Jet Zero™

JET ZERO PROJECT ULYSSES LCA SUMMARY

Author: Jet Zero

27 March 2025

DISCLAIMER AND ACKNOWLEDGEMENT

The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

This Project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA'S Advancing Renewables Program.

This document and the information contained herein are being provided to you solely for your information and may not be copied, reproduced, distributed, disclosed or published, in whole or in part, to any other person for any purpose whatsoever at any time without the prior written consent of Jet Zero Australia Pty Ltd (ACN 656 170 393) ("Jet Zero" or the "Company").

To the maximum extent permitted by law, no responsibility is accepted and no representation, undertaking or warranty, express or implied is made or given by or on behalf of Jet Zero, or any of their respective associates or associate undertakings (or any of our or their respective directors, shareholders, members, officers, employees, agents or advisers) as to the accuracy, reliability or completeness of the information or opinions contained in this document or any written or oral communication supplied, disclosed or made available to any person in connection with this document or as to the reasonableness of any assumptions on which any of the same is based or the use of any of the same.

Accordingly, no liability is accepted by the Company or such persons and neither it nor they will be liable for any direct, indirect or consequential loss (including without limitation loss of profit) or damage suffered by any person resulting from the use of the information contained in this document or any written or oral communication supplied, disclosed or made available to any person in connection with this document, or for any opinions expressed by any such person, or any errors, omissions or misstatements made by any of them, even if such loss is as a result of the negligence of the Company, or any of their respective associates or associate undertakings, or any of our or their respective directors, shareholders, members, officers, employees, agents or advisers.

Any person who places reliance on the contents of this document or the contents of any written or oral communication supplied, disclosed or made available to any person in connection with this document does so entirely at their own risk and without recourse to the Company, or any of their respective associates or associate undertakings, or any of our or their respective directors, shareholders, members, officers, employees, agents or advisers.

27 March 2025

JET ZERO PROJECT ULYSSES LCA SUMMARY

Introduction

Jet Zero Australia Pty Ltd (Jet Zero) is a private company established in 2021 committed to the development of a low carbon liquid fuels (LCLF) industry to benefit the aviation sector and contribute towards the Federal Government's Nationally Determined Contributions (NDCs). Jet Zero's flagship project, named "Project Ulysses" (the Project), will co-produce sustainable aviation fuel (SAF) and renewable diesel (RD) via the Alcohol-to-Jet (AtJ) process.

Project Ulysses will be located in Townsville in Far North Queensland and is forecast to produce 112 million litres (ML) of SAF and 6 ML of RD. All SAF produced will be ASTM compliant and certified under the International Civil Aviation Organisation's (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)[1]. Renewable Diesel, produced as a co-product, will comply with Australia's new Paraffinic Diesel Standards[2].

Goal and Scope

This Proof-of-Concept Life Cycle Assessment (LCA) was prepared in line with the Australian Renewable Energy Agency (ARENA) Guidelines for Life Cycle Assessment (LCA) of Bioenergy Products and Projects[3], in compliance with the ISO 14040 and ISO 14044 framework.

The LCA has been prepared to:

- quantify the environmental flows and their impacts from cradle-to-grave
- predict if the proposed Project will have environmental benefits compared to the reference system, i.e. if the fuel LCLF produced by Project Ulysses will have lower environmental impacts than the conventional fuels they replace
- provide insights into potential avenues to reduce the environmental impact of Jet Zero's production system and optimise environmental outcomes.

As the proposed Project will co-produce both SAF and RD, the functional units (FU) in this study were "1 megajoule (MJ) of SAF supplied to the Australian market" and "1 MJ of RD supplied to the Australian market". The respective reference systems are the production of kerosene and diesel in conventional fossil fuel production system.

The system boundary for the analysis is captured in Figure 1 below, showing the process steps considered for the proposed product scenario from cradle-to-grave. A cut-off threshold was applied to exclude processes from the system boundary that are insignificant, i.e. those contributing less than 1% of total greenhouse gas (GHG) emissions. An allocation method was required for the AtJ process to assign impacts between the production of SAF and RD, with the energy content allocation approach used to align with certification schemes such as CORSIA.

1 https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx
2 https://www.legislation.gov.au/F2025L00174/asmade/text
3 https://arena.gov.au/assets/2017/05/AU21285-ARENA-LCA-Guidelines-12-1.pdf

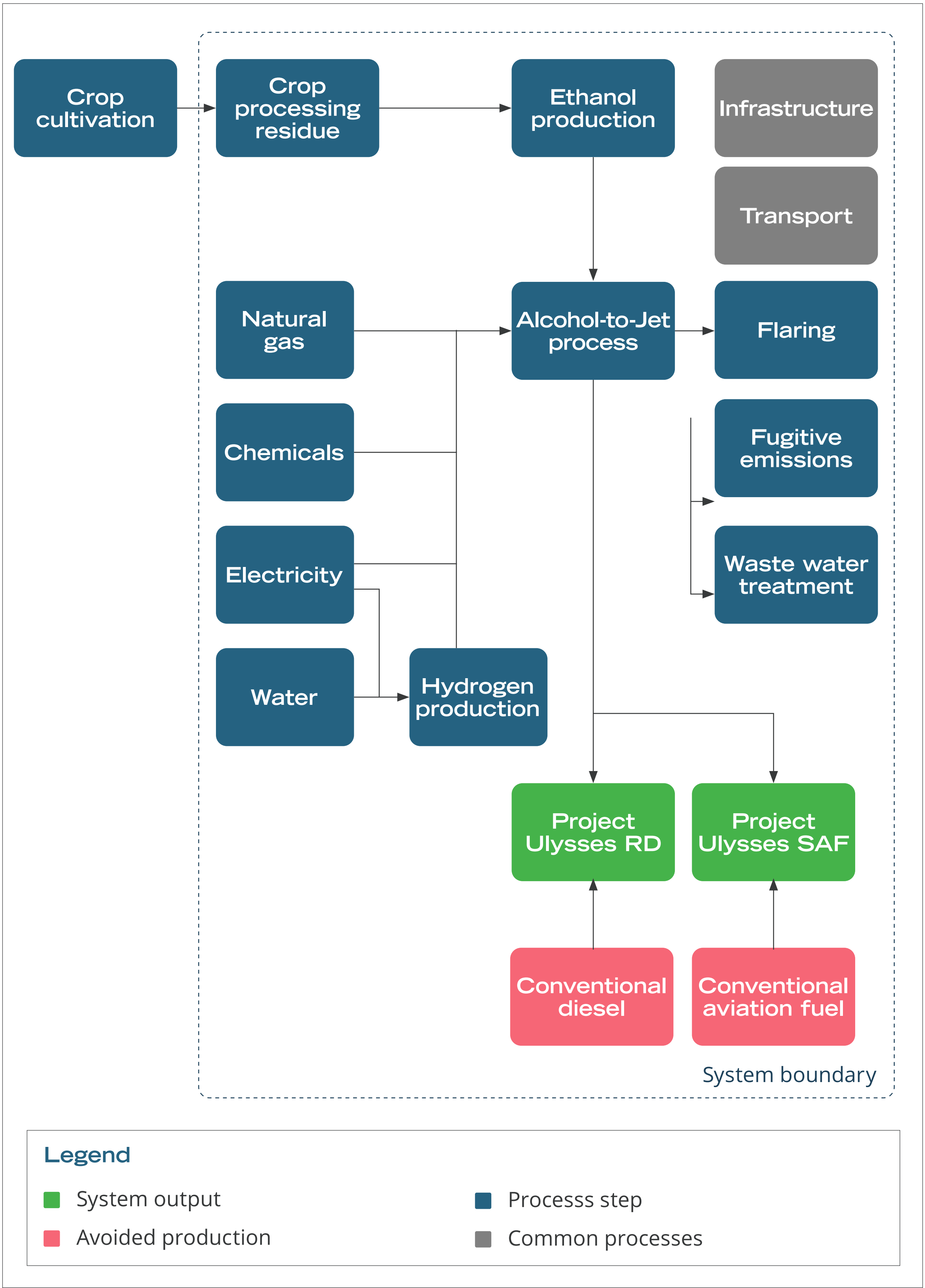

Figure 1: System boundaries considered in the LCA

Assumptions and calculation approach

This Proof-of-Concept LCA was prepared using data prior to the completion of Front-End Engineering Design (FEED), and, as such, the inputs are likely to change as the engineering design is further refined during FEED. The analysis adopted the following conservative assumptions:

- 80% of electrical demand will be met by renewable power, with the remaining 20% using the grid emissions factor
- Hydrogen will be produced on site, utilising the electricity mix stated above
- Wastewater will be treated on-site
- A small amount of fugitive and flaring emissions will be produced from the Project's processes
- No biomethane will be used in the Project's processes
- Infrastructure emissions will be similar to the background model of a European chemical plant

Summary of LCA results

The impact assessment results were calculated per MJ of SAF and RD produced and compared against those for the reference fuels, with the results reported in Table 1. Project Ulysses' SAF and RD will conservatively provide a 48% reduction in comparison to their respective reference fuels when using the climate change indicator (measured in kgCO_2-eq) and 43% reduction when using the fossil energy use indicator (measured in MJ).

	Climate change kg CO_2-eq	Fossil energy use MJ
Project Ulysses SAF	0.045	0.65
Reference fuel (kerosene)	0.088	1.15
% variation with reference	**-48%**	**-43%**
Project Ulysses RD	0.045	0.65
Reference fuel (diesel)	0.088	1.14
% variation with reference	**-48%**	**-43%**

Table 1: Characterisation results for the production of SAF and RD from Project Ulysses, compared to the reference fuels, per MJ of fuel produced

Discussion and interpretation

Contribution analysis was used to identify the largest contributors to the overall environmental impacts of Project Ulysses' SAF and RD. Figure 2 compares the production of SAF with the production of fossil kerosene through the climate change indicator. For Project Ulysses, Jet Zero are focussed on the LCA of SAF because this is the primary product of interest, however, as shown in Table 1, the smaller stream of RD is estimated to have the same LCA emissions.

The largest source of GHG emissions for Jet Zero's Project Ulysses SAF comes from the ethanol production, representing over 50% of the total climate change impact. The remaining emissions are largely associated with the energy consumption by the Project Ulysses production plant, including the electricity and natural gas for plant operations and the electricity for hydrogen production, which together represent over 40% of the total.

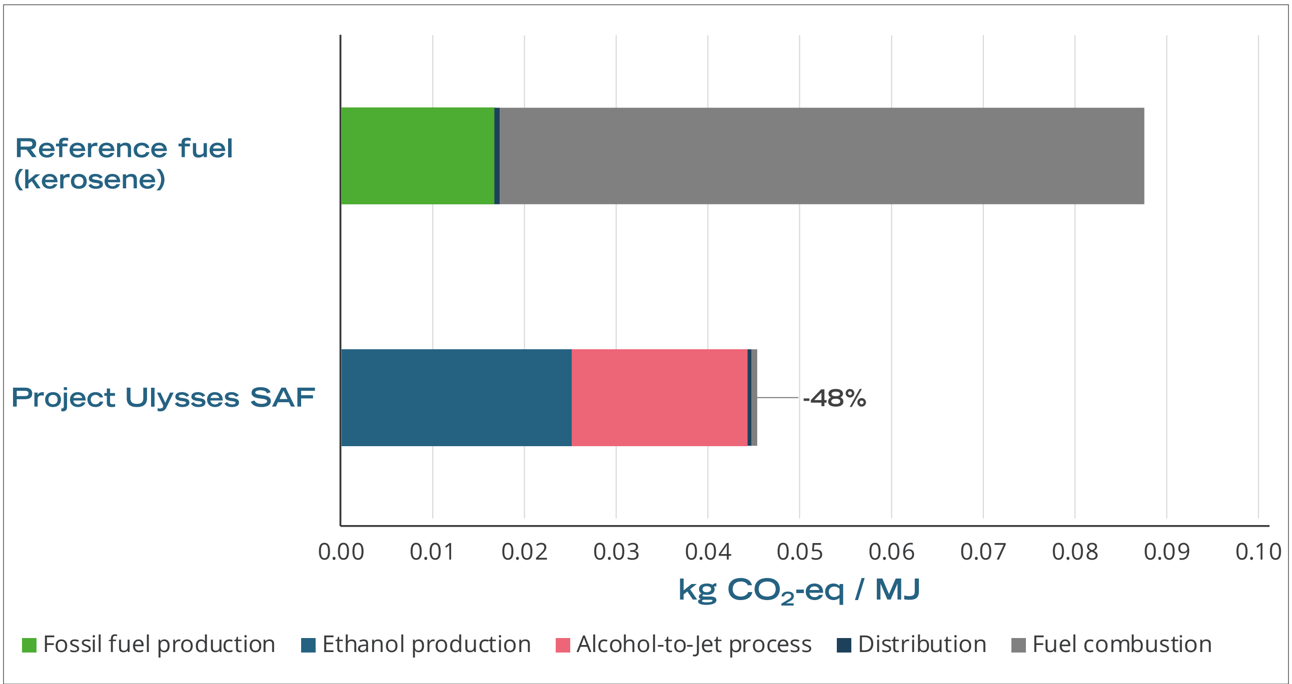

Figure 2: Comparing the climate change impacts results of Project Ulysses SAF with reference fuel (kerosene), per MJ.

Improvements going forward

A key outcome of FEED is to assess design and supply chain optimisations to reduce the Project's GHG emissions and improve Project economics ahead of Final Investment Decision. The following optimisations have been identified to date and were modelled to identify further opportunities to reduce the environmental impact of Project Ulysses' LCLFs:

- 100% of electricity supplied by renewable sources
- 100% of natural gas displaced by biomethane
- Optimisation improvements in the bioethanol production process

The cumulative effects of the three scenarios are shown in Figure 3, and demonstrate potential for a further 23% emissions reduction (71% reduction from the reference fuel) to an estimated ~25 g CO2-eq / MJ when compared with Project Ulysses' baseline using the climate change indicator.

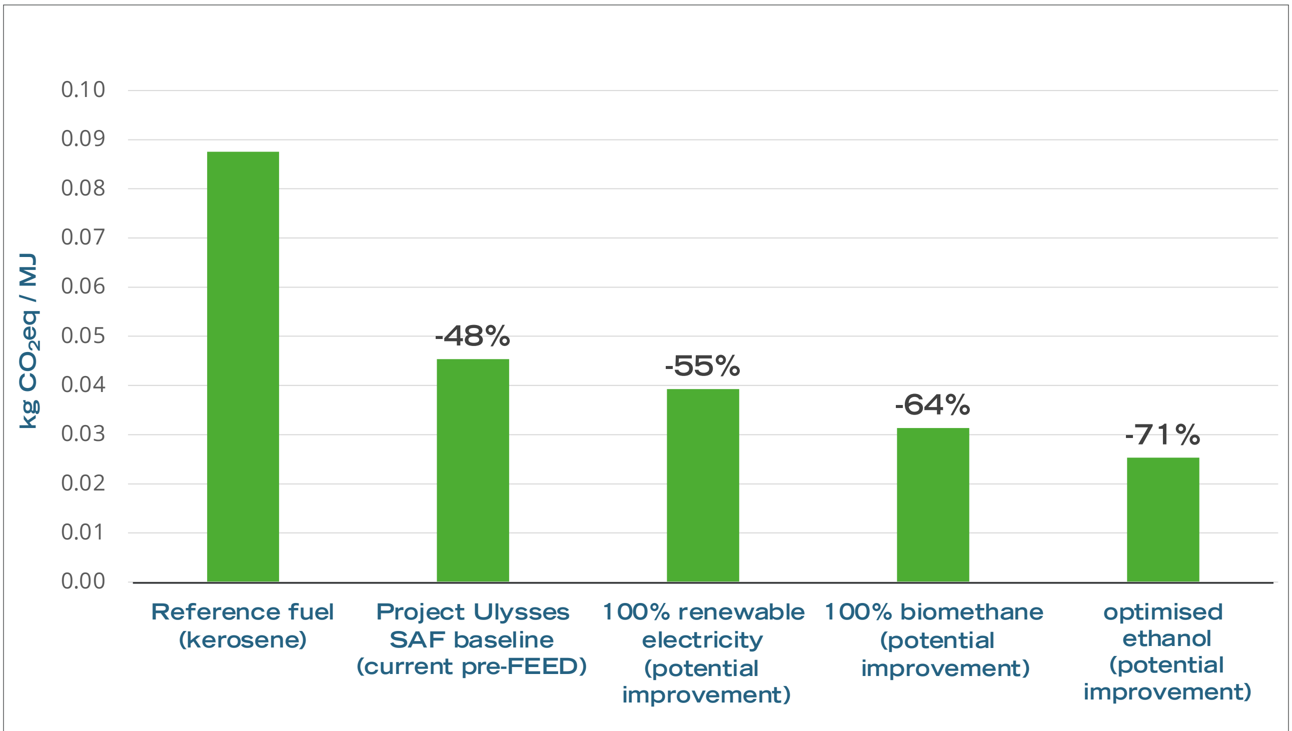

Figure 3: Cumulative effects of improvement measures on climate change results of SAF, per MJ of fuel produced.

This analysis highlighted three key areas of focus for Jet Zero to explore to further improve the carbon footprint of its products. As Project Ulysses moves toward being operational, any GHG emissions for the SAF product and co-produced RD will be accounted for and comply with the strict CORSIA standards in order to achieve CORSIA eligible fuel certification, alongside any domestic regulations and standards.

Jet Zero™

Bringing the regions to the runway with SAF

GET IN TOUCH

Sydney
Level 20, Greenwich Office, Australia Square,
264 George St, Sydney, NSW 2000, Australia

Brisbane
Level 10, 270 Adelaide St, Brisbane, Qld 4000,
Australia

jetzero.com.au