February 2012

Unlocking the Sugars in Seaweed to Produce Renewable Chemicals and Fuels

bio architecture lab

Company Introduction

We Make Chemicals and Fuels From Seaweed

Highly Efficient Capital Utilization

RENEWABLE CHEMICALS

RENEWABLE FUELS

PROPRIETARY PLATFORM
Unlocking the Sugars in Seaweed

Top-Tier Investors and Partners

InnovaChile CORFO · Statoil Venture · austral capital · AURUS · XSEED · DUPONT

Experienced Management Team

DANIEL TRUNFIO	*Chairman and Chief Executive Officer*
DR. RICH BAILEY	*Chief Technology Officer*
RIC LUCIEN	*Chief Financial Officer*
YUKI KASHIYAMA	*Founder, General Manager, Global Biomass Sourcing*
DR. YASUO YOSHIKUNI	*Founder, Chief Science Officer*
DR. CANDACE SWIMMER	*Sr. Director, Research*
AJAY KSHATRIYA	*General Manager, Chemicals*
CHIP ALLGROVE	*Gerente General, BAL Chile*

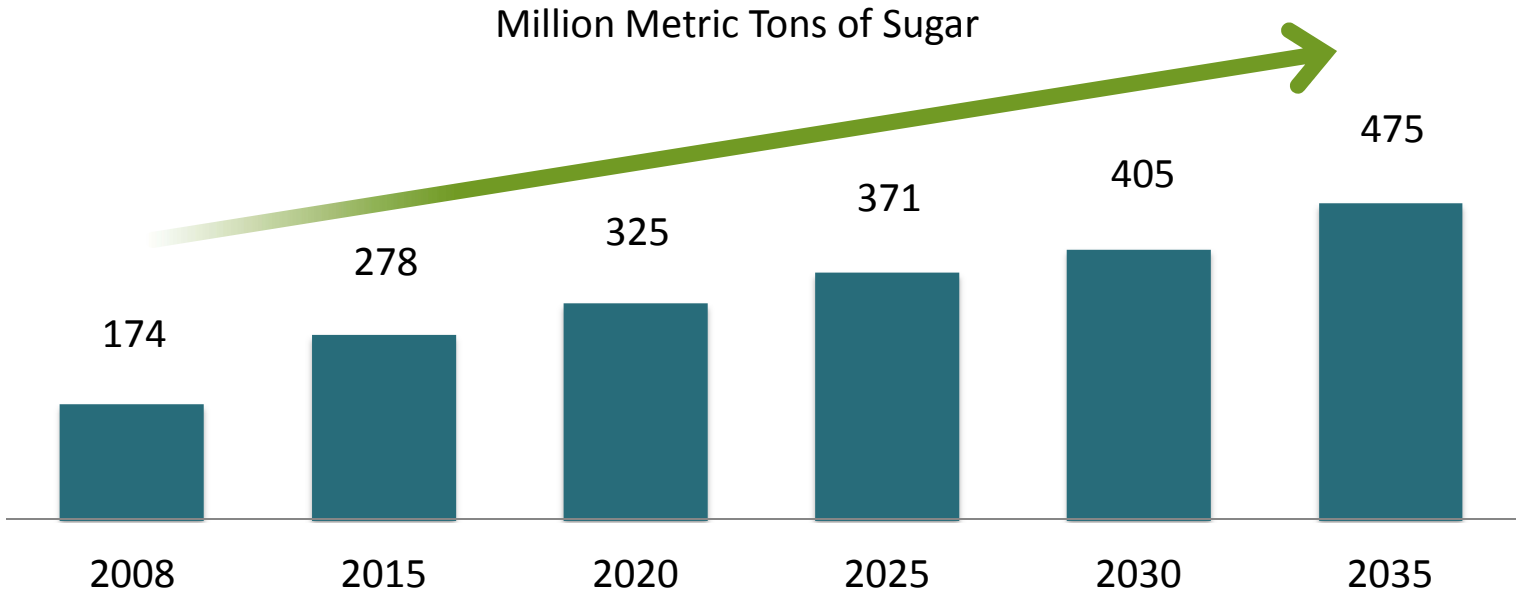
Commodity and Supply Chain

Biology & Chemistry Process Development

Scale-up and Commercialization

Sugar is the "New Crude Oil" and is the Building Block for Renewable Fuels and Chemicals

SUGAR REQUIRED TO SUPPORT GLOBAL RENEWABLE FUELS AND CHEMICALS GROWTH



Conventional sugar producers are not likely to support the growing global demand with economically viable fermentable sugars . Seaweed cultivation using BAL technology provides a low cost alternative

Source: Energy Information Administration 2010
International Energy Outlook

Seaweed is the Ideal Biomass and is Already Cultivated at Commercial Scale

ABUNDANT

- Well studied biomass
- Perennial biomass
- One of fastest growing plants on earth
- Worldwide availability

ENVIRONMENTAL

- No competition with food for land use
- No fresh water
- Beneficial to the oceans
- Low carbon footprint

SCALABLE

- Significant coastline cultivation potential
- Existing **commercial scale** farms in Asia
- Local, native species available

LOW COST

- High sugar content
- No lignin to degrade
- Cost competitive with Brazilian sugar cane
- Co-product opportunities

Seaweed Provides All of the Benefits of a Cellulosic Biomass Without the Lignin

	1st Gen Feedstock	Feedstock **WITH** Lignin	Feedstock **WITHOUT** Lignin
			
COST OF FERMENTABLE SUGAR (¢/LB.)	Cane Juice 9-28¢ Corn 17¢	$$$$$	5¢ - 10¢*
	✘ Food competition ✘ Geographically limited	✔ No food competition ✔ Not geographically limited ✘ Costly processing ✘ No established supply chain	✔ No food competition ✔ Not geographically limited ✔ Low cost processing ✔ Scalable ✔ Established supply chain

*At Scale

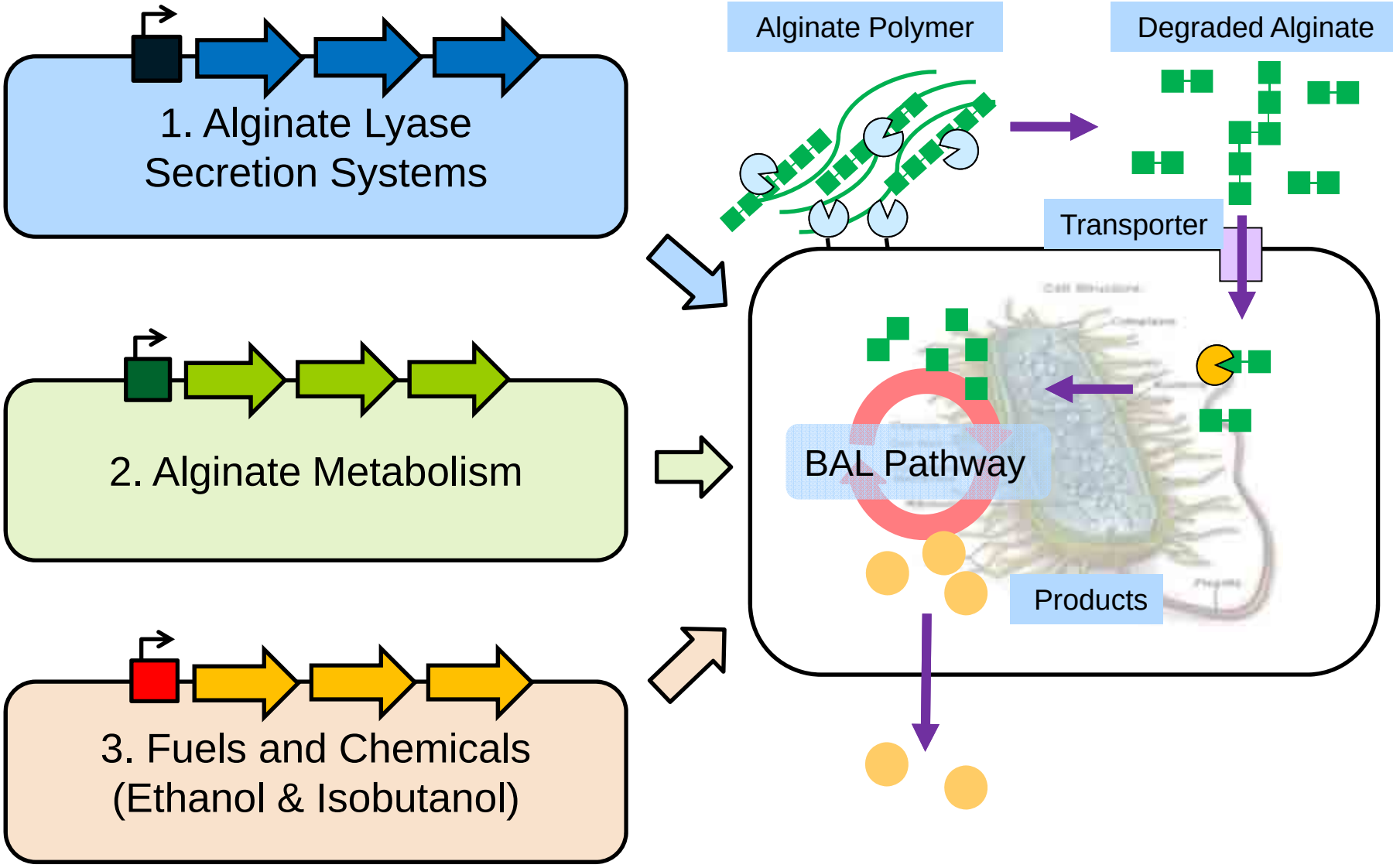
Only Bal Technology Can Unlock the Full Potential of Seaweed to Make it an Economically Viable Feedstock

Sugar ~50% of Dry Weight

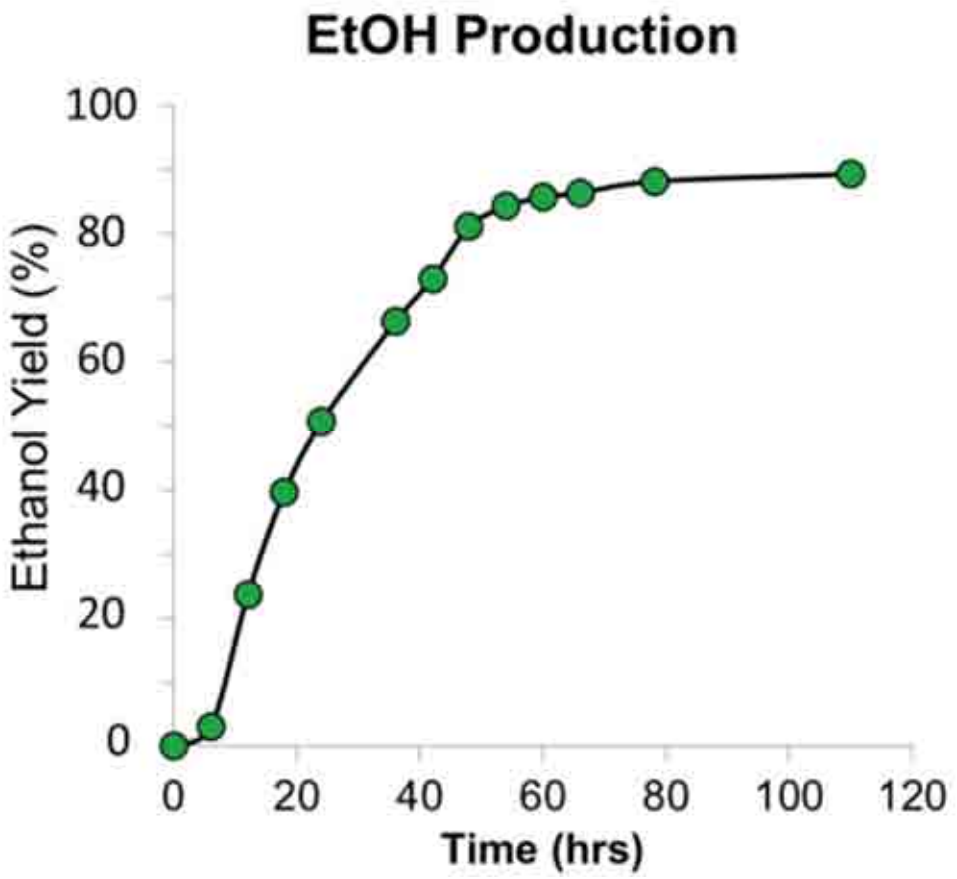
OUR PLATFORM

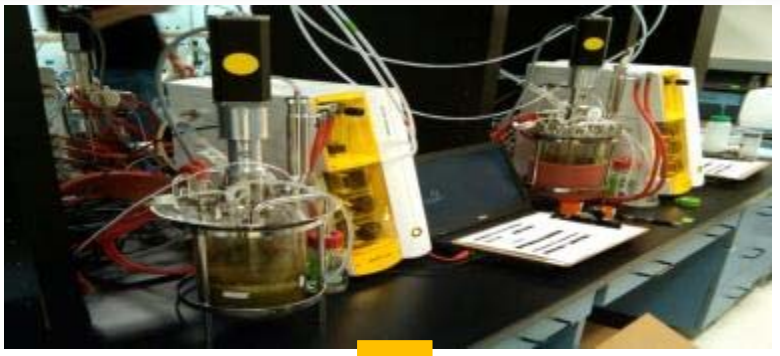
- Ability to metabolize **ALL** the sugars in seaweed
- The **ONLY** technology that can metabolize alginate, which is the most abundant sugar in seaweed
- Without alginate, seaweed is not an **ECONOMICALLY VIABLE** biomass

Architecture of BAL Bacterial Platform



High Performance Ethanol Fermentation from Seaweed





BAL Bacterial Platform is Capable of Fermenting Seaweed into Ethanol with > 5% v/v titer and ~90% max theoretical yield

Bal Technology Was Published Worldwide on the Cover of Science

"Research Article"

An engineered microbial platform for direct biofuel production from brown macroalgae

Adam J. Wargacki[1,*], Effendi Leonard[1,*], Maung Nyan Win[1,*], Drew D. Regitsky[1], Christine Nicole S. Santos[1], Peter B. Kim[1], Susan R. Cooper[1], Ryan M. Raisner[1], Asael Herman[1,5], Alicia B. Sivitz[1,6], Arun Lakshmanaswamy[1], Yuki Kashiyama[1,2,3], David Baker[4], and Yasuo Yoshikuni[1, §]

Abstract

Prospecting macroalgae (seaweeds) as feedstocks for bioconversion into biofuels and commodity chemical compounds is limited primarily by the availability of tractable microorganisms that can metabolize alginate polysaccharides. Here, we present the discovery of a 36-kbp DNA fragment from *Vibrio splendidus* encoding enzymes for alginate transport and metabolism. The genomic integration of this ensemble, together with an engineered system for extracellular alginate depolymerization, generated a microbial platform that can simultaneously degrade, uptake, and metabolize alginate. When further engineered for ethanol synthesis, this platform enables bioethanol production directly from macroalgae via a consolidated process, achieving a titer of 4.7% vol/vol and a yield of 0.281 wt ethanol/wt dry macroalgae (equivalent to ~80% of the maximum theoretical yield from sugar composition in macroalgae).

FORTUNE Magazine Picked Bal Technology as one of "4 New Ways to Solve the Energy Challenge"

"Bio Architecture Lab, headquartered in Berkeley, has built three seaweed farms off the coast of Chile. Workers using winches and lines harvest giant strands of seaweed from boats. The company recently broke ground on a pilot ethanol manufacturing plant in the Los Lagos region of Chile, slated to start operations next year."

Commercial Scale Hatchery Required for Biomass Production Has Been Proven in Asia

Gametophyte production

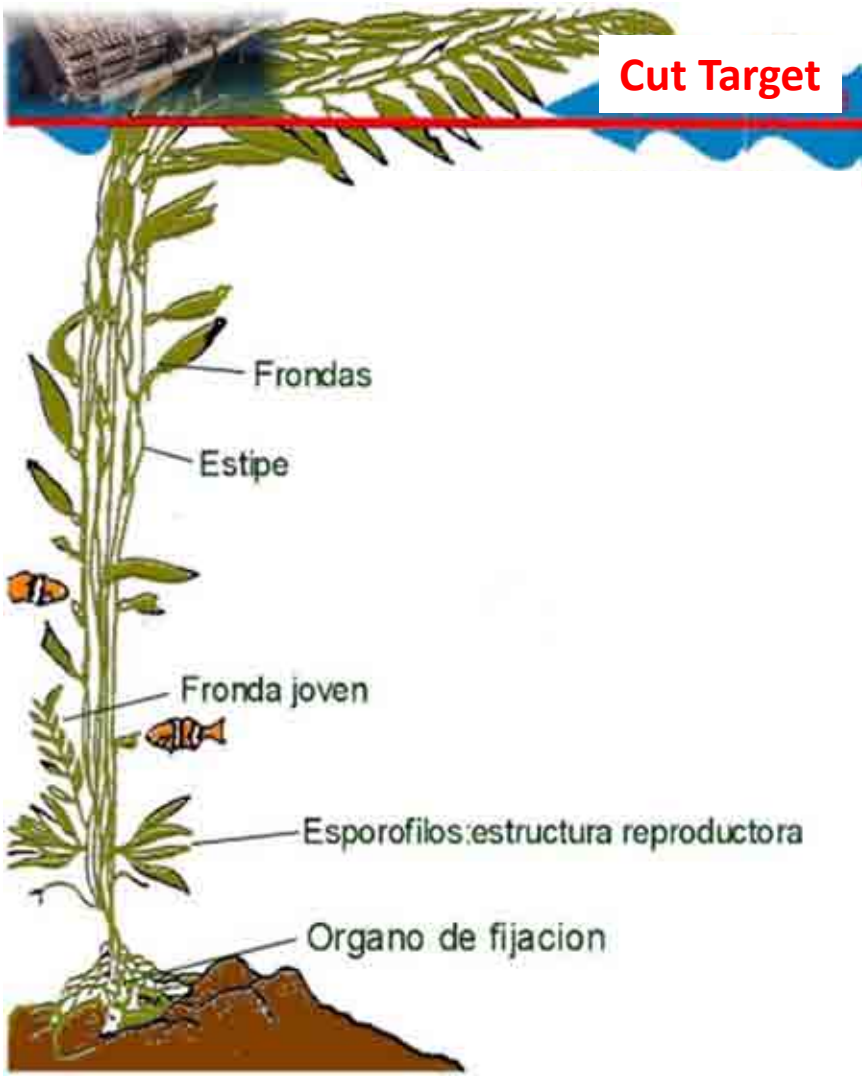
Gravity-fed cement tanks

Commercial hatchery in Qindao, China for 3,000+ Ha seaweed Aquafarming

3,000 Hectare Aquafarming of Brown Macroalgae

In 2011, BAL Delivered ~40+ DMT/Ha/Yr Achieving Commercially Viable Yields

Mowing Canopy (1m Under Surface)



Industrial Harvester Used by Kelco

Industrial Scale Unloading Process in Ensenada, Mexico

Thank You

FIRST MOVER

EXECUTION

COMPELLING BIOMASS

STRONG PARTNERSHIPS

INNOVATION

EXPERIENCED TEAM