

13 June 2018

Australia Securities Exchange Announcement

## **Leaf's proposed Malaysian biorefinery site study confirms strong project economics, technical feasibility and sustainability**

### **Project Highlights**

- **Independent Feasibility Study by Aurecon represents a key milestone in planning and execution for a proposed biorefinery facility in Malaysia ("Biorefinery Project")**
- **Key findings of the Aurecon Feasibility Study, FEL 2 MAY 2018 include:**
  - Establishment of Biorefinery Project at Segamat, Malaysian site location and use of empty fruit bunch feedstock to Glycell™ process is technically feasible
  - Segamat site is "ideally suited" to the Biorefinery Project with large volumes of local, low cost empty fruit bunch biomass available for sugars conversions and energy supply
  - Strong Malaysian Government support
  - All major environmental impact assessment approvals achievable within reasonable timeframe
  - Strong project economics on base case, with potential for upside
- **Estimated Financial results (approximate):**

▪ Base case (no debt, before tax)	NPV US\$193m	IRR 23%
▪ Base case (50% debt, after tax)	NPV US\$174m	IRR 31%
▪ Upside Case (50% debt, after tax)	NPV US\$438m	IRR 58%
- **Leaf is now moving forward on next stages of execution with phase 2 of the Integrated Development Study now underway in Delft, Holland.**

Leaf Resources Limited (ASX: LER) ("Leaf" or "the Company") is pleased to announce the results of an independent engineering and feasibility study regarding Leaf's proposed biorefining facility to be developed at Segamat in the Southern Malaysian state of Johor.

International engineering consultancy Aurecon has completed an analysis of the Biorefinery Project, which will incorporate Leaf's proprietary Glycell™ technology and provided a Feasibility Study.

The Feasibility Study marks an important milestone for Leaf and is a critical step in the process to the advancement of the Biorefinery Project and facilitate its progress towards final design, financing, regulatory and board approvals.

Leaf's Glycell™ technology converts plant biomass into high value industrial sugars and other low carbon alternatives instead of petroleum-based chemicals and plastics. The process is relatively low cost and testing to date has been shown to

achieve yields up to 25% higher than rival technologies. Leaf has secured an option on a site in Segamat, Johor, where it plans to establish a proposed biorefinery facility and use an abundant and renewable supply of empty fruit bunch ("EFB") (a waste product of palm oil production) as the primary feedstock for the Biorefinery Project.

Aurecon was commissioned to independently review the technical data relating to the Glycell™ process and report on the technical feasibility of the process, as well as the suitability and co-location opportunities of the proposed Segamat site for the Biorefinery Project. The Feasibility Study will be used to progress the Company's planning and to help secure (off balance-sheet) financing for the project.

Leaf previously commissioned independent analysis engineering reports – referred to as front end-loading (FEL 1 and FEL 2) - on a proposed plant location in the Southeast region of the United States, with mixed southern hardwood as the primary feedstock. Following the Company's decision to focus on a plant location in Malaysia, this Feasibility Study has specifically scoped the Segamat site and covers the requirements to establish the complete biorefining value chain at this location.

The Feasibility Study focussed on the enabling infrastructure needed to establish the Glycell™ process using EFB feedstock on a co-located site in Segamat. The assumptions used for the base case included predicted EFB yields for C5 and C6 sugars conversion, glycerol recycling and refinement, as well as lignin treatment for product sales into local markets. These process assumptions will be undergoing integrated demonstration trials in Holland commencing in June 2018, to further support the predicted yields and product quality used in the Leaf Resources financial model. The major process elements of the project have all been undertaken in biorefining plants before, where tried and proven technology exists. The Holland trials will also confirm that the equipment list remains equivalent to that used to compile the FEL 2 capital cost estimate.

The executive summary of the study (excluding commercially confidential content) is attached to this announcement and is available at [www.leafresources.com.au](http://www.leafresources.com.au).

**The executive summary includes a summary of the highest risks, financial model analysis and sensitivity analysis.**

The Feasibility Study included reviews of the financial model with Segamat site assumptions that projected a capital cost for the proposed biorefinery if major utilities are supplied externally to the project of approximately US\$146 million, including indirect costs and 10% contingency. If the utilities are included within the overall project, the base case capital cost is approximately US\$178m on the same basis. Leaf's expectation is that utilities will be provided externally to the battery limits of the Glycell™ Biorefinery.

### **Study Conclusions**

Aurecon concluded that the project is technically feasible with the ability to value-add low cost EFB biomass and raw glycerol into high value renewable feedstocks and products.

The Feasibility Study also concluded that, on a base case basis, the project would generate annual revenues in the first full year of operation of approximately US\$109 million and earnings before interest, tax, depreciation and amortisation (EBITDA) of approximately US\$47 million. The modelling established a pre-tax net present value (NPV) at 20 years of approximately US\$193 million, with an internal rate of return of approximately 23% pre-tax. The Company has applied for a tax exemption of 100% for up to 15 years under “Less Developed Area” incentives provided by the Malaysian Investment and Development Authority (MIDA).

### Additional Financial Data

Additional work to assess the financial feasibility was undertaken by ResourceInvest, who assessed the Segamat site project data and modelled two additional scenarios: (1) The project base case with 50% debt financing and (2) the upside case with all products sold at assumed prices with 50% debt finance, gave an estimated free cash flow before debt repayments of US\$84 million.

US\$m	NPV* (10%)	IRR*
Base case (before tax)	\$193	23%
Base case with 50% debt (after tax)	\$174	31%
Upside** with 50% debt (after tax)	\$438	58%

\* Estimated figures based on the base case scenario [as described in the executive summary].

\*\* Assumes all production from the biorefinery: industrial sugars, glycerol and lignin is sold.

### Segamat site

Aurecon concluded that the Segamat site is ideally suited to the Glycell™ biorefinery project, with an established industrial scale biomass supply chain available at a competitive cost, as well as the potential to partner with the operator of an existing EFB fibre plant located adjacent to the site. Leaf recently signed a letter of intent with the plant operator with the aim of entering into a binding commercial agreement to take supply of EFB as the key biomass input for the Biorefinery Project.

### Other report conclusions included:

- The Leaf team includes experienced project managers and project professionals that have engaged reputable industry consultants and used classic project management tools and techniques in developing this project to this point in the project life cycle.
- There is evidence that Leaf has consulted well with community, developers/landowners, government, regulators, value chain stakeholders, construction contractors and OEM service providers.
- With the availability of low cost local EFB and energy supply, there is potential for Malaysian manufacturing and chemical industries to purchase 100% of the industrial sugars output via long term offtake contracts.

- All major EIA approvals have been discussed with local planning bodies and are achievable within reasonable timeframes for the Project.

In terms of the broader rationale for the project, Aurecon commented: "The world market for bioproducts is rapidly changing as consumers demand cleaner, safer and biodegradable options from the current hydrocarbon-based products. Once the emerging process technologies are proven in commercial scale biorefinery operations, emerging bio-industry proponents like Leaf Resources will be in a strong position to obtain further financial benefits from emerging government incentives and state development programs."

### **Risk issues**

Aurecon has distilled Risk Register entries into some common themes. These provide focus areas for multiple project issues that would form the basis of the FEL 3 study risk reduction scope. These risks are contained in section 1.15 of the attached executive summary and that section should be read to give context to this announcement.

To manage these risks, Leaf Resources have allocated some contingency/provisional sums in with the direct costs to the loosely defined components in the capital estimate, as well as an overall contingency applied to cover the potential Capex impact of any scope updates to address these potential project issues.

Leaf Resources have also proposed to continue with further demonstration plant testing at the Holland Bioprocess Pilot Facility BV (BPF) in parallel with FEL 3 and detailed design, in order to optimise the full- scale design parameters. This may lead to some scope changes that impact the capital estimate, operational costs and revenue projections. The FEL 3 financial model may produce different results than that obtained with the FEL 2 May 2018 review. However, further work on markets, costs and different operational scenario's is needed in the FEL 3 stage to assess and optimise the broad range of assumptions, options and variables available for the project and the results of that work will determine what tangible impact those issues would have on the project NPV, approvals or attractiveness for investors to proceed.

In addition to these risks Leaf Resources will need to fund the FEL3 study and the cost of that study is likely to be in the \$3m to \$5m range. Leaf is looking at a number of strategies for this funding including: Incorporating the funding requirement into an EPC package and making the payment from future project funding, utilising trade facilities as part of a funding package, support from third parties for the project, government and private, and finally if necessary equity funding raised by Leaf Resources.

## **Leaf comments**

Leaf CEO, Ken Richards welcomed the findings of the Feasibility Study, describing them as a strong validation of the work done to date and further confirmation of why Malaysia is such a good location for the Biorefinery Project.

“The Company will now proceed with confidence to complete Phase 2 (currently underway) and phase 3 of the Integrated Demonstration Study in Delft, Holland, which will involve approximately 1,000 hours of run time on the Glycell™ process and will provide important additional data for the final FEL3 feasibility study.”

“The phase 2 work currently underway will generate samples of C6 industrial sugars and lignin while Phase 3 will generate samples of all four products (C5 and C6 industrial sugars, lignin and refined glycerol) in quantities that can be supplied to potential customers for testing.”

Mr Richards said the Company and its development partner Claeris – through their joint development company Leaf Development and its wholly owned subsidiary Leaf Malaysia – will continue to engage with relevant government authorities in Malaysia to secure relevant approvals; available tax incentives; and “off balance sheet” financing support for the project.

“We have very positive early indications of support and I’m confident the Aurecon feasibility analysis of the Segamat site location will considerably strengthen our position.”

## **ENDS**

### **Forward-looking statements**

*This announcement may contain certain “forward-looking statements” which may not have been based solely on historical facts, but rather may be based on the Company’s current expectations about future events and results. Where the Company expresses or implies an expectation of belief as to future events or results, such expectation or belief is expressed in good faith and believed to have a reasonable basis. The detailed reasons for that conclusion are outlined throughout this announcement and all material assumptions are disclosed. However, forward looking statements are subject to risks, uncertainties, assumptions and other factors, which could cause actual results to differ materially from future results expressed, projected or implied by such forward-looking statements. Such risks include, but are not limited to availability of EFB, success of further plant testing, currency fluctuations, increased production costs and governmental regulation. For a more detailed discussion of such risks and other factors, see the executive summary of the Feasibility Study, the Company’s Annual Reports, as well as the Company’s other filings. Readers should not place undue reliance on forward looking information. The Company does not undertake any obligation to release publicly any revisions to any “forward looking statement” to reflect events or circumstances after the date of this announcement, or to reflect the occurrence of unanticipated events, except as may be required under applicable law. The Company has concluded it has a reasonable basis for providing the forward-looking statements that relate to the Feasibility Study that are included in this announcement.*

**About Aurecon:**

As one of the world's leading engineering, management and technical services consultants, Aurecon is focused on adding significant value to its clients' businesses and ensuring reliable, effective delivery of infrastructure and projects. With a global presence, an unrivalled breadth of technical expertise and a client-centric approach, Aurecon is structured to rapidly respond to its clients' needs to deliver consistently high-quality outcomes. The company operates within a culture of integrity, honesty, innovation and collaboration across the sectors of mining, manufacturing, aviation, agriculture, construction, data and telecommunications, defense, education, energy, health, property, resources, transport, water, government and tourism.

**About ResourceInvest:**

ResourceInvest Pty Ltd, was established in 2001 to provide commercial, economic, and technical advice to the resource sectors. ResourceInvest principal is Peter Cameron, GAICD, BSc (Hons) Geophysics, FAIMM, CP(Man): Peter has over thirty years experience in geoscience, exploration, resource project economics and analysis. Since 1988, Peter has worked largely as a consultant to the finance and resource sectors providing economic analysis, company research and valuation. Between 1998 and 2000 he was a Director and Head of Research & Client Services at Johnson Taylor & Company Limited (now Bell Potter Securities), responsible for resource sector research and corporate advice with respect to resource company capital raising.

**About Leaf Resources:**

Leaf Resources is one of the world's leading companies in converting plant biomass into industrial sugars. Our proprietary process for converting biomass-to-functional industrial sugars enable a myriad of downstream technologies for the production of renewable chemicals and bioplastics that will substitute petrochemicals used in manufacturing today. With our project development and continued technical innovation we are building a robust global business centered on renewable carbon containing products to deliver environmental and economic benefits to our shareholders and our planet. More on [www.leafresources.com.au](http://www.leafresources.com.au)

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# Leaf Resources Segamat Glycell Biorefinery Project

FEL 2 Feasibility Review  
Report – Executive Summary

Leaf Resources

Reference: 502548

Revision: 1

8 June 2018

# 1 Executive summary

## 1.1 Background

Leaf Resources is proposing to develop a fully integrated biorefining facility in Segamat Malaysia, using palm oil empty fruit bunch (EFB) as primary feedstock. The Project will incorporate an integrated biomass processing facility to deliver up to approximately 22,000 Tonne/yr (dry basis) of C5 Sugars @ 70% Solids; 38,800 Tonne/yr (dry basis) of C6 Sugars @ 71% Solids; 14,792 Tonne/yr (dry basis) of Lignin and 60,700 Tonne/yr of Refined Glycerol. The process can be run to select the proportion of glycerol that is recycled or refined to create a value-added product, to maximise the achievable margin as the glycerol market dictates. Similarly, the lignin can be burnt as fuel in the boiler or refined as a valuable coproduct, with volumes cycled up or down based on economics.

Leaf Resources is commercialising the Glycell™ process, which 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 with a SMB to separate glycerol and C5 sugars. The lignin, C5 sugars, C6 sugars and refined glycerol become valuable co-products.

The process has been proven to work effectively on a variety of biomass feedstock, including woody (eucalyptus, poplar) and non-woody feedstock (bagasse, empty fruit bunch and corn) making the process applicable to a wide range of biomass, including low-grade plantation waste. Low-value, marginal agricultural land can be used for growing biomass or utilising coproducts for the Glycell™ technology.

Aurecon conducted this technical review on the new Segamat location to further assess the changed scope and to provide an independent technical perspective to Leaf Resources and potential financiers to assess the feasibility of the updated site. This FEL 2 May 2018 review report has been generated following reviews of project information in the data room and parallel discussions with project stakeholders, as well as EPC contractors on what new scope is required to establish the complete biorefining value chain in a Malaysian location.

## 1.2 Project technical feasibility

Following reviews of the previous Leaf Resources FEL 2 Study in March 2017, the Addendum to FEL 2 study in November 2017, plus scope evolution and stakeholder discussions for the current proposed Segamat location, the results of the latest financial modelling and the included assumptions shows that the project is technically feasible. This is predicated on the assumption that the Glycell process using EFB feedstock, undergoing integrated demonstration trials in Holland commencing in June 2018, provides the predicted yields and product quality used in the Leaf Resources financial model and the equipment list remains equivalent to that used to compile the capital cost estimate. Aurecon has not assessed the commercial aspects of the project in this study.

The major process elements of the project have all been undertaken in biorefining plants before, where tried and proven technology exists. In order to achieve operational advantages through innovation and economy of scale, Leaf Resources has been developing some conceptual aspects that have been identified with technology readiness risks at this stage of the project. Leaf Resources is undertaking demonstration scale work on EFB at the Holland Bioprocess Pilot Facility (BPF) and has proposed further design work to take these items to the next level of definition, which will include optimisation to minimise risk. However, there are also established and existing alternative options for many of these areas that could be adopted in subsequent phases (at a different financial basis), to mitigate or negate these risks.

## 1.3 Leaf Resources' project definition

Leaf Resources have structured the project to value-add low cost biomass into high value renewable feed stocks and products. They have assessed the markets in each area to target the highest margin products



and intermediaries. The figure below shows how these target products have been developed as part of the current project definition.

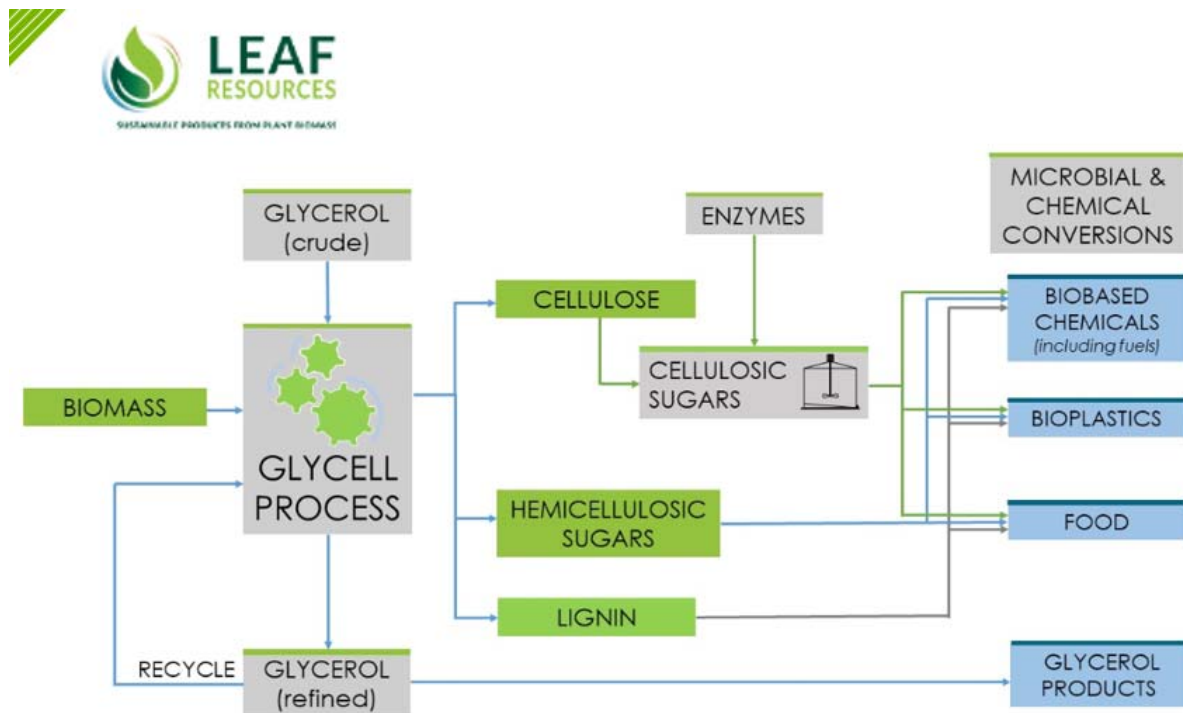


Figure 1 Leaf Resources' process functional areas

## 1.4 Project commercial scale site selection

Leaf Resources has spent five years developing a bioprocessing technology that will process biomass into C5 and C6 Sugars.

Leaf Resources believes that partnering with industry leaders across a breadth of product supply chains will bring synergies and speed the commercial production of these production process technologies in a capital efficient manner. Leaf sees this path as an effective means of deployment of their technologies to multiple plants in diverse settings with multiple feedstocks and the opportunity to further innovate in both product and process technologies.

The overall process is based on three technology applications that have been proven in isolation. The individual processes are: Pre-treatment using the Glycell process, enzymatic saccharification, and chromatographic separation, that will be integrated to produce the sugars from biomass.

Leaf has advanced through the FEL1 and FEL2 stages, and is currently planning for the next stages of testing to prove the integrated process. The front-end loading work done to date was based on a plant location in the Southeast region of the United States, with mixed southern hardwood as the feedstock.

Due to a shift in strategy, Leaf is focussing on a plant location in Malaysia, with EFB as the feedstock. The updated scope for the Segamat site and the work from this technical review will be referred to as FEL 2 May 2018.

As the proposed new location and feedstock has a significant impact on the project development, Leaf would like to assess the impact on the front-end loading work done thus far.

Leaf Malaysia has executed an Option agreement for land to site it's plant at an existing biorefining site in Segamat, Johor

The site is ideally suited to collocate Leaf's proposed Glycell biorefinery project. It has an established industrial scale biomass supply chain 'over the fence' at competitive cost, through the existing B&G Segamat Fiber Plant. B&G will provide a key strategic local partner and considerable capital savings can potentially be realized by co-location with existing B&G infrastructure and utilities.

The proposed project stakeholder organisation is outlined in the figure below:

**NOTE: FIGURE 2 REMOVED DUE TO CONFIDENTIAL INFORMATION**

**Figure 2 Leaf Resources Proposed FEL 2 May 2018 Project Stakeholder Organisation Chart**

## 1.5 Leaf Resources Segamat Site Location – Glycell Biorefinery Layout

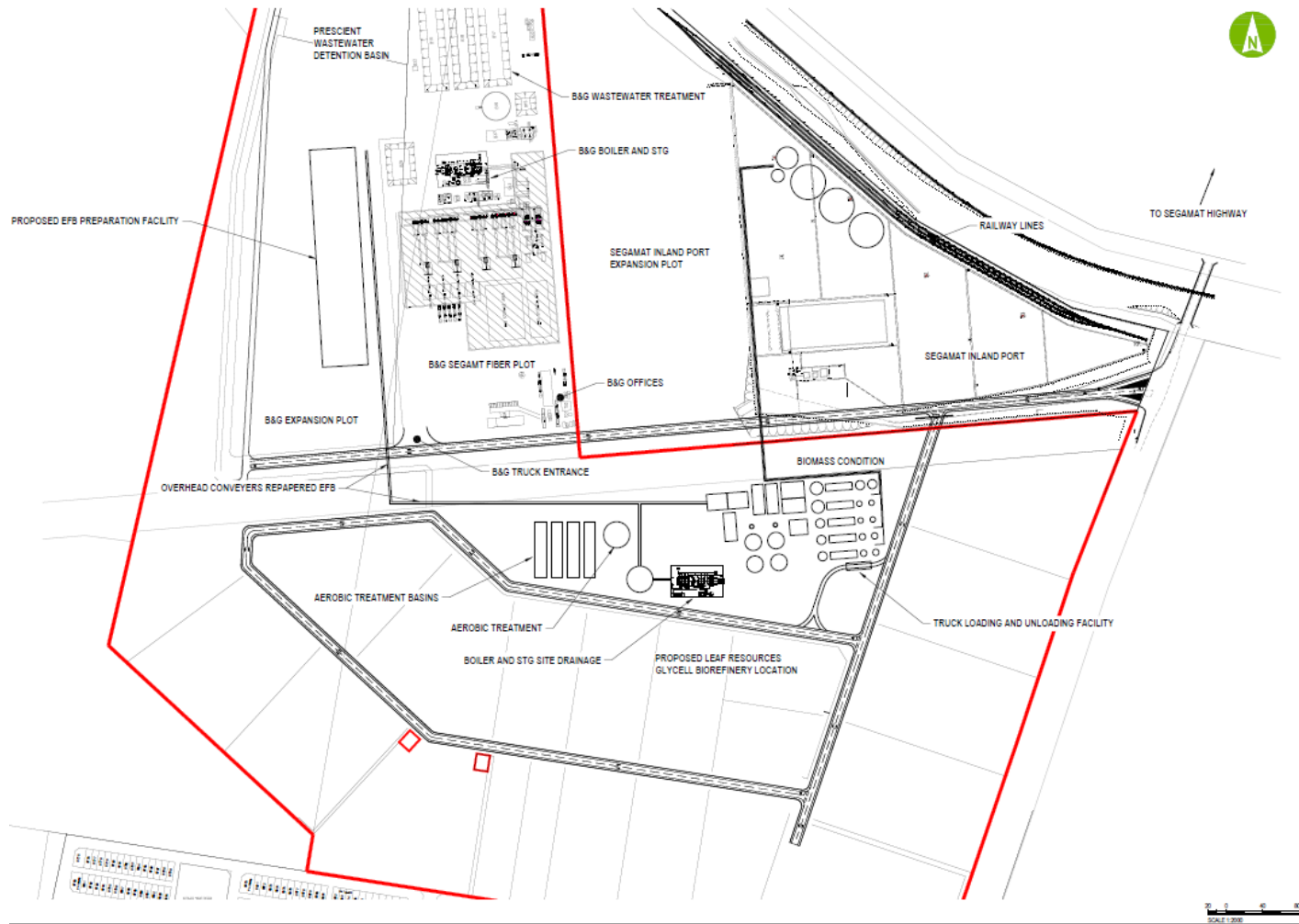


Figure 3 Segamat Site Location – Glycell Biorefinery Layout

## 1.6 Leaf Resources Segamat Site Location – Related Infrastructure



Figure 4 Segamat Site Location – Related Infrastructure

## 1.7 Leaf Resources Segamat Glycell Biorefinery FEL 2 May 2018 Block Flow Diagram

NOTE: FIGURE 5 REMOVED DUE TO CONFIDENTIAL INFORMATION

Figure 5 Glycell Biorefinery Updated FEL 2 May 2018 Block Flow Diagram

## 1.8 Key project impacts with Segamat site location

A large part of this review involved developing the project scope to reflect changed conditions, design assumptions and operational strategies that resulted from constructing the biorefinery in Malaysia. Assumptions on the functional requirements and process design for the EFB feedstocks, energy sources and utilities were developed with Leaf Resources staff to create an updated FEL 2 May 2018 project scope. Capital cost estimates have been developed that includes the new and updated items, as well as including local Malaysian quotes and estimating factors.

As part of the review assessments, the Aurecon team has identified potential project risks and undertaken a high-level risk assessment for residual risks for that issue over the project life cycle.

The key areas of difference that the selection of the Segamat site has made on the original USA based FEL 2 study include:

- Location in centre of large palm oil industries with ready supply of low cost palm empty fruit bunch (EFB) for use as biomass feed to Glycell Process.
- Availability of suitable facilities and project services in the remote Segamat site, that can be supported by mature service providers within 250 km in Malaysian major cities in Kuala Lumpur and Johor.
- Opportunity to utilise low cost EFB as a boiler fuel for steam and power generation, to minimise fuel and electricity costs, as well as enable lignin to be sold as a value-added product.
- Opportunity to collocate with the existing B&G Segamat Fiber Plant and gain synergies for biomass preparation, energy production, logistics, operations and maintenance functions. B&G have proven EFB biomass handling and preparation equipment and operational experience.
- Opportunity for construction cost savings to construct in Malaysia versus USA costs
- Potential sovereign risk associated with Malaysian government interaction versus USA government from previous study.
- Changed environmental regulations in Malaysia versus USA regulations included in earlier studies.
- The target Glycell process operating hours of 7920 per year requires high reliability of equipment, energy and logistics operations, that need to be understood for the Segamat equipment, utility and service providers.
- Cost of grid electricity is high relative to the SE USA site.
- The Segamat water cost, if reliant on city water treated by the municipality (SAJ), is relatively high when compared with SE USA. The base case in the FEL 2 May 2018 model is to utilise bore water at a low cost, rather than the relatively high cost of water from SAJ's treated water main to the site. Quantification of the long-term groundwater supply is required in later studies.
- Reliability and market cost of raw and refined glycerol supply logistics needs to be understood to determine the proportion of glycerol that is recycled, or refined, to maximise the achievable margin as the glycerol market dictates.
- Market price and dynamics of lignin market in Malaysia needs to be understood to determine the proportion of the lignin to be burnt as fuel in the boiler, or refined as a valuable coproduct, with volumes cycled up or down based on economics.
- Attracting experienced staff, managers, technical staff, maintainers and operators to Segamat may require higher pay than the coastal districts, adding to operational costs.

See the 'Changes Impact Register' in Appendix A for a summary of the impacts on the project for this FEL 2 May 2018 review.

The key areas of impact that are discussed in detail in later chapters of this report for context, materiality, key risks and proposed control measures, include the following work areas:

- Site Geography
- Facility feedstock
- Operations strategy and process control
- Construction contracts
- Capital costs
- Operating costs
- Logistics and associated infrastructure
- Management / organisation
- Environmental and social
- Workplace health, process and safety management
- Financial model
- Project timeline
- Risk and opportunity assessment
- Utilities and services

## 1.9 Well-developed aspects of the project

Whilst the focus of Technical Review Reports is generally to concentrate on elements that represent a risk to the project, Leaf Resources and potential financiers, it should be noted that there were many positive aspects of this project that our project team reviewed that contribute to the positive feasibility of the project.

The Leaf Resources team are developing a commercial scale second generation biorefinery that utilises a waste biomass in empty fruit bunch in the Malaysian Palm oil heartlands and their drive, energy and motivation should be commended. Agricultural projects are notoriously difficult to synchronise with the accompanying manufacturing bioprocessing facilities and Leaf Resources have designed the project to minimise interfaces that complicate operations and drive up operating costs.

Leaf Resources' main goal has been to establish a facility that creates the lowest cost of production for C5 and C6 Sugars, Lignin and refined glycerol. This is what has driven their FEL 2 May 2018 operational strategy to establish a fully integrated and energy self-sufficient commercial scale production facility in Malaysia, utilising feedstocks from palm oil empty fruit bunch.

Leaf Resources have predominantly selected 'off the shelf' technologies for the various project elements and utilised reputable Original Equipment Manufacturer (OEM) service providers, to prepare their project scope of facilities. The process design is still being developed and will undergo further optimisation in the FEL 3 study and Detailed Design. The FEL 2 May 2018 capital cost breakdown has adopted conservative allowances for plant and equipment design to accommodate scope evolution and further reliability improvements.

Leaf Resources' team includes experienced project managers and project professionals and they have utilised classic project management tools and techniques in developing this project. Reference to the Leaf Resources data room provided 100 documents, drawings and detailed technical data for the review.

There is evidence of considerable front end loading that has been done over five years to improve cost accuracy, as definition improved with each project stage. Considerable effort has been invested in site investigations, with reputable consultant reports available in the data room to confirm design assumptions.

There is evidence that Leaf Resources have consulted well with community, developers/ landowners, government, regulators, value chain stakeholders, construction contractors and OEM service providers.

These interfaces are well described within documents outlining feedstock supply, options for turnkey supply and operations contracts.

Leaf Resources have sought to establish a contractual framework and project delivery vehicle that pushes project and operational risks onto the EPC contractors. Discussions with local contractors such as Ritma have been undertaken to better appreciate the local Segamat costs and conditions. Ritma has considerable knowledge and experience in building the B&G Segamat Fiber Plant and have been able to supply factual information on relative costs to the USA FEL 2 study. The nature of the project execution contracts will need to be further developed in FEL 3 to transfer foreseeable scope, schedule, cost and quality risks to the hierarchy of local Malaysian EPC contractors, sub-contractors and OEMs who have the greatest capacity to manage the risks of executing projects in Malaysia. However, some project risks are uncontrollable (such as EFB quality, weather etc) and the contractual specifications and performance guarantees need to be clearly drafted for Leaf Resources to avoid financial and non-financial impacts.

Leaf Resources plan to take a pragmatic approach to project logistics and minimised capital by putting infrastructure into operations contracts. Leaf Resources are contemplating contracts with the Segamat Inland Port to toll operate their logistics facility for C5 Sugars, C6 Sugars, Glycerol and lignin transport and export operations. Similarly truck logistics quotes were sourced from local suppliers using tried and proven trucking configurations.

The above comments are representative of well executed areas of the project. Similar assessments can be found in the Risk Register in Appendix D, where items identified as potential issues have received a low risk rating for the project.

## 1.10 Investment highlights

The Segamat Glycell Biorefinery Project team has developed considerable levels of documentation to present to investors to achieve financial close. Some investment highlights include:

- Strong Project economics with a base case, with potential for upside with other options
- Strong Malaysian Government support via Biomass Delivery Unit 1MBAS Innovation, Johor State Government and Segamat local council
- Large volume of low cost biomass available within 50 km radius of biorefinery
- Multiple high value products including: c5 Sugars, C6 Sugars, Refined Glycerol and refined lignin.
- Potential for Malaysian manufacturing and chemical industries to purchase 100% of the Project output via long term offtake contracts
- Existing B&G Segamat Fiber Plant shows what 'good looks like' in a Malaysian context for a biorefinery and provides first mover impetus for the Segamat location to be developed into a biorefinery precinct.
- Water from groundwater is at low cost with an alternative for the water authority SAJ to provide treated council water to the Project if groundwater proves insufficient
- All major EIA approvals have been discussed with local planning bodies and are achievable within reasonable timeframes for the Project

## 1.11 Project environment and market developments

The Malaysian Government has a 2020 vision for sustainable and export-oriented industrial biotechnology and bioproducts sector, with a focus on attracting significant investment and creating regional, high-value and knowledge intensive jobs. The Malaysian Government Biomass Delivery Unit, Agensi Inovasi Malaysia and 1MBAS Innovation have been providing Leaf Resources with support as a major project, with dedicated resources and funding. The Australian Government is processing a grant to Leaf Resources to support progression of the project to Financial Close.

Current environmental concerns for hydrocarbon feedstocks are providing increased market acceptance of bio fuels, bioproducts and biochemicals in niche applications. In addition, organic feedstocks for the



manufacture of specialty bio-products, and increased market demand, presents an opportunity to develop integrated bioprocessing facilities in new locations around the world, or with local agribusiness (or energy park) sites where energy and biomass feedstock is cheap. The world market for bioproducts is rapidly changing as consumers demand cleaner, safer and biodegradable options from the current hydrocarbon based products. Once the emerging process technologies are proven in commercial scale biorefinery operations, emerging bio-industry proponents like Leaf Resources will be in a strong position to obtain further financial benefits from emerging incentives, state development programs and royalty for regions.

The market for the EFB derived C5 and C6 sugars will be competitive with other bio feedstocks in the market for biofuel or biochemicals production. A number of issues exist for commercial deployment of renewable bioproducts, including biomass production, economics and the establishment of new value chains. There is approximately 2million tonnes of EFB produced within a 120Km radius of the Segamat site. Biomass aggregation is the key, and has already been successfully achieved by B & G with their long fibre plant.

To be acceptable for commercial use, renewable feedstocks will not initially compete with fossil based fuels, but the fuels derived from renewable feedstocks must fulfil internationally recognised sustainability criteria that ensures land, water resources and biodiversity are not adversely affected during production, including reducing overall carbon emissions over the bioproduct's lifecycle.

Government has a role to assist biorefinery proponents, such as Leaf Resources, to navigate the complexity of getting projects up and manage project risks through the entire project life cycle. As such, the Agensi Inovasi Malaysia may provide considerable support and resources to assist Leaf Resources in gaining project approvals. Facilitating the removal of hurdles on this project will assist to raise the level of certainty for sustainable operations, enabled the project business case to be refined and the project to proceed towards financial close.

## 1.12 Context and materiality of risks identified

This Review Report has been prepared as a summary document to assist Leaf Resources, shareholders and financiers to appreciate the current FEL 2 May 2018 scope of work for the Segamat site location. It will also provide some background for the demonstration plant trials overseas in Holland at the Bioprocess Pilot Facility BV (BPF). The review team have developed a methodology to focus on the specific tasks requested in the project brief and strategically focused on the most important issues to deliver the best report possible in the timeframe. The review risk register has been mapped to Leaf Resources' project brief and the team has identified potential risks that may occur on the project and assessed these risks in a holistic sense, with the information available from the Data Room and from discussions with project staff and stakeholders.

There has been insufficient time to quantify the materiality of these key risks and whether they represent factors that are material to the project's success. The standard financial definition of materiality states: '*a factor is material if a reasonable person would think or act differently were they to know of the existence of that factor*'. In this instance the review team has included some of the context for raising the issue with the issues descriptions in this report and the risk register, so as to enable the reader to place it into context against their interest in the project. Aurecon have provided input into preliminary financial modelling to determine what tangible impact that the issues would have on project NPV, approvals or attractiveness for investors. However, further work on markets, costs and different operational scenario's is needed in the FEL 3 stage to assess the broad range of assumptions, options and variables available for the project.

We have also not undertaken a review of the appropriate security packages to be provide by the EPC contract, sub-contractors and operators.

The project life cycle has been reviewed by the technical team and mapped to being at an AACE Class 4 Feasibility level and the next step is to undertake FEL 3 or AACE Class 3 design, then a detailed design process. This aligns well with Leaf Resources' perception of project maturity. Leaf Resources have stated that their plans and budget include further tasks, investigations, process measurement, negotiations and specifications to address known issues. Many of the issues identified are solvable through further engineering and negotiations, which may mitigate the potential impacts altogether. A further risk review at the end of FEL 3 would provide a different perspective of the likelihood of the identified risks materialising. This will also flag the residual risks to Leaf Resources from issues proposed to be transferred to the EPC contractors, which were not locked up contractually, nor controllable.

## 1.13 FEL 2 May 2018 Project capital cost

A summary of the key capital items for the updated FEL 2 May 2018 Segamat Glycell Biorefinery Project is shown below in Figure 6:

WBS	Description	Total Level 2	Total Level 1
<i>Leaf Malaysia Segamat Biorefinery FEL 2.5 Study Review</i>			\$ 177,589,640
S0000	Planning and Enabling Work	\$ 167,261	\$ -
S0020	Site Wide Infrastructure	\$ 4,235,506	\$ -
S0100	Biomass Handling	\$ 2,156,625	\$ -
S0150	Glycell Pre-Treatment	\$ 13,596,500	\$ -
S0210	Digestate Filtration	\$ 10,893,190	\$ -
S0220	Enzymatic Hydrolysis	\$ 6,342,544	\$ -
S0230	Lignin Filtration	\$ 6,865,817	\$ -
S0240	Hexose Evaporation	\$ 8,689,763	\$ -
S0250	SMB Guard Filtration	\$ 415,237	\$ -
S0260	SMB 1 Feed Evaporation	\$ 11,728,730	\$ -
S0310	Glycerol Extraction SMB 1 (Salt/MONG Removal)	\$ 10,221,750	\$ -
S0320	SMB 2 Feed Evaporation	\$ 11,728,730	\$ -
S0330	Glycerol/ Pentose Extraction SMB	\$ 2,026,584	\$ -
S0340	Pentose Raffinate Evaporation	\$ 6,795,625	\$ -
S0350	Glycerol Evaporation	\$ 8,227,375	\$ -
S0360	Glycerol Polishing Evaporation	\$ 2,790,875	\$ -
S1000	Water Systems	\$ 2,416,406	\$ -
S1100	Waste Water Treatment Plant	\$ 3,862,383	\$ -
S1200	Boiler and Steam Systems	\$ 20,411,850	\$ -
S1300	Clean in Place Systems	\$ 329,500	\$ -
S1400	Utilities	\$ 2,743,818	\$ -
S1500	Raw Material and Product Storage	\$ 2,775,218	\$ -
S1600	Shipping and Receiving	\$ 523,000	\$ -
S1700	Site Balance of Plant Items	\$ 1,090,000	\$ -
S1800	General Facilities	\$ 598,750	\$ -
S1900	Electrical Distribution	\$ 1,514,400	\$ -
<b>S Directs Sub-Total</b>		\$ -	\$ 143,147,435
S2000	Indirects	\$ 18,297,692	\$ -
<b>S Indirects Sub-Total</b>		\$ -	\$ 18,297,692
S3000	10% Contingencies	\$ 16,144,513	\$ -
<b>Contingency Sub-Total</b>		\$ -	\$ 16,144,513
<b>Leaf Segamat Glycell Biorefinery - FEL 2 Study Capital Cost Estimate, including 10% Contingency</b>		\$ 177,589,640	\$ 177,589,640

Figure 6 Segamat Glycell Biorefinery Project– Summary of FEL2 MAY 2018 Level 2 Capital Budget

### 1.13.1 Potential Capital Items that could be funded by biorefinery partners outside of battery limits (OSBL)

Leaf Resources have undertaken investigations that may lead to a reduction in upfront capital, by contracting out utilities and services to Build Own Operate Transfer (BOOT) proponents, for items outside of the battery limits (OSBL) for the Glycell Biorefinery.

The total Direct Costs that could be apportioned to equipment funded by other proponents outside of the battery limits would be:

**Table 1 Description of Potential Items Outside of Battery Limit (OSBL)**

Plant Tag Name	Description of Items Outside of Battery Limit (OSBL)	Total Level 2 Direct Cost Only
S0100	Biomass Handling	\$ 2,156,625
S1100	Waste Water Treatment Plant	\$ 3,862,383
S1200	Boiler and Steam Systems	\$ 20,411,850
	<b>Potential OSBL Direct Costs</b>	<b>\$ 25,888,908</b>

### 1.13.2 Potential reduced Capital Cost for elements inside of battery limits (ISBL)

If capital reduction initiatives were adopted, the following table shows what the potential capital cost could be for elements potentially inside of battery limits (ISBL).

**Table 2 Potential Reduced Capital Costs for Items Inside of Battery Limit (ISBL)**

Plant Tag Name	Description Items Inside of Battery Limit (ISBL) <i>Leaf Malaysia Segamat Biorefinery FEL 2 Study Review - INSIDE BATTERY LIMITS</i>	Total Level 2
S0000	Planning and Enabling Work	\$ 167,261
S0020	Site Wide Infrastructure	\$ 4,235,506
S0100	Biomass Handling	\$ 630,125
S0150	Glycell Pre-Treatment	\$ 13,596,500
S0210	Digestate Filtration	\$ 10,893,190
S0220	Enzymatic Hydrolysis	\$ 6,342,544
S0230	Lignin Filtration	\$ 6,865,817
S0240	Hexose Evaporation	\$ 8,689,763
S0250	SMB Guard Filtration	\$ 415,237
S0260	SMB 1 Feed Evaporation	\$ 11,728,730
S0310	Glycerol Extraction SMB 1 (Salt/MONG Removal)	\$ 10,221,750
S0320	SMB 2 Feed Evaporation	\$ 11,728,730
S0330	Glycerol/ Pentose Extraction SMB	\$ 2,026,584
S0340	Pentose Raffinate Evaporation	\$ 6,795,625
S0350	Glycerol Evaporation	\$ 8,227,375
S0360	Glycerol Polishing Evaporation	\$ 2,790,875
S1000	Water Systems	\$ 2,371,206
S1100	Waste Water Treatment Plant	\$ -
S1200	Boiler and Steam Systems	\$ 541,950
S1300	Clean in Place Systems	\$ 329,500
S1400	Utilities	\$ 2,743,818
S1500	Raw Material and Product Storage	\$ 2,775,218

<b>S1600</b>	<b>Shipping and Receiving</b>	<b>\$ 523,000</b>
<b>S1700</b>	<b>Site Balance of Plant Items</b>	<b>\$ 1,090,000</b>
<b>S1800</b>	<b>General Facilities</b>	<b>\$ 598,750</b>
<b>S1900</b>	<b>Electrical Distribution</b>	<b>\$ 1,514,400</b>
<b><u>S</u></b>	<b><u>Directs Sub-Total INSIDE BATTERY LIMITS</u></b>	<b><u>\$117,843,453</u></b>
<b>S2000</b>	<b><u>Indirects Sub-Total INSIDE BATTERY LIMITS</u></b>	<b>\$ 15,261,214</b>
<b>S3000</b>	<b>10% Contingencies</b>	<b>\$ 13,310,467</b>
	<b><i>Contingency Sub-Total INSIDE BATTERY LIMITS</i></b>	
	<b><i>Leaf Segamat Glycell Biorefinery - FEL 2 Study Capital Cost Estimate, including 10% Contingency INSIDE BATTERY LIMITS</i></b>	<b><u>\$ 146,415,134</u></b>

Note that the scenario where some capital has been transferred to proponents outside of the battery limits has not been evaluated in the Financial Model. This is because the Opex charges from the BOOT proponents is not known at this stage. Under normal situations, the NPV for the scenario where Capex is transferred to third parties (who would in turn charge a fee for service back to Leaf Resources), would normally be lower by the amount of profit the BOOT operators would charge to supply the utilities and services. Further evaluations during FEL 3 would be able to quantify these impacts on project financials.

## 1.14 Commentary on potential issues for changed project location

Following the initial review, the review team has concluded that there are no fatal flaws with the project's overall scope or delivery structure at this stage of the project's lifecycle.

Aurecon has prepared the risk register for identified project issues in a format that assesses these risks against what activities have occurred to date, and then have recorded what activities are planned to be undertaken through FEL 3, Detailed Design and undertaken a residual risk assessment.

The main risk register is included in Appendix D and has been assembled using the Leaf Resources briefs review work area breakdowns. Our team has aimed to answer the potential review questions put forward in the brief to inform shareholders and financiers.

The risk register contains commentary for each risk on the proposed future control measures and other areas of opportunity that can potentially be undertaken to further reduce risk. These nominated measures may have an impact on the overall project Capex, Opex and profitability. Most are considered unlikely to be beyond the realms of the project contingencies for this nominal Class 4 estimate maturity level.

Leaf Resources' proposed project contractual engagements includes transferring construction risk to the EPC contractors, who may agree to fixed price scopes.

A large number of these risk reduction measures have already been proposed by Leaf Resources to be included in the FEL 3 and Detailed Design phases, where optionality studies can compare NPV impacts between Capex, operating costs and revenue. Leaf Resources have included budget in the next phase to increase the level of definition.

Where appropriate, Aurecon has nominated other constructive alternatives that the review team believes could also provide elegant solutions to optimise the design and lower identified risks.

With such a large vertically integrated facility, a large number of the risks could be averted by providing risk management attention to some common areas in the FEL 3 study. We note that the proposed strategy for EPC contracts and O&M Contracts need to be performance based, with penalties for not achieving performance standards. However residual risks will remain if extenuating circumstances arise.

## 1.15 Summary of highest risk issues identified in the review

Aurecon has distilled Risk Register entries into some common themes as follows. These provide focus areas for multiple project issues that would form the basis of the FEL 3 study risk reduction scope.

- Transferability of current data to accurately extrapolate demonstration plant operational parameters into the full-scale production plant. This is a critical component to enable determination of the commerciality of the Glycell process for EFB and potential to roll this technology out on other feedstocks and locations. This will be mitigated through the through the Integrated Demonstration Study upcoming at the Delft BPF. Information from these trials will provide Leaf Resources with the data to extrapolate and indeed improve upon the demonstration plant data to date
- Leaf Resources have proposed to continue with further demonstration plant testing at the Holland Bioprocess Pilot Facility BV (BPF) in parallel with FEL 3 and detailed design, in order to optimise the full-scale design parameters. This may lead to some scope changes that impact the capital estimate, operational costs and revenue projections. The FEL 3 financial model may produce different results than that obtained with the FEL 2 May 2018 review.
- In the initial start-up years of commercialising plants, there are associated risks with achieving the target annual operating hours. Whilst a large number of major plant items are 'tried and proven' it is the integration of these units into a single process that will enable the proposed capacity for the novel Glycell process to be achieved. It will take some time to fully commission and optimise the performance of the inter-related process modules to achieve safer, reliable and highly efficient operations. These scenarios will be assessed through HAZOP analysis in the next phase and controls developed accordingly.
- Impact of proposed 7920 hours of operation per year on product rate and quality in terms of harvesting conditions, extraneous mud, fibre levels and cellulosic sugar content on process designs for biomass preparation, cogeneration and C5 Sugars, C6 Sugars, Lignin and Glycerol production. B&G and Ritma have constructed designs for the Segamat Fiber Plant that are similar in elements and have met similar performance guarantees. Leaf Resources have proposed to partner with B&G to gain design, construction and operations synergies.
- Operating philosophy to start Stage 1 of the project could initially be to buy electricity from the electricity grid and then introduce electrical generation, power factor and stability controls with high pressure, medium pressure and low-pressure flows, with a dedicated cogeneration boiler and powerhouse. Leaf Resources will develop a Power Supply Strategy in FEL 3 that proposes to assess these scenarios in a staged fashion.
- Sufficient allowances for biomass preparation plant, cogeneration equipment and Glycell plant operational spares, routine wear refurbishment and maintenance consumables equipment costs need to be assessed for the proposed operational hours. Leaf Resources propose to assess Opex cost suitability and required flexibility for critical and operational spare parts from 1% to 2.5% to match plant availability at 90%. The financial model should include 2 years spare parts. Further assessment of wearing items and routine replacement maintainable items needs to be undertaken in the FEL 3 phase.
- Reliability and quality of unregulated ground water supply and associated operating costs for alternate water supplies. While groundwater can be the primary source of process water supply, the impact on costs and profitability of buying additional treated water supply from the local SAJ main needs to be confirmed. Capex and Opex costs around the water strategy will be firmed up in the next phase, pending the outcomes of the investigations on groundwater reliability proposed to be undertaken.
- The proposed cascading of responsibilities through the multi-layered designs, resource sharing, EPC contractual arrangements and integrated operations with B&G, will require strong leadership and contract management to ensure that OEMs can indeed deliver on their promise for equipment process performance, reliability and projected operational costs. Future EPC Term sheets are recommended to include performance, reliability and cost management requirements. It is recommended Leaf Resources conduct an early contractor involvement (ECI) process, undertake HAZOP reviews and specification development in FEL 3 and detailed design.
- Leaf Resources propose to transfer substantial contractual risk to B&G to provide prepared fibre. This requires efficient management of risk with EPC sub-contracts for warranties and performance guarantees

from OEMs and plant and equipment designers. It is recommended to conduct risk analysis on the ability and reliability of B&G to provide all required feedstocks, service and support for the project lifecycle.

- Strategies dealing with materials handling of EFB to produce feedstock of the optimum quality will require some R&D from the existing processes. Infrastructure capital costs and the operational costs are proposed to be further developed in the plan for B&G to construct a biomass preparation plant that processes EFB into streams of fiber for delivery to the Glycell process feed. The plan is to have an independent line 3 on the B&G site to specifically provide biomass to the Leaf Resources site.

The Project Risk Register can be found in Appendix D.

To manage these risks, Leaf Resources have allocated some contingency/ provisional sums in with the direct costs to the loosely defined components in the capital estimate, as well as an overall contingency applied to cover the potential Capex impact of any scope updates to address these potential project issues.

## 1.16 Summary of Financial Model Analysis of FEL 2 May 2018 Base Case

A Base Case version of the Leaf Resources Financial Model has been updated for the latest FEL 2 May 2018 assumptions, operating strategies and changed location to Segamat. There are many options and scenario's that could be modelled and it is not the intent that this necessarily represents the optimum case. At this stage of the project, the model is focussed on representing the technical interactions and impacts of process inputs and outputs across various operating conditions. It is anticipated that more detailed financial and economic modelling will be undertaken in the FEL 3 phase, once the process design is optimised.

The base case includes features available with the Segamat site, compared to previous studies. The current Glycell process can be run to select the proportion of glycerol that is recycled or refined for on-sale, to maximise the achievable margin as the glycerol market dictates. Similarly, the lignin can be burnt as fuel in the boiler or refined as a valuable coproduct, with volumes cycled up or down based on economics. The model has been built on Option 2 described in Chapter 8, which includes Capex and Opex for an EFB fired boiler for process steam and electricity generation. Inputs are summarised in the table below:

**Table 3 FEL 2 May 2018 Base Case Model Inputs**

**NOTE: TABLE 3 REMOVED DUE TO CONFIDENTIAL INFORMATION**

A summary of the key cash flow financial model results, at this stage of the FEL 2 May 2018 project development for the base case with an assumed 10% Discount cash rate and pre-tax calculations is:

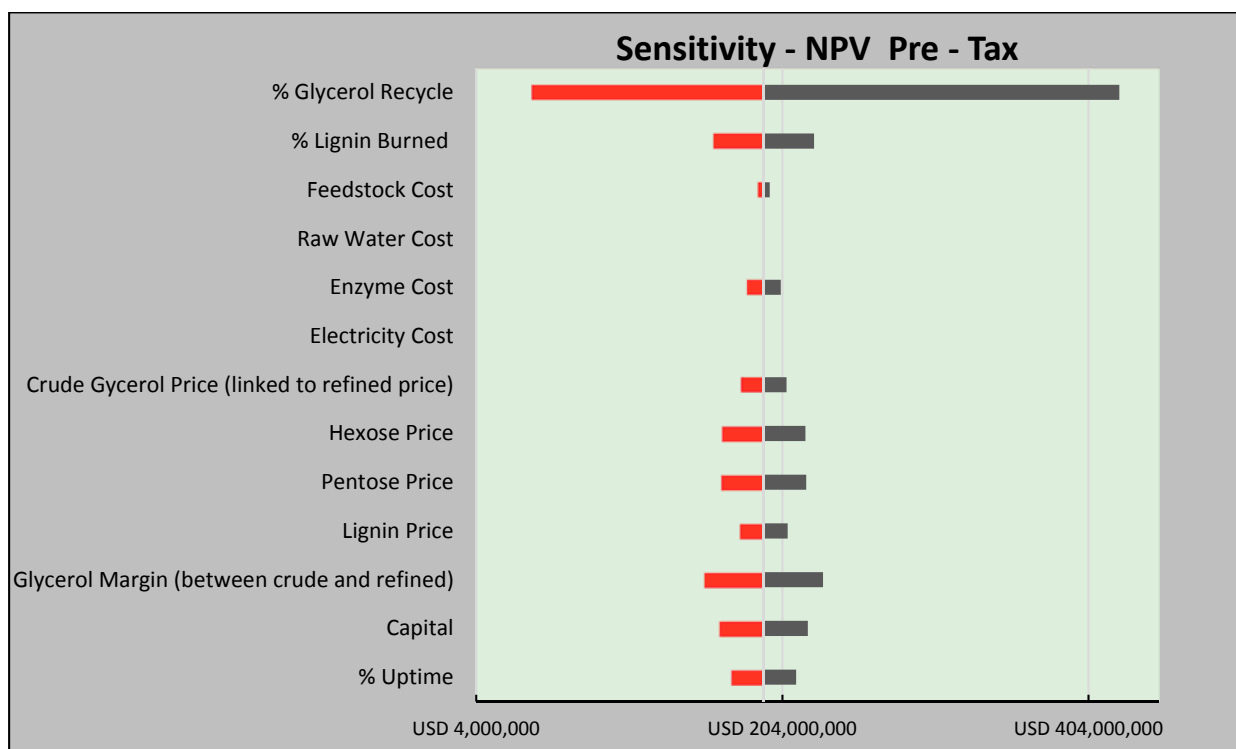
- NPV Base Case      US\$ **191,590,014**
- IRR Base Case        **23%**

Further details on the FEL 2 Model inputs, outputs and assumptions can be found in Section 20 and the Model spreadsheet results in Appendix F.

## 1.17 Sensitivity Analysis

A high-level review of key sensitivities in the updated FEL 2 May 2018 Financial Model was undertaken. The key input and output variables' sensitivity can be seen in the figures below in tornado plot form, showing which inputs are the most elastic/least robust (highest variance). Variance in NPV pre-tax and IRR need to be seen relative to potential changes on project assumptions.

The results of the updated FEL 2 May 2018 project scope sensitivity modelling on the project financial model is summarised as follows:



**Figure 7 Segamat Glycell Biorefinery FEL 2 May 2018– Summary of variables with biggest NPV Impact**

Note the tornado plot above illustrates that the import raw glycerol price point and base case assumption on % recycle has a large impact on the project NPV, due to the large amounts required in the Glycell process. Similarly, the market price for refined glycerol sold has a considerable impact on NPV. Note that these two variables would not produce impacts at the same time, as they are linked in the market. Different assumptions on the level of recycle of glycerol will provide impacts on the NPV and should be modelled in subsequent phases to find the sweet spot to maximise the margin achievable by refining glycerol as a coproduct. In the model, refined glycerol price is linked to the raw price with a \$450/t margin to minimise sensitivity impact. The sensitivity to that margin is what is reflected in the tornado plot.

Figure 10 below provides a summary of the key sensitivity variables and impact on NPV and IRR.

<b>% Glycerol Recycle</b>						
	0%	30%	61%	80%	100%	
NPV	USD 424,158,878	USD 310,370,444	USD 191,590,014	USD 118,178,594	USD 40,396,266	
IRR	37.0%	30.4%	23.0%	18.1%	12.3%	
<b>% Lignin Burned</b>						
	30%	60%	45%	30%	15%	0%
USD 191,590,014	USD 158,457,462	USD 175,023,738	USD 191,590,014	USD 208,156,290	USD 224,722,567	
23.0%	20.8%	21.9%	23.0%	24.1%	25.2%	
<b>Feedstock Cost</b>						
	USD 7.00	USD 5.60	USD 6.30	USD 7.00	USD 7.70	USD 8.40
USD 191,590,014	USD 195,811,173	USD 193,700,594	USD 191,590,014	USD 189,479,435	USD 187,368,855	
23.0%	23.3%	23.2%	23.0%	22.9%	22.8%	
<b>Raw Water Cost</b>						
	USD 80.00	USD 64.00	USD 72.00	USD 80.00	USD 88.00	USD 96.00
USD 191,590,014	USD 191,658,136	USD 191,624,075	USD 191,590,014	USD 191,555,954	USD 191,521,893	
23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	
<b>Enzyme Cost</b>						
	USD 4,000.00	USD 3,200.00	USD 3,600.00	USD 4,000.00	USD 4,400.00	USD 4,800.00
USD 191,590,014	USD 202,996,732	USD 197,293,373	USD 191,590,014	USD 185,886,655	USD 180,183,297	
23.0%	23.8%	23.4%	23.0%	22.7%	22.3%	
<b>Electricity Cost</b>						
	USD 0.12	USD 0.10	USD 0.11	USD 0.12	USD 0.13	USD 0.14
USD 191,590,014	USD 191,795,601	USD 191,692,808	USD 191,590,014	USD 191,487,221	USD 191,384,428	
23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	
<b>Crude Glycerol Price (linked to refined price)</b>						
	USD 450.00	USD 360.00	USD 405.00	USD 450.00	USD 495.00	USD 540.00
USD 191,590,014	USD 206,818,522	USD 199,204,268	USD 191,590,014	USD 183,975,760	USD 176,361,507	
23.0%	24.0%	23.5%	23.0%	22.5%	22.0%	
<b>Hexose Price</b>						
	USD 496.00	USD 396.80	USD 446.40	USD 496.00	USD 545.60	USD 595.20
USD 191,590,014	USD 164,052,004	USD 177,821,009	USD 191,590,014	USD 205,359,019	USD 219,128,024	
23.0%	21.2%	22.1%	23.0%	23.9%	24.8%	
<b>Pentose Price</b>						
	USD 882.00	USD 705.60	USD 793.80	USD 882.00	USD 970.20	USD 1,058.40
USD 191,590,014	USD 163,583,809	USD 177,586,912	USD 191,590,014	USD 205,593,117	USD 219,596,220	
23.0%	21.2%	22.1%	23.0%	23.9%	24.8%	
<b>Lignin Price</b>						
	USD 750.00	USD 600.00	USD 675.00	USD 750.00	USD 825.00	USD 900.00
USD 191,590,014	USD 175,662,066	USD 183,626,040	USD 191,590,014	USD 199,553,988	USD 207,517,962	
23.0%	22.0%	22.5%	23.0%	23.5%	24.1%	
<b>Glycerol Margin (between crude and refined)</b>						
	USD 450.00	USD 360.00	USD 405.00	USD 450.00	USD 495.00	USD 540.00
USD 191,590,014	USD 152,547,600	USD 172,068,807	USD 191,590,014	USD 211,111,221	USD 230,632,429	
23.0%	20.4%	21.7%	23.0%	24.3%	25.5%	
<b>Capital</b>						
	USD 177,589,640	USD 142,071,712	USD 159,830,676	USD 177,589,640	USD 195,348,604	USD 213,107,568
USD 191,590,014	USD 220,723,521	USD 206,156,768	USD 191,590,014	USD 177,023,261	USD 162,456,507	
23.0%	28.3%	25.4%	23.0%	21.0%	19.3%	
<b>% Uptime</b>						
	90%	85.00%	87.50%	90.00%	92.50%	95.00%
USD 191,590,014	USD 170,126,194	USD 180,858,104	USD 191,590,014	USD 202,321,925	USD 213,053,835	
23.0%	21.6%	22.3%	23.0%	23.7%	24.4%	

Figure 8 Segamat Glycell Biorefinery FEL 2 May 2018 – Sensitivity Model results for key variables



## 1.18 Annual project costs summary

A summary of the project's annual costs broken down by the key operational parameters is shown in the figure below for the base case scenario:

### Project Cost Summary

25 metric tonnes / hour of biomass at \$7 / tonne (as is) and 50 % moisture

Plant Run for 24 hours per day, 7 days per week, with 90 % uptime

CAPITAL COST SUMMARY		
Direct Cost	USD	143,147,435
Indirect Cost	USD	18,297,692
Contingency	USD	16,144,513
Fixed Capital Investment	USD	177,589,640
Working Capital	USD	-
<b>Total Capital Investment</b>	<b>USD</b>	<b>177,589,640</b>

OPERATIONS ANNUAL SUMMARY		
Incoming biomass - process (as is)	197,100	MT/yr
Incoming biomass - fuel (as is)	243,160	MT/yr
Crude glycerol input	83,629	MT/yr
Sulfuric Acid input	4,022	MT/yr
Enzyme input	1,977	MT/yr
C6 syrup produced, CB	38,671	MT/yr
C5 syrup produced, CB	22,117	MT/yr
Refined Glycerol sold (99.7%)	60,432	MT/yr
Lignin produced	21,132	MT/yr
Lignin sold, dry basis	14,792	MT/yr
External water purchase	590,467	m <sup>3</sup> /yr
External electricity purchase	1,188,000	kWh/yr
Steam produced	546,973	MT/yr

PRODUCTION SUMMARY (DRY BASIS)		USD/annum
Glucose rich sugar product	USD	19,181,055
Glucose derivative product	USD	-
Pentose rich sugars product	USD	19,507,167
Pentose derivative product	USD	-
Lignin product	USD	11,094,297
Glycerol product	USD	54,388,440
Glycerol derivative product	USD	-
<b>Total</b>	<b>USD</b>	<b>104,170,959</b>

ANNUAL OPERATING COST SUMMARY		USD/annum
Feedstock for process	USD	1,379,700
Feedstock for fuel	USD	1,547,381
Glycerol	USD	37,633,116
Water	USD	47,237
Sulphuric acid	USD	1,608,980
Enzyme	USD	7,909,767
Natural Gas	USD	32,400
Diesel	USD	32,400
Electrical power	USD	142,560
Labor	USD	2,597,182
Maintenance	USD	4,036,128
<b>Total</b>	<b>USD</b>	<b>56,966,851</b>

FINANCIAL SUMMARY		USD
NPV Pre-Tax	USD	191,590,014
IRR Pre-Tax		23%

Figure 9 Segamat Glycell Biorefinery FEL 2 May 2018 – Annual Project Costs Summary – Base Case

# Limitations of this report

## Important things you should know about this report

### Timeframes

Aurecon commenced work on the Leaf Resources Segamat Glycell Biorefinery Project FEL 2 Feasibility Review on the 20<sup>th</sup> April 2018. A draft Report was issued on the 23<sup>rd</sup> May in order to meet the compressed project schedule to achieve Financial Close, with the Final project report due by 30<sup>th</sup> May. Aurecon has undertaken a high-level Stage 1 assessment to fit this timeframe and the information may be updated in subsequent stages as further information is able to be reviewed.

### Reliance on this report by third parties

- It is not possible to make a proper assessment of this report without a clear understanding of the terms of engagement under which the report has been prepared, including the scope of instructions and directions given to and the assumptions made by the engineers who have prepared the report.
- The report is scoped in accordance with instructions given by or on behalf of Leaf Resources. The report may not address issues which would need to be addressed with a third party if that party's circumstances, requirements and experience with such reports were known and may make assumptions about matters of which third party is not aware.
- Aurecon therefore does not assume responsibility for the use of the report by any third-party.

### Limits on investigation and information

- The extent of investigation was to provide a comprehensive report on the key matters that Leaf Resources should address in future phases of the project. Technical site inspections or testing of field conditions and material properties did not form part of the original technical brief, however two Aurecon engineers visited the Segamat Malaysian site as part of a change note. No detailed testing or inspection of geographical features, or physical infrastructure was carried out. Except as expressly stated otherwise, the assessments we have made and this initial report covers issues that are reasonably discoverable through desktop assessments, data reviews and a limited number of meetings with key stakeholders.
- The report is also based in part on information provided to Aurecon by Leaf Resources and other parties, for example, by B&G and Ritma and through the Virtual Data Room (VDR). The report is provided strictly on the basis that the information that has been provided is accurate, complete and adequate.
- Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that Leaf Resources or associated third parties may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the report that it has verified the information to its satisfaction.

### Errors or inaccuracies

If the reader should become aware of any inaccuracy in, or change to, any of the facts, findings or assumptions made either in our report or elsewhere, the reader should inform Aurecon so that it can assess the significance and review its comments and recommendations.

### Specific limitations

The reader should be aware of, and take into account, the following specific limitations to the work undertaken to prepare this report.

## Interviews and Q & A

Significant aspects discussed in this report are sourced primarily from interviews with staff on the various sites and reports prepared by 3rd Parties. Certain management question and answer sessions were held, providing scope for understanding of issues raised, but within limitations.

## Asset Condition of existing infrastructure

Where existing infrastructure and assets are proposed to be utilised, it has been assumed that these items will be fit for purpose and in operational condition. Asset suitability comments are based on limited document reviews, reports provided and equipment lists. A more detailed programme of inspection would be required to better determine colocation site asset condition and interfaces to existing operations.

## Materiality levels

There has been insufficient time to quantify the materiality of issues identified in the review and whether they represent factors that are material to the project's success. The standard financial definition of materiality states: *'a factor is material if a reasonable person would think or act differently were they to know of the existence of that factor'*. In this instance the review team has included some of the context for raising the issue with the issues descriptions in this report and the risk register, so as to enable the reader to place it into context against their interest in the project. However, we have not undertaken the next step to determine what tangible impact that the issue would have on project NPV, approvals or attractiveness for investors.



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