Project Swift – Knowledge Sharing

Market Context & Opportunity Report

Project name:

Licella - Project Swift - SAF from Sugarcane Residues Feasibility Study

Organisation:

Licella Holdings Limited

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Contents

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This Market Context and Opportunity Report has been prepared by Licella as part of knowledge sharing.

It provides an overview of the sustainable aviation fuel (SAF) market and how Licella's Project Swift is anticipated to contribute to the advancement of SAF production and deployment in Australia.

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Executive Summary

Licella - Project Swift - SAF from Sugarcane Residues Feasibility Study

Licella has been working on an innovative biorefinery project ("Project Swift" or "the Project") for Australia and the Queensland sugar industry, utilising its patented and Australian-developed Cat-HTR™ (Catalytic Hydrothermal Reactor) Hydrothermal Liquefaction (HTL) technology to convert sugar mill residues to significant volumes of sustainable aviation fuel (SAF).

The Project will contribute towards building a new industry through the creation of new, locally based SAF production capacity, by facilitating subsequent replication across the sugar growing districts of Queensland. It will also result in a new pathway to certified SAF through HTL of agricultural biomass residues.

Figure 1: Sugarcane - Bundaberg, Queensland

Market and Opportunities Overview

Renewable fuels demand

Renewable liquid fuel demand is forecast to expand by 38 billion litres over 2023-2028, a near 30% increase from the last five-year period.[1] The total demand for renewable fuels is projected to rise to 200 billion litres by 2028.[1]

The aviation sector accounts for 2.5% of the world's total carbon emissions.[2] Current projections estimate that global demand for air passenger journeys in 2050 could exceed 10 billion passengers, more than double the 2025 passenger journey forecast. [3] The expected carbon emissions on a 'business as usual' trajectory between 2021-2050 is approximately 21.2 gigatons of CO_2.[3]

In 2021, the International Air Transport Association (IATA) announced *Fly Net Zero,* representing the commitment of airlines around the world to achieve net zero carbon by 2050.[3] IATA recognises that SAF represents the only viable low carbon solution for medium to long–haul travel over the next 25+ years.[3] For the aviation sector to achieve net zero carbon by 2050, SAF would need to represent 90% of all jet fuel.[4] This makes the aviation industry one of the most challenging sectors to decarbonise, and why accelerating the production of SAF is a key priority of governments and the airline industry around the world.

Aviation fuel market size

The global aviation fuel market size was valued at US$249.9 billion in 2022 and is estimated to reach US$696.2 billion by 2030.[5] This reflects a significant growth trajectory driven by increasing global travel and the expansion of the aviation industry.

Of the total aviation market, the SAF market was valued at around US$882 million in 2024, and is estimated to reach US$64.2 billion by 2033.[6] This rapid growth demonstrates a major shift towards sustainable solutions, with SAF playing a critical role in decarbonising aviation.

[1] International Energy Agency (IEA), Renewables 2023, (2024)
[2] CSIRO, Sustainable Aviation Fuel Roadmap, (2023)
[3] Air Transport Action Group (IATA), Fuelling Net Zero by ICF for Waypoint 2050
[4] Air Transport Action Group (ATAG), Waypoint 2050 Report, (2021)
[5] Market & Markets Research (2025)
[6] Straits Research (2024)

Opportunities for LCLF production in Australia

Australia relies heavily on liquid fuels for more than half its final energy demand. This is particularly the case for the transport sector, which accounts for ~70% of Australia's consumption of refined liquid fuel products. [7]

To achieve Australia's legislated commitment to reach net zero emissions by 2050, Australia needs a pathway to decarbonise sectors of the economy which are currently reliant on fossil liquid fuels. Low carbon liquid fuels (LCLF) offer such a pathway.

In 2024, the Australian Government identified the LCLF industry as a priority within its *Future Made in Australia* agenda.[7] This is in recognition of the important role LCLF will play in Australia's journey to net zero, and the potential for a domestic LCLF industry to contribute to economic growth, job creation, regional development and support national fuel security. The LCLF being considered include advanced biofuels (such as SAF, renewable diesel and green marine fuel). These LCLF are drop-in fuels, meaning that they are compatible with existing fuel infrastructure, unlike first-generation biofuels (such as biodiesel), that are typically not compatible with existing fuel infrastructure, or with vehicles, ships and planes.[7]

Barriers to the deployment of SAF

1. **Access to feedstock**

CSIRO have highlighted that Australia has significant potential to produce SAF from domestic feedstocks. The CSIRO 2023 Roadmap outlined that in 2025, Australia could meet 60% of local jet fuel demand using its biogenic feedstocks, growing to 90% by 2050 as biogenic feedstock sources continue to grow, and hydrogen production ramps up.[2]

CSIRO reinforce that, while Australia has an abundance of potential feedstock for SAF, the key barrier is diverting them away from existing supply chains, and in some cases historical applications that are carbon intensive.[8] Where industries are using these feedstocks for energy and can decarbonise through electrification, an opportunity exists to divert these feedstocks to hard-to-abate sectors such as aviation.

It is critical that new feedstocks are unlocked for the deployment of SAF to meet the scale required to achieve the aviation industry's decarbonisation commitments.

Conventional feedstocks (such as used cooking oil, tallow and sugar), used to make SAF via HEFA (Hydroprocessed Esters and Fatty Acids) and 1st-generation Alcohol to Jet (ATJ) pathways, are generally volume constrained and will therefore struggle to alone meet the future demand for SAF.

A lack of policy or regulation to support the re-allocation of feedstocks that are already competing against the price of fossil fuels remains a key barrier to deployment of SAF in Australia. CSIRO's *SAF State of Play* report published in 2024 highlighted the need for a National Feedstock Strategy to address these barriers related to feedstock. [8]

[7] Commonwealth of Australia, Low Carbon Liquid Fuels – A future made in Australia (2024)
[8] CSIRO, SAF State of Play (2025)

2. High production cost

One of the key barriers to the deployment of LCLF, including SAF, is the higher production costs compared to conventional fossil fuels. The higher production costs are in part driven by the challenges of collecting and aggregating sustainable feedstocks, the extra processing steps, and the lack of scale in current production. SAF is currently estimated to be 2-5 times more expensive than standard jet fuel.[8] The production of SAF benefits from economies of scale, so achieving scale in many of the sub-processes will be critical for scaling the broader emergent industry in Australia.

3. Lack of policy

Globally, approximately 44 SAF policies have been adopted or are under consideration, together accounting for over 65% of jet fuel use.[8]

A strong link exists between investments made into the deployment of SAF and a more developed regulatory landscape that supports LCLF. An analysis done by Argus of all known global SAF plants indicates that 78% of nations have a type of instrument or policy either implemented or pending.[9] Where demand-side and/or supply-side policies exist, greater investments have been made. Of the US$18bn in SAF investments made globally to date, a large portion (nearly $8.3bn or 46%) has gone to projects in the US (a market characterised, up until now, by strong supply-side policies and incentives), with France ($3.4bn), Finland ($1.6bn) and Canada ($1.3bn) following behind.[10]

While the Australian Government's *Aviation White Paper* has confirmed the intent to consider a SAF mandate or target, a formal government policy is yet to be confirmed.[11] This remains a barrier to the development and growth of the local SAF market as it creates uncertainty and perceived risk for investors on the commercial viability of SAF projects, while the use of SAF remains voluntary and mostly unregulated.

4. Access to capital

Another key barrier to the deployment of SAF is the high cost of capital for SAF production facilities, which stems from the technology risk, long project timelines, and lack of policy support. Often private investors mandate higher investment returns to compensate for these perceived risks. Governments have an important role to play to set appropriate SAF policies and provide meaningful investment to support de-risking these first of kind facilities for the Australian market.

[9] Argus – Sustainable Aviation Fuels
[10] Innovate UK Business Connect
[11] Commonwealth of Australia, Aviation White Paper (2024)

Preliminary SAF feedstock opportunity

Australia's large landmass, climate, advanced farming practices, established supply chains and renewable energy potential are all significant assets in developing a range of feedstocks to support a domestic SAF industry.[2]

Advanced biofuel pathways that can process non-food feedstocks, such as agricultural residues, have several advantages over pathways that target feedstocks such as edible oils and food crops. Lignocellulosic feedstocks are plant-based materials made up of cellulose, hemicellulose, and lignin. Lignocellulosic feedstocks derived from non-edible biomass, particularly wastes and residues sourced from agricultural and forestry by-products, combine an abundant supply with significant potential for emission reduction benefits. This makes non-edible biomass residues high potential feedstocks to scale the production of low-cost, low-carbon intensity LCLF, including SAF. [12]

Australia's agricultural sector could participate in building a domestic SAF industry by providing a range of abundant, low-cost lignocellulosic feedstocks. Targeting residues and waste streams as feedstocks for the LCLF market allows industries to continue their core business while creating a new revenue stream for farmers and regional communities. Providing feedstock to the SAF market supports diversification of existing industries, such as the sugar industry, supporting its long-term viability.

Almost 85% of Australia's sugar industry revenues originate from raw sugar sales in the global market.[13] By comparison, Brazil and Thailand (two major and competing sugar producing markets) generate 50% and 75% of revenues respectively from raw sugar sales.[14]

The Australian Biomass for Bioenergy Assessment (ABBA) estimates that in Queensland alone there is 17 million tonnes (mt) of dry residual renewable feedstock produced each year, with over 10 mt of this being produced by the sugarcane industry, as seen in Figure 2 below.[15] If this was converted, it could produce over 2 mt of SAF, or 28% of Australia's annual jet fuel consumption.

[12] CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels (2024); supply estimates based on company research from third party sources (Licella data on file).
[13] Australian Sugar Milling Council (ASMC) – Market access and trade
[14] Food and Agriculture Organization of the United Nations (FAO) - Sugar: the impact of reforms to sugar sector policies a guide to contemporary analyses
[15] Australian Biomass for Bioenergy Assessment (ABBA) – data available online in National Map and DSDI online

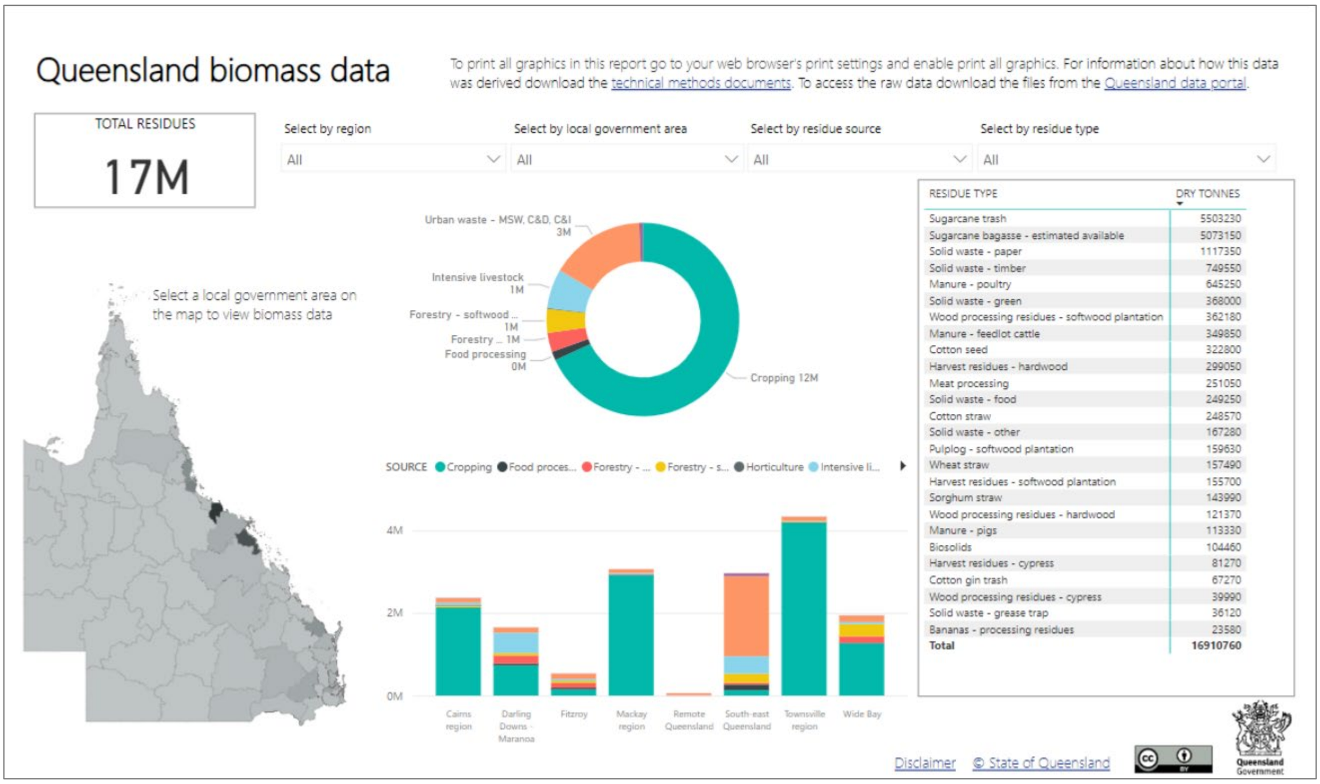

Figure 2: Queensland biomass data [15]

Preliminary analysis of sugarcane bagasse feedstock

Bagasse, also known as sugarcane pulp, is the dry, fibrous residue remaining after sugarcane stalks are crushed to extract the juice used in sugar production.

Figure 3: Licella and ICSM team members on-site at the sugar mill - pictured in-front of bagasse

For Project Swift, Licella proposes to utilise bagasse arising from Isis Central Sugar Mill (ICSM) core milling operations as its primary feedstock. The selection of bagasse is in keeping with the desire for all project partners to secure and scale Australia's SAF industry in the long term. The most effective way to do so is by shifting the use case of lower-value feedstocks like bagasse towards higher value markets such as SAF.

The current use of bagasse by sugar mills (including ICSM) mainly consists of incineration for on-site energy generation. However, the low-energy efficiency has meant that sugar mills are increasingly looking at alternate high-value market opportunities. Licella is also exploring the opportunity to use surplus leaves from the harvesting of cane as a feedstock.

Over the past 5 years, Licella has worked closely with the Queensland Government (within its pre-feasibility study[16]) and the wider sugar industry to build awareness, further develop its understanding of technical challenges and develop strong commercial models that can support new value chains for residue streams from sugarcane.

[16] Queensland Government (2020) Pre-Feasibility Study

Licella™

Availability and scale of production

National perspective

From a national perspective, Government estimates suggest a total of 52 million dry, ash-free tonnes of biomass feedstock are available.[17] This corresponds to 350 x Cat-HTR™ plants (150 k tonnes processing capacity) producing a total of 17.3 million tonnes of LCLF of which 11.2 million tonnes (or 3.7 B gallons/year) could be SAF.

Queensland perspective

LCLF feedstock potential in Queensland alone is significant, with Government estimates suggesting that a total of 15.6 million dry, ash-free tonnes of total biomass feedstock is available in Queensland. Of this total biomass feedstock, 30.9 million 'as-is' tonnes are estimated to be bagasse. If unlocked for LCLF, this total potential feedstock corresponds to just over 100 x Cat-HTR™ plants (150k tonne processing capacity) producing a total of 5.2 million tonnes of LCLF a year, of which 3.4 million tonnes or 1.1 billion gallons/year is SAF.[18]

Wide Bay Burnett region, Queensland

The Wide Bay Burnett region of Queensland (that includes Bundaberg) is recognised for its established sugar growing supply chain, harvesting and sugar mill processes. These facilitate substantial throughput of sugarcane into its local mills, including the Isis Central Sugar Mill (ICSM), and result in approximately ~600,000 dry tonnes of bagasse volume across the region.

Currently, ICSM produces ~215,000 tonnes per annum of dry bagasse that fits the Cat-HTR™ feedstock specification requirement.[17] Licella and ICSM currently have a preliminary agreement in place for the supply of feedstock to the Project.

Considerations for availability of bagasse as a feedstock

Bagasse volume is influenced by both cane crop yield and mill reliability during the season. ICSM's 2024 annual report data of cane tonnes crushed gives long range historic assurance for consistent feedstock volumes that exceed Project requirements. In 2023 for example, ICSM's holding of dry bagasse represented ~26% of the tonnes crushed, which aligns with industry norms.[19] Other by-products from sugarcane harvesting, such as surplus leaves, also represent a potential source of feedstock for the Project.

A feedstock mapping study was conducted for the Project by GHD to ensure that the facility could access alternate contingent feedstocks to maintain ordinary operational levels in the event of an unforeseen shutdown at the ICSM mill. As the feasibility study progresses, it is expected that engagement with alternate feedstock providers will continue.

Bagasse is already used as a source of green energy (for co-generation) by sugar mills but diverting it as feedstock for the domestic production of SAF supports decarbonisation of a hard-to-abate sector, alongside being a higher value, lower emission application. The Australian

[17] Enea, Deloitte, Australia's Bioenergy Roadmap (2021)
[18] Queensland Government (2023) – Queensland Biomass Mapping and Data
[19] Isis Central sugar Mill (ICSM) Annual Report (2023)

Sugar Manufacturers (previously the Australian Sugar Milling Council) is advocating for policy mechanisms and investment into more efficient co-generation at sugar mills that would support liberating bagasse towards the domestic production of LCLF including SAF.[20]

"Bioenergy represents a diversification opportunity for the sugar industry, providing the industry with exposure to markets other than sugar, and in turn reducing the market risk for our businesses."
Australian Sugar Manufacturers[20]

Figure 4 - Licella and Isis Central Sugar Mill representatives gathered on-site for a project briefing on Friday 21 March

Sustainability and certification requirements

Licella's Project will comply with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) sustainability criteria applicable for batches of CORSIA SAF produced by a certified producer on or after 1 January 2024.[21] ICSM's bagasse feedstock is of biogenic origin, grown annually and clearly meets the Renewable Feedstock definition under CORSIA.

Under CORSIA standards, feedstocks derived from wastes, residues or by-products attract a nil emissions contribution factor. The proposed feedstock for the Project falls into this category and favourably impacts upon the overall 'feedstock to fuel' emissions calculation. Moreover, the ILUC (indirect land use change) value allocation is also nil, given the long history of sugarcane growing and milling in the Wide Bay Burnett region that feeds into the ICSM facility.

A detailed LCA (Life Cycle Assessment) with comprehensive evaluation of technology and process impacts will be conducted as part of the Project's feasibility study to substantiate the CI (carbon intensity) calculation of the proposed facility. An additional scope of work to benchmark CI profile against global regulatory incentive schemes and SAF facilities in other markets will also be considered.

[20] Australian Sugar Manufacturers Pre-budget submission (2025)
[21] ICAO, Corsia Sustainability Criteria for CORSIA Eligible Fuels (2022)

Project Overview

Aim and objectives

The aim of Project Swift ("The Project" – a Feasibility Study that includes Pre-FEED and FEED for the proposed biorefinery) is to achieve a Final Investment Decision (FID) to commence building the Cat-HTR™ biorefinery (the "Deployment Project").

The proposed biorefinery will utilise Licella's Cat-HTR™ Hydrothermal Liquefaction (HTL) technology to process biomass residues, including bagasse (targeting processing a total feedstock volume of 150,000 dry tonnes per annum) to a bio-intermediate (renewable oil). The Project will investigate the bio-intermediate being upgraded on-site, using adapted versions of commercially available refining technologies from Shell and green hydrogen, to produce significant volumes of low carbon liquid fuel (LCLF) including sustainable aviation fuel (SAF) (and to a lesser extent, Naphtha and renewable diesel).

Project Swift's Feasibility Study and FEED is scheduled to run for 1.5 – 2 years, with the Deployment Project commencing post FID. As such, Licella is currently targeting commencing construction of the biorefinery in 2027.

Site selection

Licella has signed a Project Development Agreement (PDA) with Isis Central Sugar Mill (ICSM), in the Bundaberg region of Queensland, that reflects the intention of ICSM to provide the site and feedstock for the Project.

The sugar industry in the Bundaberg region (Wide Bay Burnett, Central Queensland) is well established, with a supply chain on firm footing with sugar product predominately exported into overseas markets. Queensland is recognised globally for its innovative growing practices and willingness to adapt to meet emerging industry challenges.

ICSM has a 120-year history in the Australian sugar industry. The ICSM mill in Childers crushes more than 1.2 million tonnes of sugarcane per annum, along with operating a cane railway network with over 150 km of mainline. ICSM's pre-existing infrastructure and access to significant cane volumes make the site a desirable location for a large scale SAF production facility.

Figure 5: Isis Central Sugar Mill (ICSM), Childers, Queensland

Feedstock and technology selection

At the heart of the Project is Licella's patented Cat-HTR™ HTL technology, which converts the biogenic feedstock into a sustainable liquid bio-intermediate (see Figure 7). This renewable oil produced on-site can be fed directly into on-site upgrading technology to produce LCLF including SAF, renewable diesel and low sulfur marine biofuel. This secondary conversion, commonly referred to as 'upgrading', is the second major step for the proposed integrated biorefinery. This two-step process (see Figure 6) from feedstock to fuel, reduces plant complexity and enhances project economics.

Bagasse, a residual biomass stream from sugarcane processing, offers a promising source of feedstock for SAF. Other by-products from sugarcane harvesting, such as surplus leaves, also represent a potential source of feedstock for the Project. In the longer-term, sugarcane tops and trash are another potential feedstock, but more work is needed to determine the most efficient methods for aggregation and pre-processing.

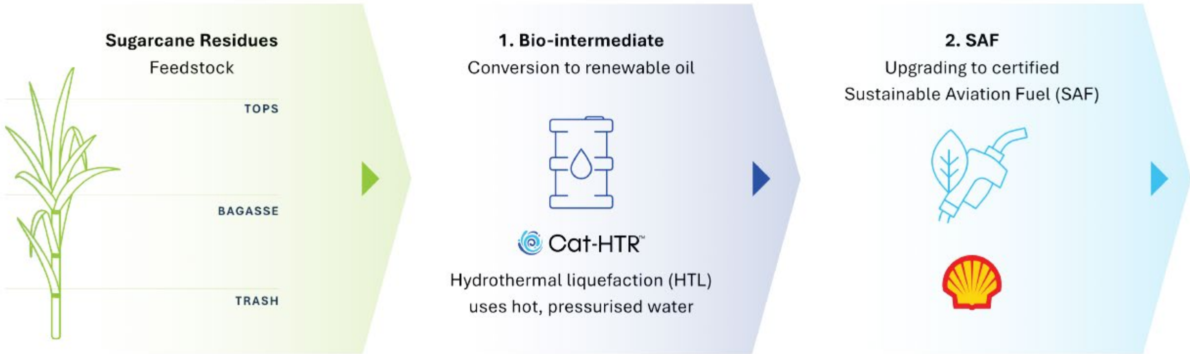

Figure 6: Licella's proposed biorefinery's two step process to produce SAF from sugarcane residues

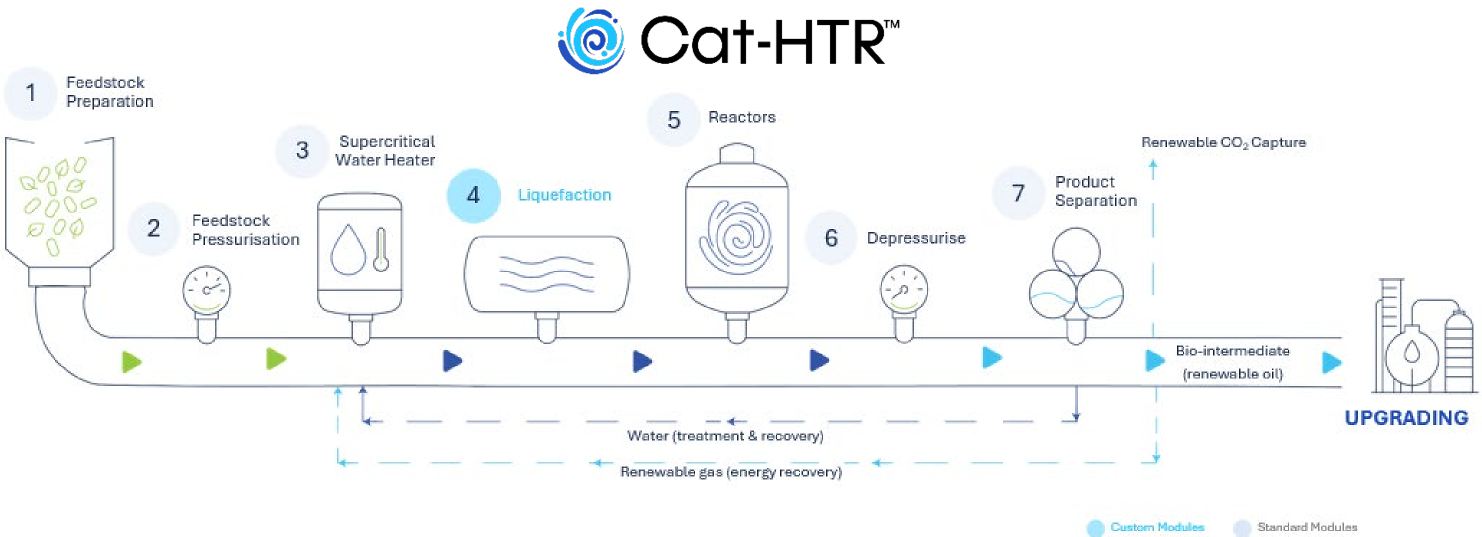

Figure 7: Simplified process flow of the core Cat-HTR™ hydrothermal liqufaction process from feedstock to bio-intermediate upgrading

High level competitive advantages

Licella's Cat-HTR™ HTL technology is an emergent platform to produce SAF. However, more than 17 years has been invested in its progressive technology development across multiple feedstocks, and commercial facilities with Cat-HTR™ at their core are being commissioned globally in 2025. Several competitive advantages have been acknowledged by Licella's strategic partners, investors and technology licensees including its feedstock flexibility, process efficiency and therefore its ability to scale as a cost-effective and low carbon intensity (CI) LCLF production platform.

Through its extensive technology development, the Cat-HTR™ core process design has been simplified and modularised, which has allowed for optimal commercial scaling of the platform.

High-level competitive advantages of Licella's Cat-HTR™ technology:

1. **Feedstock flexibility**

A conversion technology that can access a range of abundant and low-cost feedstocks helps to de-risk new LCLF projects. Feedstock flexibility mitigates project risk by providing a steady supply of raw materials and enabling adjustments to be made if feedstock supply is impacted or costs increase.

Licella's Cat-HTR™ platform is recognised for its ability to process a wide range of lignocellulosic (biomass) feedstocks, targeting residual streams that are non-edible and do not compete with food for land use. These feedstocks include by-products from agriculture and forestry, and other low-cost, renewable materials that might otherwise go to landfill or be burnt for energy.

Conventional feedstocks used to produce SAF through the HEFA[22] and alcohol-to-jet (AtJ) pathways, such as used cooking oil, tallow, oil seeds and sugar[23], will become supply constrained in the medium to long-term and are therefore subject to increasing price volatility.

Biomass wastes and residues have several advantages over conventional feedstocks. They have higher potential to deliver LCLF that are low CI under schemes like CORSIA[24], are low cost and offer more secure and scalable supply in the long term.

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[22] HEFA stands for Hydroprocessed Esters and Fatty Acids.

[23] Sugar is used to produce ethanol by 1st generation alcohol to jet (AtJ) pathways, but other feedstocks, such as corn, can also be used to produce ethanol.

[24] CORSIA, or the Carbon Offsetting and Reduction Scheme for International Aviation, is a global scheme, developed by the International Civil Aviation Organization (ICAO), designed to address CO_2 emissions from international flights by requiring airlines to offset any growth in emissions above a certain baseline.

2. Process efficiency & carbon retention

One of the standout features of the Cat-HTR™ technology is its energy efficiency and ability to maximise carbon retention throughout the conversion process (from feedstock to fuel).

The bio-intermediate produced by the Cat-HTR™ platform retains a high portion of the carbon from the feedstock, a key factor in improving the CI and economic feasibility of the process.

Applied to LCLF, high carbon retention is important for several reasons:

i. **Lowers carbon intensity (CI)**: The more carbon retained through the process from feedstock to fuel, the lower the net carbon emissions during the production and use of the LCLF. This directly contributes to meeting carbon reduction targets and enhances the overall sustainability of the fuel.
ii. **Lowers cost of production**: Higher carbon retention translates into higher product yields, which reduces the per-unit production cost of LCLF. This makes SAF production more competitive in a rapidly evolving market with varying regulatory and economic conditions.
iii. **Maximises sustainability credentials:** The ability to retain a high percentage of carbon through the process supports its compatibility with global carbon certification programs, such as CORSIA[24], which prioritise lower-carbon fuels for aviation.

Thus, the Cat-HTR™ technology's process efficiency and carbon retention reduces its environmental impact, maximises its sustainability credentials and improves its economic viability of SAF production.

3. Modularisation & ability to scale

A critical factor for the commercial success of any emergent technology is its ability to achieve commercial scale efficiently. Through extensive technology development, the Cat-HTR™ core process design has been simplified and modularised, allowing for optimal commercial scaling. Its process modularity reduces plant complexity, enabling faster, more cost-effective commercial deployment and making it easier to duplicate across multiple locations.

The streamlined process design helps ensure technical feasibility and improves economic viability of commercial projects. Additionally, the modular design approach allows for optimal integration into existing industrial value chains, enhancing adoption and expansion in regions with established infrastructure. For more explanation, see Summary of lessons learned from CS1 and CS2 plants.

For a simplified explanation of the core Cat-HTR™ HTL conversion process, please see Figure 7.

Figure 8: Dr Len Humphreys, Licella Co-Founder and Co-Inventor of the Cat-HTR™ technology, pictured at the CS1 facility, Somersby, NSW

Figure 9: Cat-HTR™ commercial-scale reactors at the CS1 facility, Somersby, NSW

Summary of lessons learned from CS1 and CS2 plants

CS1 - Commercial Stage 1 *is Licella's Cat-HTR™ small-scale commercial facility, operated in short run campaigns for process development purposes and located in Somersby NSW. It was commissioned in 2021.*

CS2 - Commercial Stage 2 *is the Cat-HTR™ full-scale commercial facility completed and in commissioning by Licella's joint-venture with Canfor, Arbios Biotech, in Prince George, BC, Canada. The facility's name, "Chuntoh Ghuna" or "the forest lives," was bestowed by the Lheidli T'enneh First Nations.*

Figure 10: Licella's CS1 facility in Somersby, NSW (commercial demonstration facility used for short runs of biomass)

Significant technical progress for the Cat-HTR™ platform with biomass has been achieved over the past 24 months. Specifically, Licella's technology readiness level (TRL) for biomass advanced significantly following the commissioning of its Commercial Stage 1 facility (CS1[25]) in Somersby, NSW.

Over the past two years, Licella (via its joint venture with Canfor, Arbios) constructed a greenfield Cat-HTR™ commercial-scale project in British Columbia, Canada, known by Licella as CS2[26], that will convert woody biomass residues from forestry into a bio-intermediate, to produce LCLF. As of March 2025, the CS2 facility (known in the market as *Chuntoh Ghuna*) is in the final stages of commissioning.

[25] CS1 - Commercial Stage 1 is Licella's name for the Cat-HTR™ small-scale commercial facility, operated in short run campaigns for process development purposes located in Somersby NSW, and commissioned in 2021.
[26] CS2 - Commercial Stage 2 is Licella's name for the Cat-HTR™ full-scale commercial facility completed and in commissioning by Licella's joint-venture with Canfor, Arbios Biotech, in Prince George, BC, Canada.

The *Chuntoh Ghuna* facility is the world's largest Hydrothermal Liquefaction (HTL) facility and has been designed by Licella's engineering team to be modular. It builds upon technology learnings from Licella's CS1 facility in Somersby, NSW. The modular design of CS2 will be replicated and scaled up for Project Swift in Queensland, which will develop alongside CS2's capacity scale-up. The Licella team managed the overall planning, engineering and construction of the Arbios CS2 (*Chuntoh Ghuna*) facility, in conjunction with Canadian engineering and construction companies.

The CS2 plant has provided valuable lessons in developing a LCLF plant utilising a first-of-kind technology, including important lessons in project delivery, engineering, procurement, risk management, and expediting project delivery schedules. By applying these lessons to future projects including Project Swift, Licella can improve project efficiency, reduce project risks, and support timely project execution and completion.

Figure 11: Arbios Chuntoh Ghuna facility (CS2) in Prince George, Canada - commercial-scale Cat-HTR™ plant commissioning scheduled for operations in 2025

Summary of key lessons learned

A summary of the key lessons learnt from CS2 that will be carried forward to Project Swift include:

- **Engineering management** - Multiple engineering contractors, working for different project areas and using their preferred plant design and modelling tools, can lead to design integration challenges that impact execution efficiency. Appointing a lead contractor to ensure design integration of the entire project could significantly improve execution efficiency.
- **Construction management** - A split construction execution strategy that combined a stick-build and prefabricated modular construction approach optimised the package driven site construction, and the number of contractors on-site.

- **Equipment knowledge transfer** - Building on the knowledge base created by both CS1 and CS2 will be beneficial for future projects. Future scale ups should remain within the family of equipment tested. Any new concepts should be assessed and piloted before incorporating into the Project.
- **Maintaining key technology vendors** helps retain important knowledge. Early selection of the vendors will allow them to support the engineering teams early in the feasibility study for the Project.
- **Procurement** - Initiating early procurement of long lead-time equipment, and close collaboration with equipment suppliers, will help ensure smooth and timely delivery of equipment.
- **Site specific feedstock** should be processed at CS1, with product characterisation utilised for decision making.
- **Permitting** - Engaging SME (subject matter expert) consultants facilitated the approval and permitting processes with relevant local authorities. Specialised consultants offer substantial value in understanding and navigating compliance with regulatory requirements, particularly those with good understanding of the local regulatory environment.

Figure 12: CS2 facility (front-end feedstock step on left and core Cat-HTR™ modules on the right)

Figure 13: Forestry residues from trials at CS1 in NSW, supporting the CS2 facility in Canada

Figure 14 - Arbios team members on-site in Canada, pictured with forestry residues in feedstock storage area of CS2

Preliminary pre-FEED and FEED study methodology

Licella follows an industry recognised Front End Loading (FEL) stage gate process for project development. This approach allows for milestone-based technical progress and risk management.

At the core of the Project are the technical details for the feasibility study including pre-FEED and FEED (Front End Engineering Design), with a focus on project development. It is completed in two stages spanning a period of 18-24 months (targeting 18 months for completion). The two stages include a FEL-2 stage, where emphasis is on selecting the best achievable project configuration, and FEL-3 stage, where the selected configuration will be developed, and engineering deliverables will be defined.

An important element of the pre-FEED and FEED study is to define appropriate deliverables to undertake the appropriate execution strategy covering engineering, procurement and construction of the facility during the Deployment Project. The technical and commercial plans will contribute a major component of the FID Package from the deployment stage.

This gated approach allows stakeholders to measure progress and assess impact on the project economics (CAPEX and OPEX), as engineering definition is improved over the course of the Project. For an undertaking of this size, it is proposed to proceed between stages through project reviews, presented to the Project Steering Committee.

Although the Project has a modest capacity compared to typical fossil refineries, it has all the interfaces and aspects of any greenfield project. The Upgrader FEED development and the engineering, procurement and construction (EPC) contractor selection are the two critical activities that involve external development and therefore have the highest potential to impact the project schedule.

Licella plans to work with a Tier 1 global engineering partner, in which it is contemplated that the partner will develop a Process Design Package (PDP)[27] for the Cat-HTR™ platform. This is critical foundational work for the site-specific engineering that the Licella engineering team will develop towards the FEL-2 stage gate for the Project.

[27] PDP - means the process design package prepared to an FEL 2 +/- 20% level which is ready to be provided to a recognised and approved engineering firm for purposes of preparing a site-specific basic engineering design. The PDP demonstrates a commercially and economically viable design that has not yet been tailored to a specific site and that is sufficient for determining the suitability of specific sites to support a final investment decision.

Preliminary project timeline

Table 1 outlines the Gated Project Development approach for the Project.

Table 1: Staged Development

Stage Gates	Deliverables	Timeframe
FEL-2	• Process Optimisation Studies and Process Flow Diagram incorporated in PDP 1 • Plot Plan Development • Safety Studies / HazID • Constructability Study • Risk register • Project Schedule • Class 4 Estimate	4 – 5 months
FEL-3	• Piping & Instrument Diagrams • Equipment List • Electrical Design • Vendor development • Execution Strategies • Risk Management Plan • HAZOP • Class 3 Estimate • Tendering for EPC contractor	9 – 12 months (post FEL-2 gate review)
FID Package	• Technical Execution Package • Long lead equipment ready to order • EPC contractor selection • Final approvals	3-4 months (post FEL-3) Target: Q2 2026

Social licence and expected stakeholder engagement activities

The importance of social licence

As an organisation that has pioneered an innovative first-of-kind technology, Licella is committed to gaining and maintaining a social licence to operate. Licella understands the importance of engaging early and proactively with key stakeholders and the local community for the Project.

The development of a domestic SAF industry, integrated with the sugar sector presents a transformative opportunity with far-reaching impacts on numerous stakeholders, both directly and indirectly.

Projects of this nature are high profile, attracting ongoing public and media interest, as well as stakeholder commentary. Effectively communicating the benefits of a bioeconomy project is vital to gaining the community's support.

Stakeholder engagement

Driving strong stakeholder engagement across the value chain will be an important enabler for the Project.

Key project stakeholders include, but are not limited to:

- Government (Federal, State, local)
- Local community
- First Nations
- Broader industry

Local community engagement

As an organisation, Licella is deeply committed to working with the community and local stakeholders to understand their concerns and issues early, identify options to mitigate those concerns and continue to have regular touchpoints that allow the community to feel understood and heard.

While formal community consultation will commence during Q2-Q3 2025, stakeholder mapping was completed in Q4 2024 and key stakeholder engagement commenced in Q1 2025.

First Nations

Licella commenced its Reconciliation Action Plan (RAP) journey in 2024, and submitted its *Reflect* RAP to Reconciliation Australia on 9 January 2025, which was conditionally endorsed by Reconciliation Australia on 25 February 2025. Licella have established a RAP working group that meets on a fortnightly basis to ensure delivery of our RAP commitments.

First Nations groups are considered key stakeholders throughout all stages of Project Swift. Licella has commenced engagement with First Nations groups in the Wide Bay Burnett region and will continue to explore opportunities for engagement throughout the Project.

Conclusion and Next Steps

Project Swift - SAF from Sugarcane Residues Feasibility Study

Licella's Australian developed Cat-HTR™ Hydrothermal Liquefaction platform is an emergent pathway to sustainable aviation fuel (SAF). Due to its process efficiency, high carbon retention and feedstock flexibility, it is expected to deliver a new pathway to scale local production of low-cost and low carbon intensity SAF.

Project Swift aims to develop an integrated biorefinery with Licella's Cat-HTR™ technology at its core in the Bundaberg region of Queensland. With the aim to unlock agricultural residues, specifically bagasse from sugarcane, its modular design facilitates replication across other sugar growing regions of Queensland to support rapid scaling of local LCLF production.

The next steps for the Project involve continuation of the feasibility study through pre-FEED and FEED (Front End Engineering Design). The technical work will be completed over 18-24 months and runs in parallel to the Project's continued stakeholder and community engagement activities.

Figure 15 - Licella CEO, Alan Nicholl, and ICSM CEO, Craig Wood, with other team members on-site at ICSM in 2024

Licella™

Glossary

Arbios Biotech— Arbios is a 50/50 joint venture between technology pioneers Licella Holdings and integrated forest products company Canfor. Refer to www.abiosbotech.com/about

Alcohol to Jet (AtJ)— Alcohol to Jet (AtJ) is a process that converts alcohols into SAF by removing the oxygen and linking the molecules together to get the desired carbon chain length. 1st generation AtJ primarily use ethanol derived from sugar or corn.

Bagasse— Bagasse, sometimes known as sugarcane pulp or megass, is the fibre remaining after the juice is extracted from sugarcane.

Bio-intermediate— Bio-intermediate refers to the oil produced by Licella's Cat-HTR™ process when biomass is the carbon-based feedstock.

Biomass is a biogenic material that comes from plants and animals. The term is usually used to refer to solid plant and organic material. In the case of Licella's Cat-HTR™ process, biomass is a feedstock that is converted to biocrude.

Cat-HTR™— Cat-HTR™ is the abbreviation of Catalytic Hydrothermal Reactor, Licella's patented Hydrothermal Liquefaction technology platform.

CAPEX – CAPEX stands for Capital expenditures, which are funds used by a company to acquire, upgrade and maintain physical assets such as property, plants, buildings, technology, or equipment.

CORSIA— CORSIA, or the Carbon Offsetting and Reduction Scheme for International Aviation, is a global scheme, developed by the International Civil Aviation Organization (ICAO), designed to address CO_2 emissions from international flights by requiring airlines to offset any growth in emissions above a certain baseline.

CI— CI stands for carbon intensity and refers to the amount of greenhouse gas emissions (measured in carbon dioxide equivalents or CO_2e) produced per unit of activity or output, like generating electricity or producing a product.

CS1— Commercial Stage 1, or CS1, is Licella's name for the Cat-HTR™ small-scale commercial demonstration facility, run in short run campaigns for process development purposes located in Somersby NSW, and commissioned in 2021.

CS2— Commercial Stage 2, or CS2, is Licella's name for the Cat-HTR™ full-scale commercial facility in construction by Licella's joint-venture with Canfor, Arbios Biotech, in Prince George, BC Canada, in commissioning in Q3 2024 and due to be operational in 2025.

EPC— Engineering, Procurement and Construction, is a project delivery method where a single contractor handles all aspects of a project, from design and engineering to procuring materials and constructing the facility, often used for complex infrastructure projects

FEED— Front End Engineering Design (FEED) is an engineering design approach used to identify technical requirements and main costs for a proposed project, used by design/build engineering organisations.

FEL— Front End Loading (FEL) is the conceptual development process of projects into processing industries and is commonly divided into 3 stages: FEL-1, FEL-2, and FEL-3 (also called FEED). In FEL-1 the deliverable is an engineering study conducted to a +/-50%

cost level based upon a given scope and answers the question 'What are my options to achieve my project goals?'

Feedstock— Feedstock refers to the raw material to supply or fuel an industrial process. In the case of the Cat-HTR™ process, it is the material fed into the front-end of the process that gets converted into the bio-intermediate.

FID— Final Investment Decision (FID)

HEFA—Hydroprocessed Esters and Fatty Acids (HEFA) is a process used to produce renewable diesel and sustainable aviation fuel (SAF) from vegetable oils, waste oils, or fats through hydrotreating, a refining process that uses hydrogen.

HTL— Hydrothermal Liquefaction (HTL) is a depolymerisation process that utilises water under moderate temperatures (200-400°C) and high pressures to convert large carbon-based molecules, like biomass, into high energy density and smaller molecules. It is referred to as a 'next-generation' biomass to biofuel conversion technology and is the governing process for Licella's Cat-HTR™ platform.

ICSM— Isis Central Sugar Mill (ICSM)

LCA — Life Cycle Assessment (LCA) is a method for evaluating the environmental impacts of a product, process, or service throughout its entire lifespan, from raw material extraction to end-of-life disposal.

LCLF— low carbon liquid fuels (LCLF) can be produced sustainably from waste materials, biomass, or by combining hydrogen from low carbon feedstocks. Some examples include sustainable aviation fuels (SAF) and renewable diesel. They can be produced in different ways with different resulting fuel properties.

OPEX – OPEX stands for operating expense and is an expense that a business incurs through its normal business operations.

PDA— Project Development Agreement (PDA) is a contract between parties outlining the terms, responsibilities, and conditions for the planning, development, and execution of a project.

PDP—Process Design Package (PDP). It means the PDP prepared to an FEL 2 +/- 20% level which is ready to be provided to a recognised and approved engineering firm for purposes of preparing a site-specific basic engineering design. The PDP demonstrates a commercially and economically viable design that has not yet been tailored to a specific site and that is sufficient for determining the suitability of specific sites to support a final investment decision.

RAP—Reconciliation Action Plan (RAP) is a document that outlines an organization's commitment to promoting reconciliation between Aboriginal and Torres Strait Islander peoples and non-indigenous peoples.

SAF— Sustainable aviation fuel (SAF) is an alternative to traditional fossil-based jet fuel derived from renewable or waste sources, aiming to reduce carbon emissions from air travel.

TRL— Technology readiness levels (TRL) are a method for understanding the technical maturity of technology during its acquisition phase. It allows engineers to use a consistent frame of reference for understanding technological evolution, regardless of their technical background (TWI Global 2022).