



## LEAF RESOURCES LIMITED

Sustainable products from plant biomass

### Australian Securities Exchange Announcement 8 December 2014

## Results from August Trials and Update

### Highlights

- Poplar results match previously announced Eucalyptus results
- Processing time cut
- ZeaChem comment re Springfield trials
- Level 5 study on sugar show potential for 5c/lb sugars
- Comment from Biofuels Digest on Leaf Resources Technology

### August Trial Results

Leaf Resources has now received and reviewed the results for the analytical testing undertaken on the samples produced from the trials run at the Andritz demonstration facility in Springfield Ohio in late August (Andritz is a globally leading supplier of plant, equipment, and services for pulp and paper and other industries). These tests were run at approximately 5 BDT/day (bone dry tons per day, the equivalent of 10 tons biomass input). The key findings from the results were:

1. Poplar, a hardwood common in North America was processed in the trials. The results showed that the Glycell™ process performed equally well on Poplar as on Eucalyptus with a saccharification result of 100% in 24 hours. This is an important result as Poplar is the biomass that will be used by ZeaChem at their proposed plant in Boardman Oregon.
2. During the trials the time in the main reactor was cut from 30 minutes to 25 minutes with no significant reduction in results. This means a 20% improvement in processing time and a corresponding increase of 20% in throughput from the same sized equipment.

### November trials

Further trials were run at Andritz's Springfield facility over 5 days in November 2014 with ZeaChem personnel in attendance. ZeaChem provided samples of the Poplar that they intend to use at their proposed plant sourced from Boardman, Oregon and this Poplar chip was processed using our optimized conditions. Additional runs were also done utilising sawdust and shavings from Poplar, which would allow for a lower cost biomass input.



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Testing has commenced on the samples generated from this trial and ZeaChem has issued the following comment regarding the trials.

“We were very impressed with the Glycell™ process and the ability to observe the trials in progress has shown us the possibilities that the process can deliver. We await the compositional analysis with optimism and note the outstanding results from the August trials, utilising poplar.”

### Level 5 Scoping study on cellulosic sugar production

Results from a Class 5 conceptual design and engineering estimate carried out by Leaf Resources staff on the costs of production of cellulosic sugars from biomass have confirmed that the Glycell™ process can produce cheap (\$0.05 per pound) sugars. The key assumptions for the modelling of the operating costs for the production of sugars using the Glycell™ process were:

- Biomass - \$55 per bone dry ton
- Crude Glycerol sourced from the biodiesel industry - \$230 per ton
- Glycerol recovery 85%
- Enzyme loadings based on National Renewable Energy Laboratories standards (a national laboratory of the USA Department of Energy)
- Enzyme costs at commercial rates

A biomass cost of \$55 per bone dry ton was chosen as this is the number utilised by some commentators when calculating the cost of production of sugars. A sensitivity analysis was also done on the biomass cost and the results were:

#### Biomass Cost

#### Sugar cost per pound

\$100 per bone dry ton	\$0.12
\$75 per bone dry ton	\$0.08
\$55 per bone dry ton	\$0.05
\$35 per bone dry ton	\$0.03

As demonstrated above, the cost of biomass is a critical component to the costs of sugars, representing some 70% of the end value. Naturally the key to cheap sugars is to find a source of waste biomass that is available and already aggregated so that logistical costs are kept to a minimum.

The low cost of sugars is commercially important, however, the sugars also need to be clean with low degradation products and inhibitory factors. Sugars produced by the Glycell™ process have minimal degradation products and inhibitory factors and given the results of the above study, produce a very competitive source of cheap clean sugars for the renewable chemicals industry.



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### Advanced Bio-Economy Leadership Conference: San Francisco November 2014

Leaf Resources presented at Advanced Bio-Economy Leadership Conference held in San Francisco during November 2014. Following the conference Jim Lane, the Editor of Biofuels Digest, the conference organiser, published a column in the Digest on November 20<sup>th</sup> 2014 entitled "Righteous Heat: 10 hot slides from ABLNext do the show-and-tell on who's got the magic"

<http://www.biofuelsdigest.com/bdigest/2014/11/19/righteous-heat-10-hot-slides-from-ablc-next-do-the-show-and-tell/>

Leaf Resources were included as one of the fresh new faces under the question "Who are the fresh faces and how are they redefining the sector at the start-up level?"

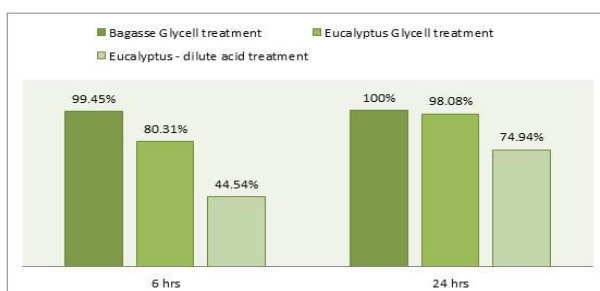
The Digests comments on Leaf Resources were:

#### **Leaf Resources**

**What's Up?** *Sugars are the new oil if sugars can be cheap enough to replace the old oils. Leaf think they have cracked a part of that puzzle with massively advantaged yields for C6 sugars.*

**Why Hot?** *The absence of competition – only a handful of companies have technology for breakthroughs on sugar costs – here's the wonder from Down Under.*

### 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 Celliic® CTec3 (Celliic® CTec3 is a registered trademark of Novozymes) at 20 FPU/g cellulose at 2% cellulose weight loading applied to all samples.



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### **About Leaf Resources Ltd (ASX: LER)**

In virtually every industry, consumer demand for greener more natural products is fuelling a surge of interest in bio-based alternatives to replace oil based products.

Leaf Resources is commercialising the Glycell™ pretreatment technology: The first essential part of the process on a path to bio-based products.

The Glycell™ Process is an innovative technology that uses a low cost, recyclable, biodegradable reagent glycerol, in a simple process, to break down plant biomass into lignin, cellulose and hemicellulose at low temperature and pressure.

Cellulose, a critical building block for many bio-based products, produced by the Glycell™ processes can be used directly as cellulose fibre, chemically converted to cellulose derivatives or converted to cellulosic sugars using enzymatic hydrolysis. These cellulosic sugars can then be converted to bio-based materials, bio-plastics and green chemicals, the markets for which are extremely large and fast growing.

Leaf Resources commercialisation strategy is to partner with industry leaders across the breadth of product supply chains that will bring synergies and speed to the commercial adaption of our production process technology in a capital-efficient manner. Leaf sees this path as an effective means of deployment to multiple plants in diverse settings and the opportunity to further innovation in both product and process technologies.

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