



LEAF RESOURCES LIMITED
Sustainable products from plant biomass

23rd June 2015

Australian Securities Exchange Announcement

Glycerol recycling reduces cellulosic sugar cost to \$47/tonne

Highlights

- Leaf Resources' cost of producing cellulosic sugars is now \$47/tonne.
- New glycerol recycling process recovers 95% of the glycerol used with higher purity and higher value.
- This low cost opens up markets for Glycell™ sugars as a cheap, clean feedstock for bio-based products, replacing:
 - Sugars derived from grain and
 - Raw sugar
- Cellulosic sugars at \$47/tonne significantly increase the number of bio-based products that can economically replace petroleum derived products

Leaf Resources is pleased to announce that its Glycell™ process can now achieve a minimum sugar-selling price (MSSP) of \$47¹ per tonne for a plant of 210,000 bone dry tonnes per annum. By way of comparison the market price for raw cane sugar is currently around \$280 per tonne.

On May 6th we announced a cost of \$151/tonne for Glycell™ sugars produced from a larger plant (based on the assumptions used by the NREL, National Renewable Energy Laboratory of the USA). Our main competition in pretreatment processes, dilute acid, had a cost of \$363/tonne² under the same NREL assumptions.

The cost reduction announced today has come about because we have now shown that we can recover 95% of the glycerol input into the Glycell™ process at a higher purity than that input. Higher purity glycerol has a higher value so, in effect, glycerol now becomes an additional co-product delivering a fourth revenue stream to our process (the others being cellulose, hemicellulose and lignin). This significantly improves the commercial viability of Glycell™ cellulosic sugars as a feedstock for bio-based products.

We have again used ResourceInvest Pty Ltd to undertake an analysis of the benefit of this result on the minimum sugar-selling price (MSSP) of the cellulosic sugars produced by the Glycell™ process. We decided to use a smaller scale plant to reflect potential uses of the Glycell™ process in the renewable chemicals markets. ResourceInvest calculated that Glycell™ process produces cellulosic sugars at a MSSP of \$47 per tonne on a fully costed basis (i.e. after capital and a return on capital).

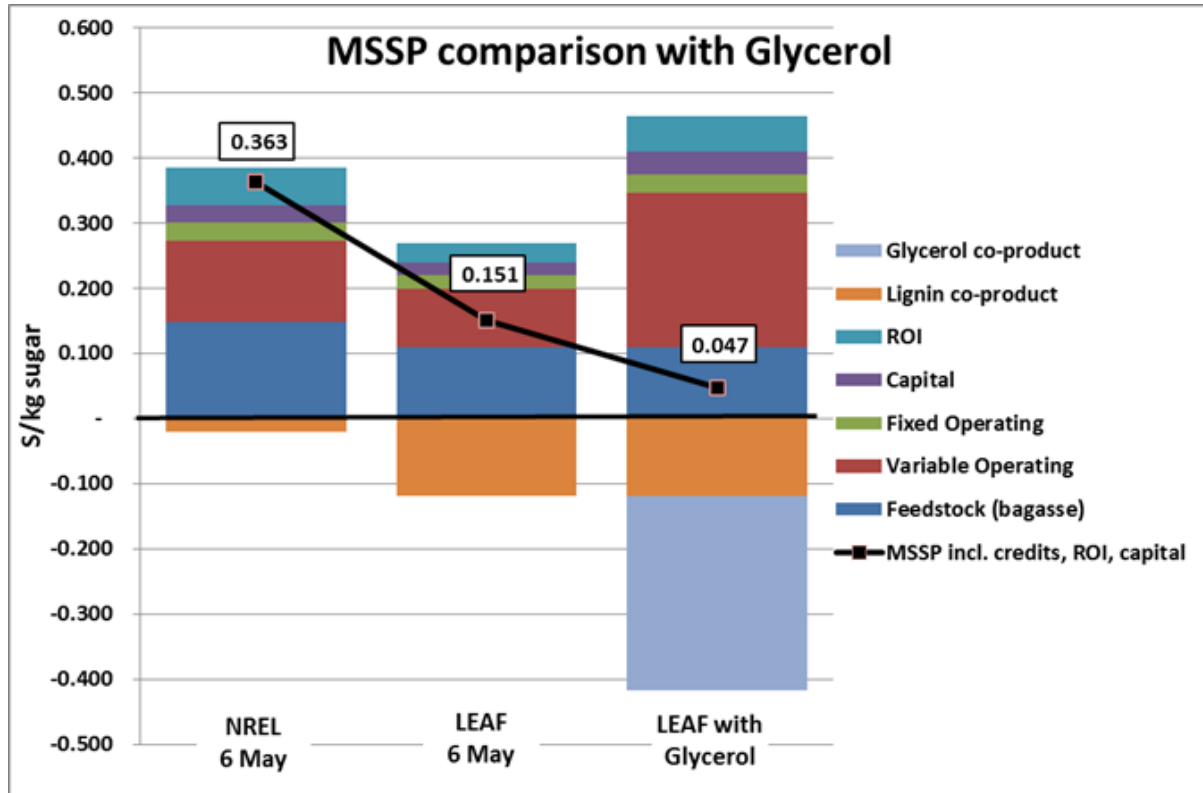
¹ all prices are in US\$

² see ASX announcement dated 6th May 2015



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What does \$47/tonne cellulosic sugars really mean?

A cellulosic sugar cost of \$47 per tonne dramatically enhances the commercial prospects of cellulosic sugars as a feedstock for bio based products and therefore should enhance the value of the Glycell™ process. This low price is an added benefit to the clean sugars produced by the Glycell™ process, which is commercially very important.

Cheap, clean cellulosic sugars are an essential feedstock to the new world of industrial biology, which is enabling bio-based chemicals and bio-plastics to economically replace petroleum-derived products. The USA National Academy of Sciences in a 2015 report entitled the "Industrialisation of Biology" commented:

"The industrialisation of biology will be as important in the next 50 years as semiconductors have been to economic growth over the last 50 years."



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Competitive Landscape

The biological processing world needs sugars as an input and can use sugars from three main sources:

1. Sugar from sugar cane or sugar beet (sucrose)
2. Sugars produced from corn starch or starch from other grains (glucose)
3. Cellulosic sugar produced from forestry and agricultural residues (glucose + other sugars)

"Sugar is the key platform for many leading opportunities in bioprocessing. Dozens of firms are creating novel metabolic pathways in microbes to produce chemicals such as butadiene, isoprene, acrylic acid and succinic acid. Most of these companies are converting sugar – sugar from corn and sugar cane – and basing their profitability on sugar prices" (Lux Research)

The Glycell™ process has now broken through the major cost barrier of first generation sugars either from starch or sugarcane.

Raw Sugar from Sugarcane Refining

Sugar prices have been declining for some time from a peak of \$654/tonne in January 2011 to a current price of just under US\$280/tonne. Clearly at \$47/tonne, Glycell™ sugars are now more than competitive with raw sugar.

Sugar from Cornstarch

Jacobs Consultancy Inc., a specialized Petroleum, Chemicals and Energy Engineering Practice and one of the largest engineering companies in the world, in their report of March 2013 "Identification of Opportunities for the Production of Bio-products from Waste Biomass in Alberta" commissioned by Alberta Innovates - Energy and Environmental Solutions, made the following comment:

"With 22 cents/kg (\$220/tonne sugars) feedstock ethanol production from biomass (cellulosic ethanol) is profitable."

Glycell™ produced sugars at \$47 per tonne are now clearly competitive for ethanol production which opens up the potential for the Glycell™ sugars as a profitable supplement/replacement for cornstarch ethanol (also known as 1st generation ethanol). There are over 200 cornstarch ethanol plants in production in the USA alone, producing over 14.5 billion gallons per annum.



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Cellulosic Sugars

Many processes have been developed over the years for the production of cellulosic sugars from forestry and agricultural residues. Lux Research in their report "*Cellulosic Chemicals raced to compete with First-Gen Sugar Economics*" identified 5 main processes and noted "*dilute acid with enzymatic hydrolysis as the cheapest route to cellulosic sugars.*"

Our May 6th 2015 announcement calculated the MSSP for NREL's (National Renewable Energy Laboratory, a division of the US Department of Energy) dilute acid process at a fully costed MSSP of \$363/tonne.

Our latest economic analysis demonstrates that Glycell™ sugars at a MSSP of \$47/tonne, fully costed, are now approximately 90% below this cost estimate.

Summary

The Glycell™ process is now one of the cheapest sources for clean cellulosic sugars for conversion to renewable chemicals and bio-plastics. Because of the advantage the Glycell™ process has, both in price and the cleanliness of sugars we are engaged in commercial discussions with over 15 companies including large chemical companies, large consumer good companies, large alternative fuel companies, paper and pulp companies and companies that require sugars as a feedstock for their proprietary processes.

The Glycell™ process arrives at a time when government and industry leaders are strengthening their resolve to get rid of fossil fuels altogether. The G7 recently announced its commitment to stop their use worldwide by the end of the century and many multinational corporations are already imbedding sustainable practices in their operations.

Cheap clean cellulosic sugars produced by the Glycell™ process will assist in the replacement of petroleum based chemicals and bio-plastics. Our latest results suggest that the Glycell™ process is the key that unlocks the door to the future of the industrialisation of biology.



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About Leaf Resources Ltd (ASX: LER)

Leaf Resources is commercialising the Glycell™ process.

The Glycell™ Process is an innovative technology that uses a low cost, recyclable, biodegradable reagent glycerol, in a simple process that breaks down plant biomass into lignin, cellulose and hemicellulose at low temperature and pressure. The cellulose is then converted to cellulosic sugars through enzymatic hydrolysis and the lignin, hemicellulose and glycerol become valuable co-products.

Cellulosic sugars are a major feedstock for green, renewable biobased chemicals, bioplastics and biofuels, products whose markets are multi \$billions and fast growing. Many biobased products can now economically replace petroleum based products.

The Glycell™ process produces cellulosic sugars up to 90% cheaper than its major rival, dilute acid and at competitive prices with raw cane sugar and sugars from grain starch. It also produces "clean" sugars i.e. sugars with negligible degradation products and therefore suitable as a raw feedstock for many biobased chemical and bioplastic production processes.

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