



**LEAF RESOURCES LIMITED**

Sustainable products from plant biomass

**Opportunities From Australia**  
**Glycell™ Technology**  
**ABLC November 2014**

# Forward Looking Statements

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- ▶ Rich research heritage
- ▶ Agricultural diversity
- ▶ Small population relative to land mass
- ▶ Currently carbon policy in state of flux
- ▶ R&D government incentives
- ▶ Gateway to Asia – particularly South East Asia

What does it all mean?

- ▶ Lots of great ideas looking for homes in larger markets

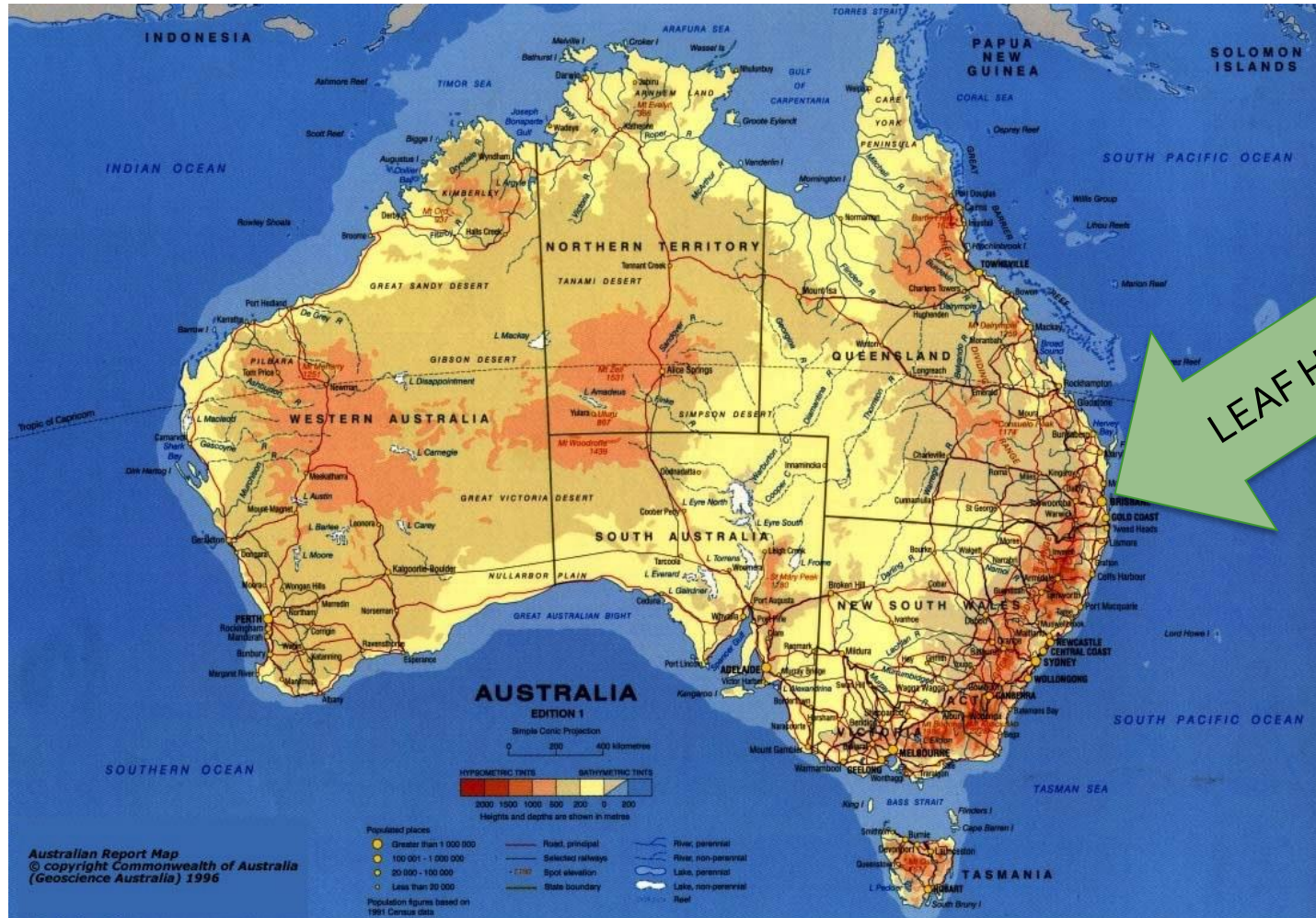
# ASEAN-Australia-New Zealand Free Trade Area snapshot

- ▶ **GDP:** US\$4.1 trillion (2013)
- ▶ **GDP per capita:** US\$6,263 (2013)
- ▶ **Population:** 653.6 million (2013)
- ▶ **Trade with Australia:** \$113.9 billion (2013)





# Australia



# Leaf Resources

Active participants in the advanced bio-economy



- ▶ Leaf Resources Limited (ASX:LER) is focused on making sustainable products from plant biomass.
- ▶ We offer an advanced technology package for breaking down plant derived biomass to useful, sustainable, renewable and biodegradable products.
- ▶ Leaf Resources' innovative Glycell™ is a disruptive process technology that can reshape the economics of using large scale biomass resources as a replacement for petroleum derived products.

# The carbon evolution

## The future of materials



Coal was the industrial material of the 19<sup>th</sup> century



Oil was the industrial material of the 20<sup>th</sup> century



Cellulose will be the industrial material of the 21<sup>st</sup> century\*

\* Lüder Gerking, CEO, Nonoval GmbH & Co.KG



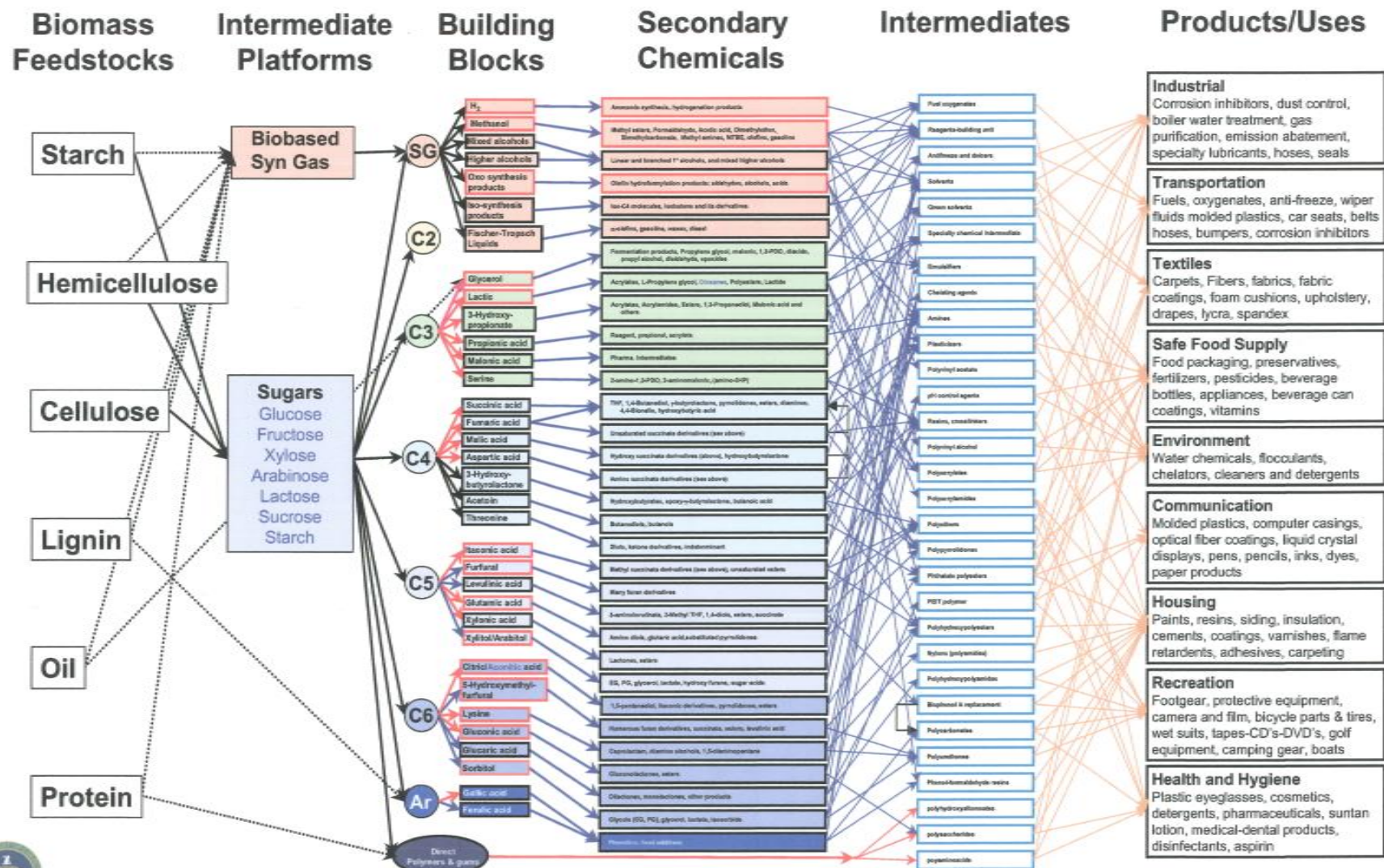


Figure 3 – Analogous Model of a Biobased Product Flow-chart for Biomass Feedstocks





# Clean sugars feed bio-based chemicals market

Bio-based chemicals: growing 20%pa, exceeding \$500b by 2017

Glycell™ process  
Low cost clean  
sugars... faster

Proprietary technology owned by  
others converts the sugars to

Renewable chemicals and  
green sustainable products.

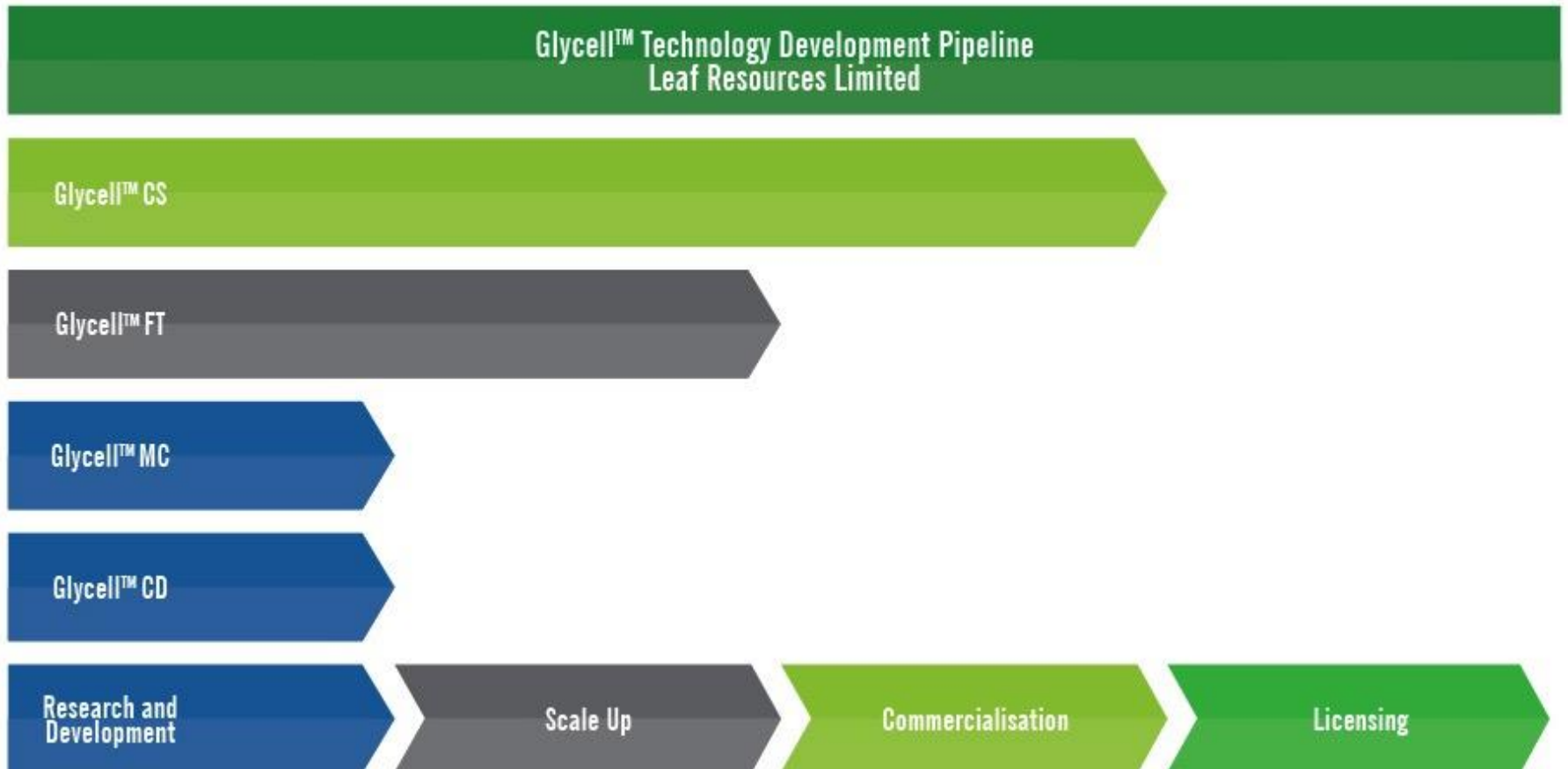
## Bio-based chemical examples

- |            |                              |
|------------|------------------------------|
| ▶ Zeachem  | - Acetic Acid, Ethyl Acetate |
| ▶ Bioamber | - Succinic Acid              |
| ▶ Myriant  | - Succinic Acid              |
| ▶ Avantium | - PET replacement            |
| ▶ Baskem   | - Polyethylene               |
| ▶ Renovia  | - Adipic and Lactic acid     |
| ▶ Multiple | - Ethanol                    |
| ▶ Others   | - Many uses                  |

## Used by companies such as:

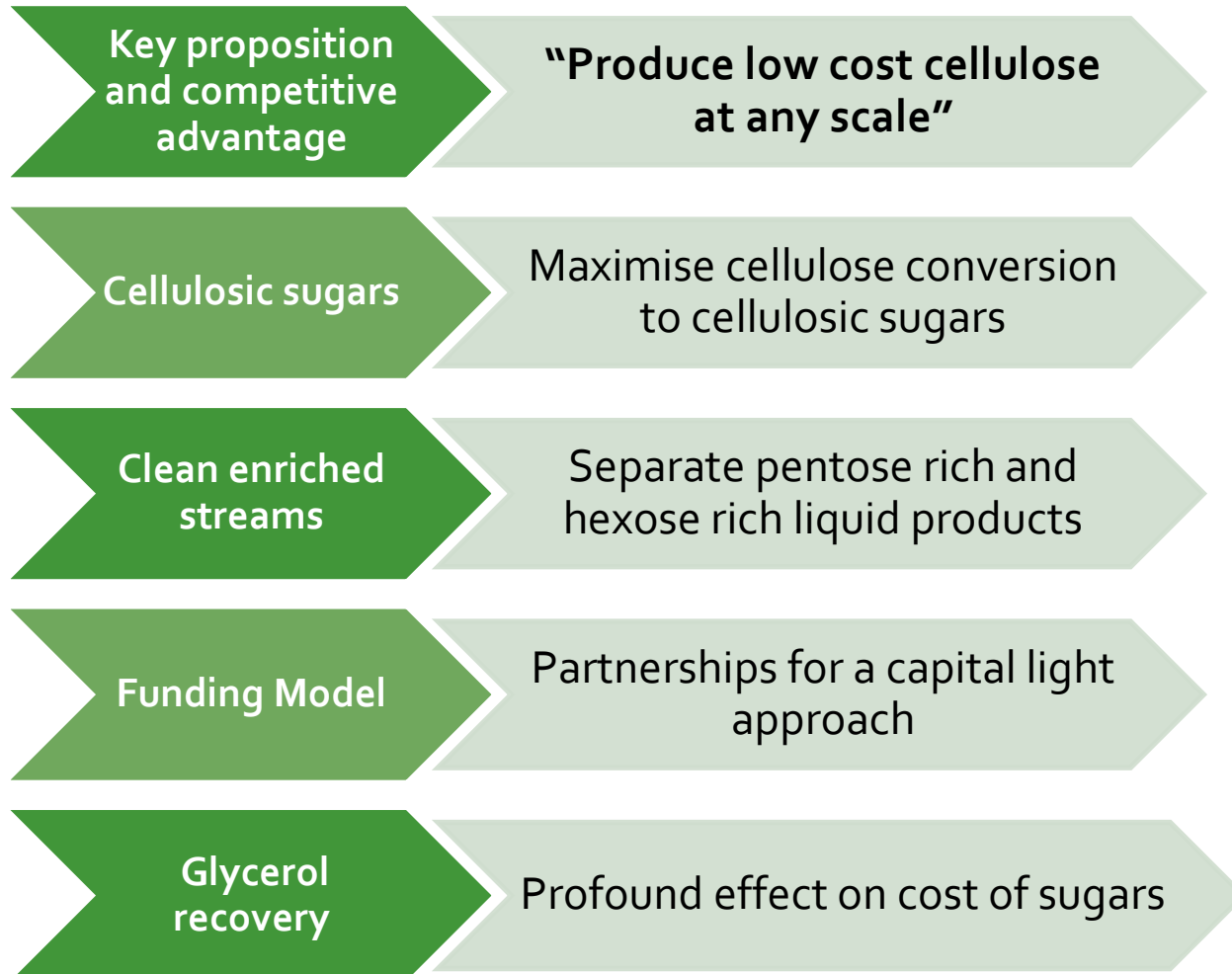
- ▶ Toyota
- ▶ Dow
- ▶ Dupont
- ▶ Mitsui
- ▶ Johnson and Johnson
- ▶ Proctor and Gamble
- ▶ Coca-Cola
- ▶ Plus many others

# Development pipeline



# Glycell™ CS Key objectives

Process focus



# The Glycell™ Process

Proprietary technology for cellulose production



The Glycell™ process has compelling advantages over traditional methods of cellulose extraction

## Product benefits:

- ▶ Simple, innovative, low cost and effective
- ▶ Uses a biodegradable reagent
- ▶ Low temperature and low pressure
- ▶ Continuous Process design
- ▶ Short processing time

## Economic benefits:

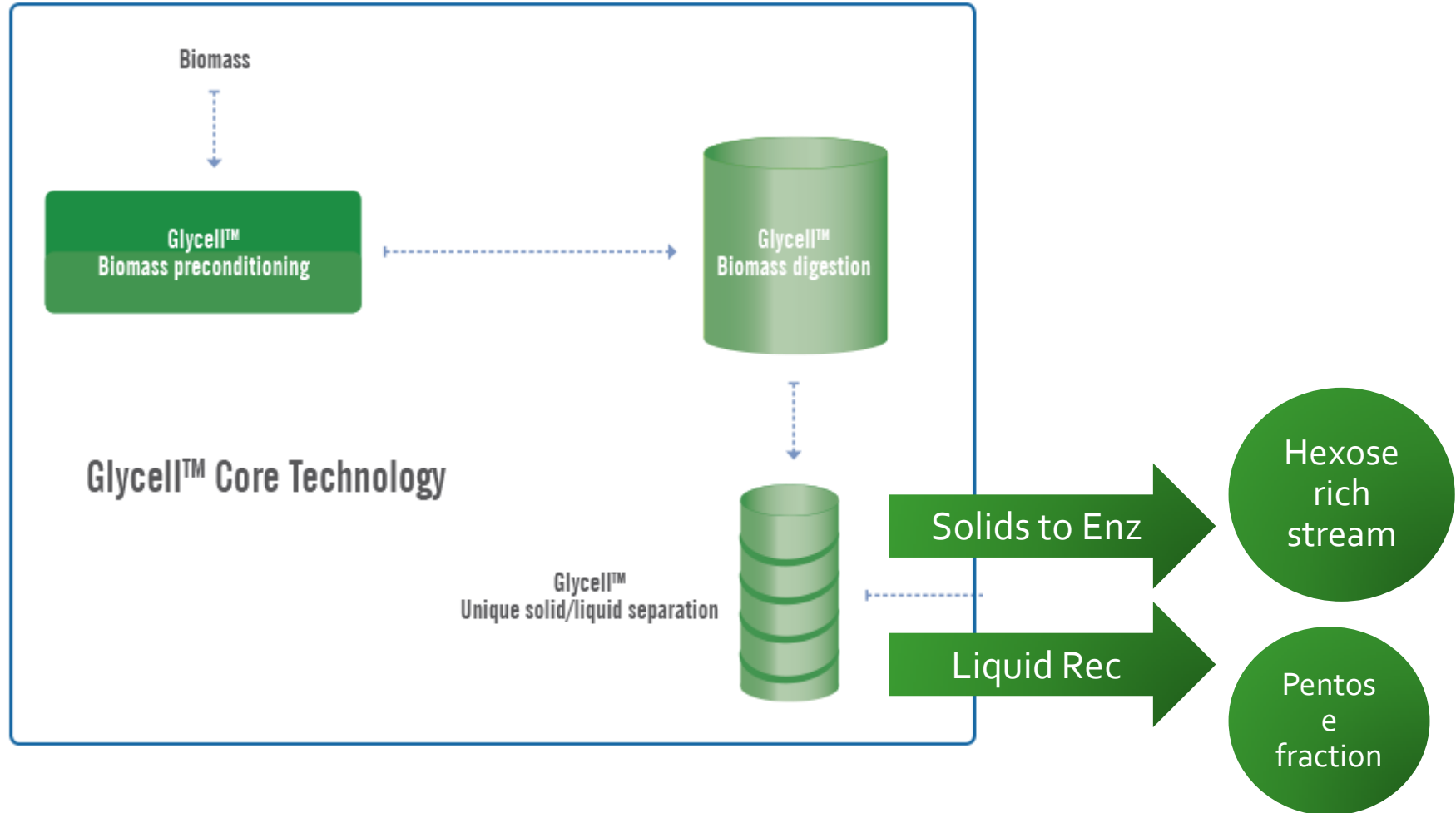
- ▶ Significantly lower capital costs<sup>1</sup>
- ▶ Significantly lower operating costs
- ▶ Industrially available equipment
- ▶ Operates at any scale
- ▶ High Cellulose recovery
- ▶ High conversion of Cellulose to Sugars<sup>2</sup>

<sup>1</sup> see announcement lodged ASX 7<sup>th</sup> July 2014

<sup>2</sup> See announcement lodged ASX 14<sup>th</sup> July 2014



# Leaf Resources Glycell™ CS Process



# Biomass flexibility

Poplar



Oil Palm fibre (EFB)



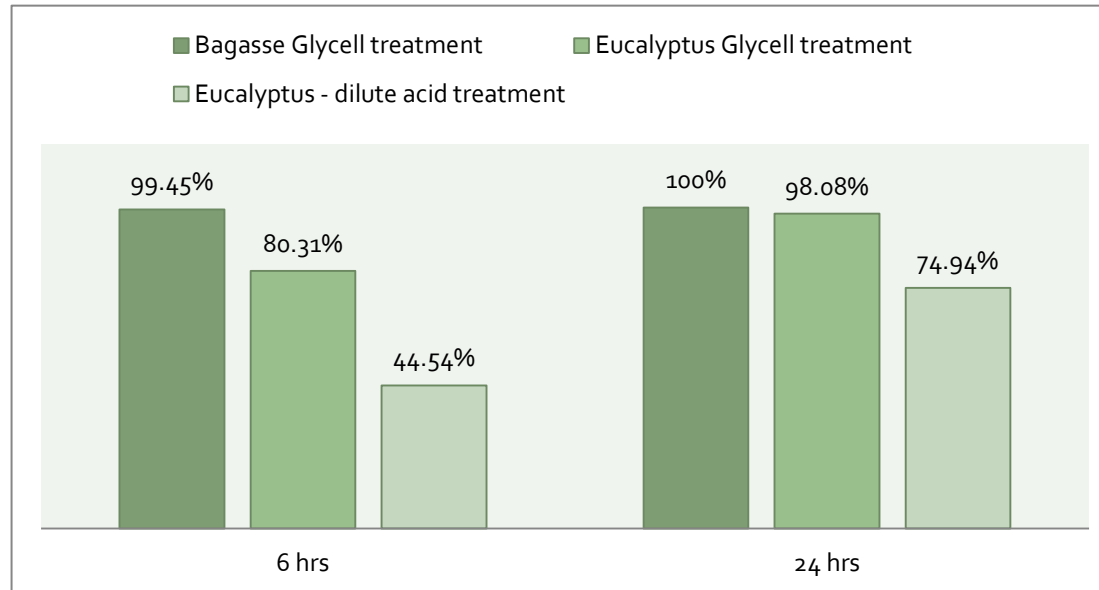
Bagasse



Eucalyptus



# C6 sugar yield



## Cellulose saccharification after enzymatic hydrolysis using the Glycell™ process - C6 Sugar yield as % of theoretical maximum

- High cellulose recovery (94%) High sugar conversion
- 30% more sugars – boost economics
- Minimal degradation products detected
- This is commercially significant as many products need “clean sugars”

The saccharification (digestibility) procedure measures the efficacy of a given pretreatment based on a maximum enzyme loading and is reported as a percentage of the theoretical mass yield. Cellulase enzyme cocktail used was Cellic® CTec3 (Cellic® CTec3 is a registered trademark of Novozymes) at 20 FPU/g cellulose at 2% cellulose weight loading applied to all samples.

# Cost of Sugars

Inputs and effect on cost of sugars	
Feedstock Input Price (\$/as is tonne at 50% moisture)	Sugar cost (¢/lb)
85% glycerol recovery	
100	12
75	8
55	5

- ▶ Class 5 conceptual design & costing
- ▶ Sugars Cost – Marginal cost of combined C5 & C6 sugars production net of lignin revenue less capital cost of production over 20 year plant life
- ▶ Estimates give ~4¢/lb cost of capital (40 tph as is brown field plant)



- ▶ Collaboration Agreement with ZeaChem Inc.
- ▶ The evaluation by ZeaChem and Leaf Resources of the Leaf Glycell™ process for the production of fermentable sugars at ZeaChem's demonstration plant at Boardman, Oregon.
- ▶ The trials will use Poplar as a feedstock.

# Key competitive advantages

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Based on current data, Leaf Energy's Glycell™ process when compared to other pretreatment processes, such as acid hydrolysis and/or steam explosion:

- ▶ Produces high yield cellulose with less degradation products;
- ▶ Excellent enzymatic conversion of cellulose to sugars;
- ▶ Enzyme kinetics improved on the Glycell™ pretreated biomass allowing quick sugar production, and;
- ▶ produces clean sugars due to milder conditions.

# Thank You

## Looking forward to Partnering

**Alex Baker**

**a.baker@leafresources.com.au**

**Ken Richards**

**k.richards@leafresources.com.au**

**[www.leafresources.com.au](http://www.leafresources.com.au)**