

# THE BUSINESS CASE FOR THE Glycell™ Process

**MARCH 2015** 

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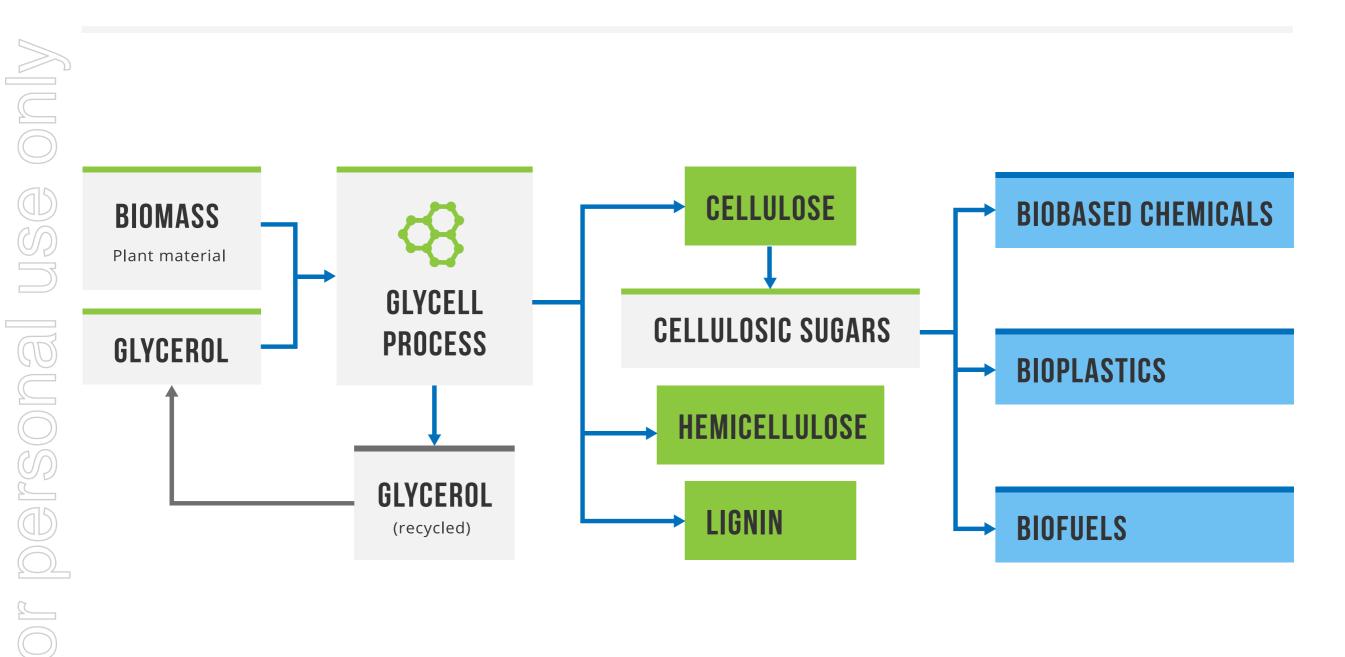
Disruptive technology that produces cellulosic sugars

...cost and performance claims provide advantages over existing technologies(dilute acid, steam explosion) - Lux Research

- Glycell™ process delivers a 35% reduction in cellulosic sugar costs<sup>1</sup>
- Glycell™ process produces clean sugars opening up multiple opportunities
- Cellulosic sugars feed many, multi \$billion, fast growing markets
- 7 agreements to share information and/or samples signed



## **THE GLYCELL<sup>™</sup> PROCESS OVERVIEW**





## **COST OF CELLULOSIC SUGARS**



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Lux report

• Dilute acid \$230 ton<sup>1</sup>

- Steam explosion \$260 ton<sup>1</sup>
- Raw Sugar \$310 ton<sup>2</sup>

Glycell™ process

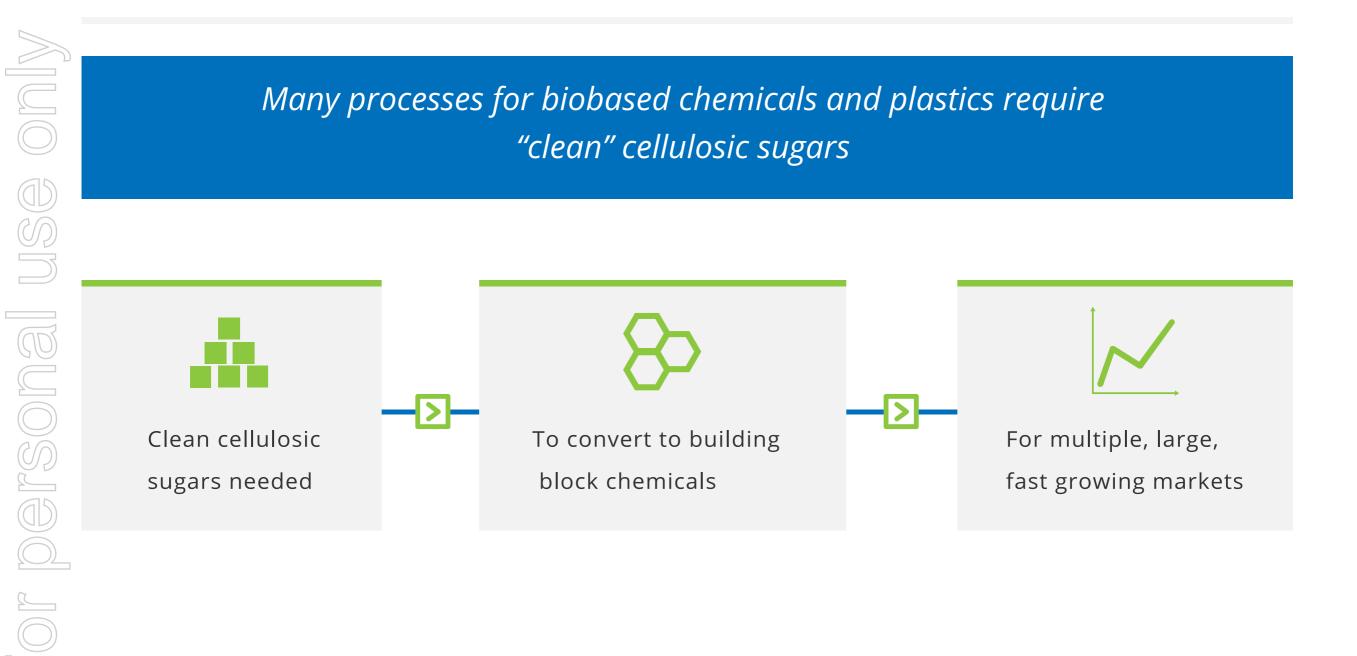
\$150 ton<sup>3</sup>

*Glycell™ process has a 35% cost advantage* 



<sup>1</sup>Lux Research report <sup>2</sup>Sugar Index US\$ <sup>3</sup>Leaf Resources level 5 scoping study

## **CLEAN SUGARS ARE COMMERCIALLY IMPORTANT**





## **BIOBASED CHEMICALS MARKET**



- Market growing by 20% pa exceeding \$500 billion by 2017<sup>1</sup>
- Predicted 22% of \$4 trillion chemical market in long term<sup>2&3</sup>
- Dupont, Proctor and Gamble 25% of sales by 2020
- Lower cost cellulosic sugars improve economics against petroleum based chemicals

Virtually every petroleum based chemical can be replaced by biomass



<sup>1</sup>European Forum for Industrial Biotechnology <sup>2</sup>USA Department of Agriculture <sup>3</sup>Deloitte & Corelli

## **BIOPLASTICS MARKET**

- - Bioplastics a 3.5 Mt \$2 billion market in 2011<sup>1</sup>
  - Fossil based plastics 265 Mt (75 times larger)<sup>1</sup>
  - 80% -90% of plastics and polymers can be biobased<sup>1</sup>
  - Potential for massive growth

We are working to completely eliminate the use of non-renewable fossil fuels in our plastic bottles – Coca Cola



<sup>1</sup> Deloitte & Corelli "Economic Impact of a future tropical biorefinery industry in Queensland



<sup>1</sup> Pike Research
<sup>2</sup>Alleid market research
<sup>3</sup>Dr Michael Knotek: US department of Energy

## **BIOFUELS MARKET**

- Global biofuel markets in 2011 \$83 billion<sup>1</sup>
- Market prediction in 2021
   \$185 billion<sup>1</sup>
- Cellulosic biofuels to grow at CAGR 50% over 2014 2020<sup>2</sup>
- Poet DSM (Project Liberty), Dupont, Abengoa cellulosic plants now operating in USA

The USA will need 1,000 plants like Project Liberty by 2040<sup>3</sup>

## **OUR RAW RESOURCE IS BIOMASS**

Available Biomass	Currently available (million Ton)	Comments
Europe	900	Agricultural, forestry, & food waste
China	700	Agricultural residues alone (rice and corn)
USA	470	
India	350	
SE Asia	300	
Australia	48	24 Crop stubble, 8 bagasse 9 forestry, 6 Municipal
World	5,000*	Agriculture residues
World 2050	40,000	

Enough biomass for \$750 billion worth of cellulosic sugars\*



\* Based on a value of \$250 per tonne

## **BUSINESS STRATEGY** MAIN OPPORTUNITIES

- Renewable Chemicals:
  - License to companies whose process requires cheap clean sugars
- *Retrofit opportunities:* There are 8 cellulosic plants in the world today Poet DSM, Abengoa and Dupont : How do we improve?
- Paper and Pulp companies strategically keen to embrace biobased markets
   40+ opportunites in USA alone
- Bolt-on plant to an existing ethanol plants: Oil prices, food for fuel, and green credentials under pressure opportunity for Cellulosic sugars is increase 200+ plants in USA



## **BUSINESS MODEL**

Licensing:

OF DEFSONA

- Technology access fee (set on individual basis)
- Royalty per ton of sugar (% of \$80 saving?)
- JV terms will depend on individual negotiations
- Leaf will embrace a capital light strategy as appropriate
  - We don't need to build a demonstration plant
  - Smart financing is the key

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- Testing at Andritz<sup>1</sup> facility in Ohio at 5 tons/day
- Andritz<sup>1</sup> have quoted on a commissioned basis for a 20 BDT/hour plant (140,000 BDT/annum)
- "Clients should continue to monitor scale up progress as cost and performance claims provide advantages over existing technologies (steam explosion dilute acid etc.)"<sup>2</sup>
  Why Leaf Resources is hot Only a handful of companies have a breakthrough on

sugar costs<sup>3</sup>



 <sup>1</sup> Andritz is a globally leading supplier of plant, equipment and services to Paper and Pulp and other industries
 <sup>2</sup> Lux Research
 <sup>3</sup> Biofuels Digest 19/11/2014)

## **MARKET VALIDATION**

#### Signed agreements

- ZeaChem Collaboration evaluate Glycell™ process at Boardman
- 4 Material Transfer Agreements signed samples for testing
- 3 Confidentiality Agreements signed comprehensive Data pack
- Market Transactions
  - Virdia to Stora Enso \$62m
  - Fibria bought Lignol assets
  - 19 other pulp companies made enquiries for Lignol assets



## **INTELLECTUAL PROPERTY AND STRATEGY**

Two patent applications lodged:

- Production of cellulose from biomass
- Production of sugars from biomass
- Leaf Resources has received a Freedom to Operate report for the Glycell<sup>™</sup> process assessed for Australia.
- National Phase application for PCT countries July 2015 for first two applications
- PCT covers all the major market countries: USA, Europe, Canada, India, Indonesia, Brazil, China, Malaysia and others



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# THE GLYCELL<sup>TM</sup> PROCESS



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## THE GLYCELL<sup>TM</sup> PROCESS COMPELLING ADVANTAGES

### **PRODUCT BENEFITS:**

- Simple, innovative and low cost
- Uses a renewable biodegradable

reagent - Glycerol

- Lower temperature and low pressure
- Continuous process design
- High Cellulose recovery



<sup>1</sup> see announcement lodged ASX 7th July 2014 <sup>2</sup> See announcement lodges ASX 14th July 2014

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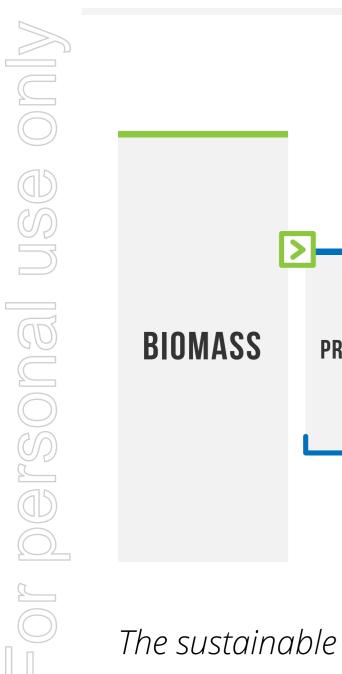
### **ECONOMIC BENEFITS:**

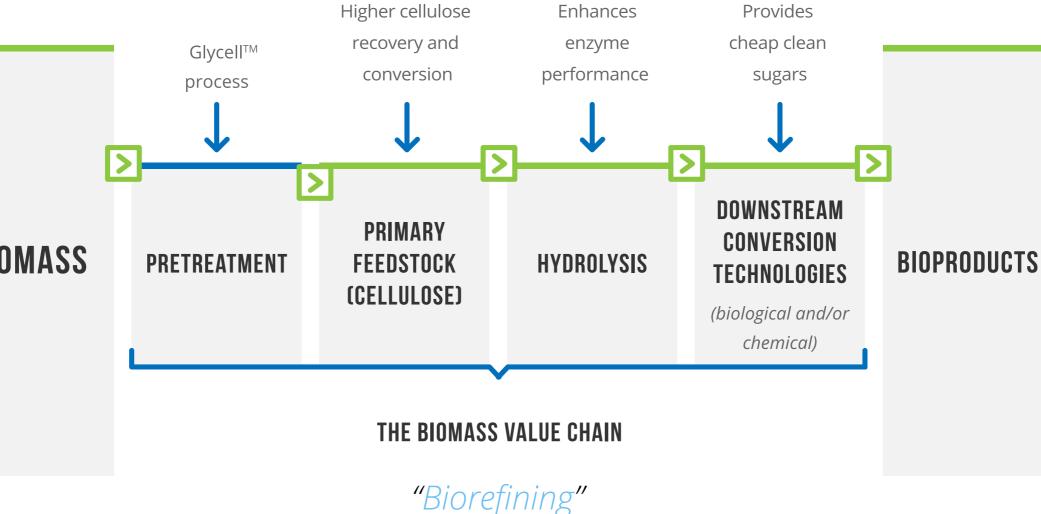
- Low capital costs<sup>1</sup>
- Low operating costs
- *"Off the shelf" equipment*
- Operates at any scale
- High conversion of Cellulose to Sugars<sup>2</sup>



<sup>1</sup> see announcement lodged ASX 7th July 2014 <sup>2</sup> See announcement lodges ASX 14th July 2014

## HOW GLYCELL<sup>™</sup> PROCESS DELIVERS CHEAPER SUGARS

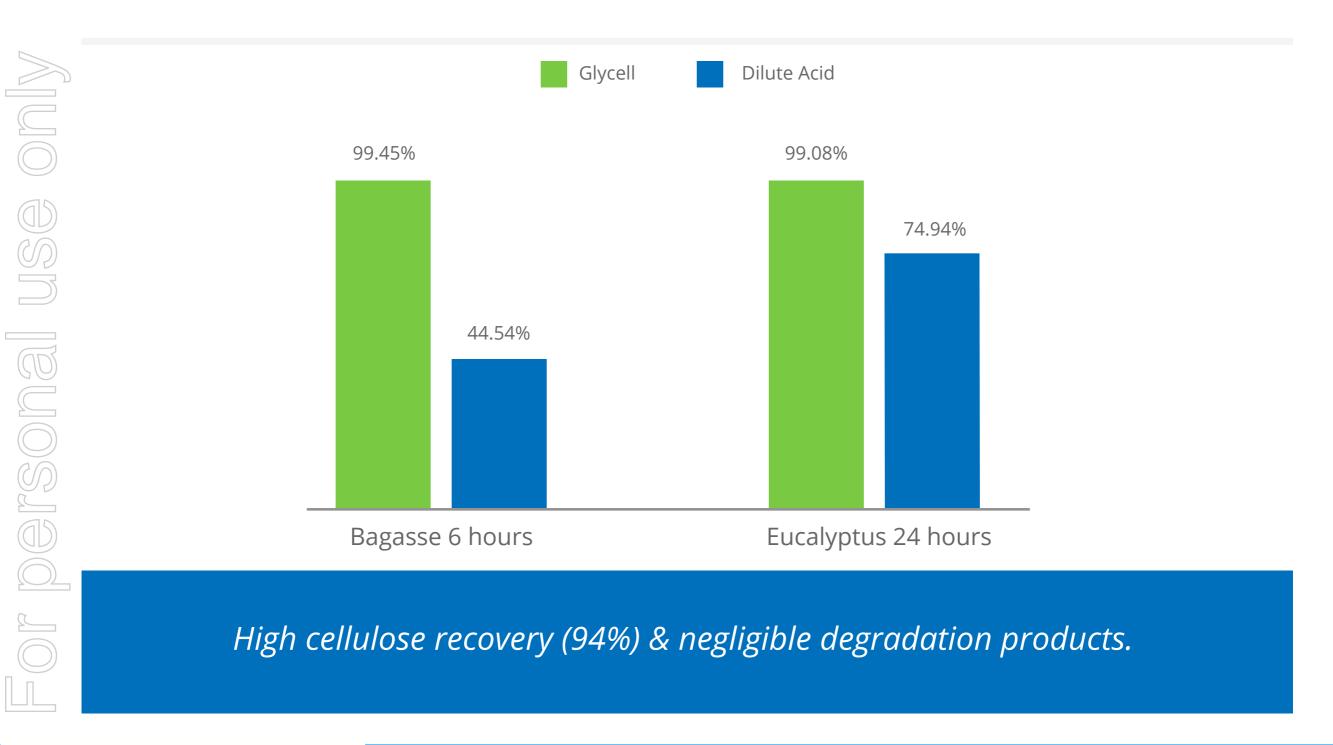




The sustainable processing of biomass into a spectrum of marketable products



## **GLYCELL<sup>TM</sup> PROCESS ADVANTAGE** OUTSTANDING CONVERSION OF CELLULOSE TO SUGARS





<sup>1</sup>All results independently validated and at standard enzyme loads (see announcement 14th July 2014)

## **DEGRADATION PRODUCTS**

or dersonal use only

Description	Cellobiose (g/L)	Xylitol (g/L)	Formic Acid (g/L)	Acetic Acid (g/L)	Levulinic Acid (g/L)	Ethanol (g/L)	HMF (g/L)	Furfural (g/L)
Bagasse	ND	ND	ND	ND	ND	ND	ND	ND
Eucalyptus	ND	ND	ND	1.85	ND	ND	ND	ND

Other than Acetic acid, all typical degradation products were not detected for both bagasse and Eucalypt conditions



## **QUALITY MANAGEMENT** SUITED TO TASK

Ken Richards Managing Director	<ul> <li>Track record in managing, growing and transitioning high growth ASX and private companies. As CEO of Norgard Clohessy Equity Ltd took the company from a start up with capitalisation of \$60,000 to \$50M</li> </ul>
Alex Baker Chief Operating Officer	<ul> <li>Over 20 years industry experience, science and technology commercialisation professional including waste stream value creation. CEO of Maverick Biosciences leading that company into the bio-medical product field.</li> <li>Bachelor and Masters degrees in science, biotechnology &amp; technology management</li> </ul>
Dr Marc Sabourin Executive VP – Business Development (Americas)	<ul> <li>29 years professional experience in research &amp; development, process engineering and project execution. Formerly held positions in process and research engineering in the pulp &amp; paper industry, including senior roles at Andritz. Bachelor and Master's degrees in chemical engineering, Ph.D in science specialising in energy reduction mechanisms in thermo-mechanical pulping</li> </ul>



## **QUALITY MANAGEMENT** SUITED TO TASK

Dr Les Eyde VP – R&D	<ul> <li>25 years professional experience in research and development in Australia and in the US. Internationally recognised - since 2007 held the position of National Task leader, International Energy Agency, Bioenergy Task 39 – Commercialising Advanced and Conventional Liquid Biofuels from Biomass</li> <li>PhD in carbohydrate chemistry, expertise in biofuels production processes and sustainable biomass supply.</li> </ul>
Directors	<ul> <li>Dr Jay Hetzel (Chairman), Charles Wilson &amp; Matthew Morgan</li> </ul>



## **LEAF RESOURCES LTD (LER)** CAPITAL STRUCTURE AND SHAREHOLDINGS

Ord Shares on Issue	113.2m
Options (10c exercise)	5.25M
Current Price	\$0.155
Market Cap	\$17.5
Top 20 Shareholders	54.0%
Board & Management	25.4%
Cash <sup>1</sup>	\$1.8m
Enterprise Value	\$15.7



Source: ASX Trading Platform, March 6th 2015

Ground floor entry into a company with world class technology enabling fast growing multiple markets



<sup>1</sup>Based on 4c for 31st December 2014