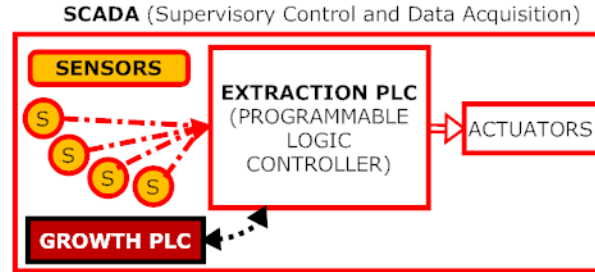
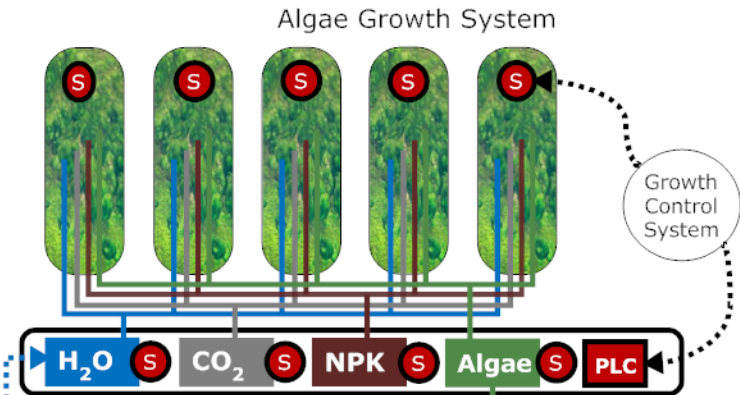
We want your opinion!



“Algae Crude”
(Uniform Intermediate Feedstock)

Produced by Evodos™ centrifugation after
OriginOil® Single Step Extraction™

OriginOil Integrated System: _____



Summary

- q Carbon capture a major driver for large-scale algae production.
- q New stage: industrial demonstration.
- q Customers demanding vendor integration and a single point of contact.
- q Biggest challenge: low tech, low-energy systems.
- q Evolution toward best-of-breed systems will drive a shakeout.
- q Focus, standardization imperative.
- q Industrial-scale algae process is like waste water treatment.
- q Growers need a defined feedstock output.
- q OriginOil helping to define a uniform intermediate feedstock – Algae Crude.

**Completion of this stage =
Key industry inflection point.**

THANK YOU!

Riggs Eckelberry

QUESTIONS?

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