Transport and Infrastructure Net Zero Consultation Roadmap

Take the survey

Department of Climate Change, Energy, Environment and Water

Response received at:
July 24, 2024 at 7:00 PM GMT+10

Response ID:
sbm2f7a113a407b7d13faa64

1 Confirm that you have read and understand this privacy notice.
Yes

2 Please indicate how and if you want your submission published.
Public

3 Published name
AGRENEW Pty Ltd

4 Confirm that you have read and understand this declaration.
Yes

5 First name
Allan

6 Last name
Green

7 Email
[redacted]

8 Phone

[redacted]

9 Who are you answering on behalf of?

Individual or individuals

10 Organisation name

Not answered

11 What best describes you or your organisation?

Not answered

12 What sector do you represent?

Not answered

13 What state or territory do you live in?

New South Wales

14 Postcode

2090

15 What area best describes where you live?

City

16 1. Do you support the proposed guiding principles?

Not answered

17 1.1 Please add details to your response.

Not answered

18 2. Do you support the use of the avoid-shift-improve framework as a tool to identify opportunities for abatement?

Not answered

19 2.1 Please add details to your response.

Not answered

20 3. Do you agree the development of a national policy framework for active and public transport will support emissions reduction?

Not answered

21 3.1 Please add details to your response.

Not answered

22 4. What should be included in a national policy framework for active and public transport and how should it be developed?

Not answered

23 5. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to ensure the movement of people contributes to transport emissions reduction?

Not answered

24 6.1 What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to ensure that the movement of goods contributes to transport emissions reduction?

Not answered

25 6.2. How would these actions address the identified challenges and opportunities for emissions reduction in the movement of goods?

Not answered

26 7. Do you agree with the proposed net zero pathway for light road vehicles?

Not answered

27 7.1 Please add details to your response.

Not answered

28 8. The Australian Government is currently developing an Australian New Vehicle Efficiency Standard and has already begun to implement actions in the National Electric Vehicle Strategy.8.1 What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce light vehicle emissions?

Not answered

29 8.2 How would these actions address the identified challenges and opportunities to reduce light vehicle emissions?

Not answered

30 9. Do you agree with the proposed net zero pathway for heavy road vehicles?

Not answered

31 9.1 Please add details to your response

Not answered

32 10. The proposed pathway for heavy road vehicles relies on a mix of battery electric, hydrogen fuel-cell and low carbon liquid fuels.Rank from 1 to 3, the order in which these should be prioritised for emissions reduction.

Not answered

33 10.1 Please add details to your response. Why did you rank them in that order?

Not answered

34 11. What role should low carbon liquid fuels play in the heavy vehicle

decarbonisation?

Not answered

35 12. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce heavy vehicle emissions?

Not answered

36 13. Do you agree with the proposed net zero pathway for rail?

Not answered

37 13.1 Please add details to your response.

Not answered

38 14. The proposed pathway for rail relies on a mix of battery electric, hydrogen fuel-cell and low carbon liquid fuels.Rank from 1 to 3, the order in which these should be prioritised for emissions reduction.

Not answered

39 14.1 Please add details to your response. Why did you rank them in that order?

Not answered

40 15. What role should low carbon liquid fuels play in rail decarbonisation?

Not answered

41 16. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce rail emissions?

Not answered

42 16.1 How would these actions address the identified challenges and

opportunities to reduce rail emissions?

Not answered

43 17. Do you agree with the proposed net zero pathway for maritime?

Not answered

44 17.1 Please add details to your response.

Not answered

45 18. The Australian Government is engaging in consultation as part of the development of the Maritime Emissions Reduction National Action Plan and those consultations will also inform the final Roadmap and Action Plan. 18.1 What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce maritime emissions?

Not answered

46 18.2 How would these actions address the identified challenges and opportunities to reduce maritime emissions?

Not answered

47 19. Do you agree with the proposed net zero pathway for aviation?

Not answered

48 19.1 Please add details to your response.

Not answered

49 20. The Australian Government has already engaged in consultation on aviation decarbonisation through the development of the Aviation White Paper and those consultations will also inform final Roadmap and Action Plan.

Not answered

50 20.1 What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce aviation emissions?

Not answered

51 21. Do you agree with the proposed net zero pathway for transport infrastructure?

Not answered

52 21.1 Please add details to your response.

Not answered

53 22. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce transport infrastructure emissions and ensure that transport infrastructure is ready for and enables low-emission transport modes?

Not answered

54 22.1 How would these actions address the identified challenges and opportunities to reduce transport infrastructure emissions?

Not answered

55 23. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to ensure the energy mix is ready to support transport emissions reduction?

Not answered

56 24. How should the use of low carbon liquid fuels (LCLFs) be prioritised across different transport modes over time to achieve maximum abatement?

Not answered

57 25. What are the best ways for the Australian Government to work collaboratively with industry, business, governments and communities to implement the proposed pathways?

Not answered

58 25.1 What are good domestic or international examples of partnership and collaboration on transport and transport infrastructure emissions reduction that could inform the final Roadmap and Action Plan?

Not answered

59 25.2 What opportunities can Government leverage to show leadership in Australia and internationally?

Not answered

60 26. What measures and metrics should be used to evaluate the final Transport and Infrastructure Net Zero Roadmap and Action Plan?

Not answered

61 26.1 What other data and evidence could governments use and how could this offer further insights on the pace, scale and location of transport emissions reduction pathways?

Not answered

62 27. Do you have any feedback on the proposed review process?

Not answered

63 28. Do you have any further feedback on the Consultation Roadmap and proposed pathways?

Not answered

64 28.1 Is there anything missing? Are the sections appropriately integrated? Is the Roadmap appropriately ambitious?

Not answered

65 29. Is there any further information or documentation that you wish to be considered with your submission?

Yes. We are submitting a standalone document that outlines a plan for how Australia can best develop and deploy LCLFs to achieve NetZero-2050 in the hard-to-abate parts of the Transport sector by scaling-up Australian-grown renewable plant oil feedstocks and processing them using already-proven fuel conversion technologies.

66 Would you like to upload a document?

Yes

67 Have you removed any identifying information from your submission?

Yes

68 Upload a submission

AGRENEW submission to Transport Net Zero Consultation - July 2024.pdf

69 Upload a submission

Not answered

70 Upload supporting file

Not answered

71 Upload supporting file

Not answered

TRANSPORT AND INFRASTRUCTURE NET ZERO CONSULTATION ROADMAP

Response to Consultation Paper

1. Purpose of this submission

This submission is a joint product from three experienced consultants who have joined together to provide feedback on the Net Zero consultation paper.

The submission aims to draw greater attention to the unique opportunity that Australia has to domestically produce sufficient low-carbon intensity liquid fuels to replace imported petroleum fuels in transportation, that cannot be readily decarbonised by electrification. Fundamental to this opportunity is the need to place greater emphasis on the potential for feedstock development than has so far been the case.

In addition, this submission outlines the challenges required to use hydrogen (originating from either low carbon or fossil production systems) as a fuel, and why it is not suitable for any form of transportation. We advocate that Australia should learn from experience in many countries that have made significant investments into hydrogen-based transport solutions that have either failed techno-economically or terminated before reaching the point of techno-economic failure. It is clear that hydrogen (of any colour) for transport fuel does not support net zero objectives. Green hydrogen wastes vast amounts of renewable energy, resulting in an expensive transport fuel that is challenging to transport, store, distribute and use.

We outline herein an implementation plan for a demonstrated commercial pathway that utilises the technically-proven HEFA fuel production process and capitalises on Australia's significant agricultural production and technological capacity to produce sufficient amounts of its own renewable oils & fats feedstocks. Execution of this advantaged pathway requires:

a) strategic, judicious and patient investment in expanding production of advanced renewable oil feedstocks;

b) scale-up and diversification of current oil extraction capacity to accommodate diverse oil-bearing feedstocks;

c) establishment of onshore HEFA fuel refining facilities; and

d) implementing the aligned policy settings that are critical for underpinning competitive fuel cost and domestic price outcomes.

Australia can immediately capitalise on this opportunity, without needing to wait for the commercial proving of alternative thermochemical biomass processing technologies, or wishfully hoping for purported and promised future eFuels. Although eFuels are technically feasible, they make very little energetic sense and have very low probability of ever achieving economically competitive cost positions compared to *current* alternative routes.

2. Refuelling Australia for NetZero emissions

If Australia is to achieve NetZero emissions it must wean itself off petroleum-based transportation fuels (petrol, diesel and jet fuels) by replacing them with renewable, low carbon intensity energy sources. Urgent action is needed to accelerate this transition towards the looming 2030 interim emissions targets and set a course for achieving full replacement within the NetZero 2050 timeline.

At the same time, we must reverse our current almost complete dependence on imported fuels by developing a strong domestic fuel production capacity, based on our abundance of renewable feedstocks and energy, coupled with the deployment of proven fuel processing technologies. It is highly unlikely that renewable fuels produced in foreign countries will be exported to any significant degree in coming decades, at least not until those nations have met their own domestic demand and associated decarbonisation goals.

Failure to develop a domestic renewable fuel industry, would consign Australia to an ongoing dependence on imported petroleum-based fuels with continued sovereign exposure to fuel insecurity risks, and result in Australia falling well short of meeting its interim and 2050 NetZero commitments.

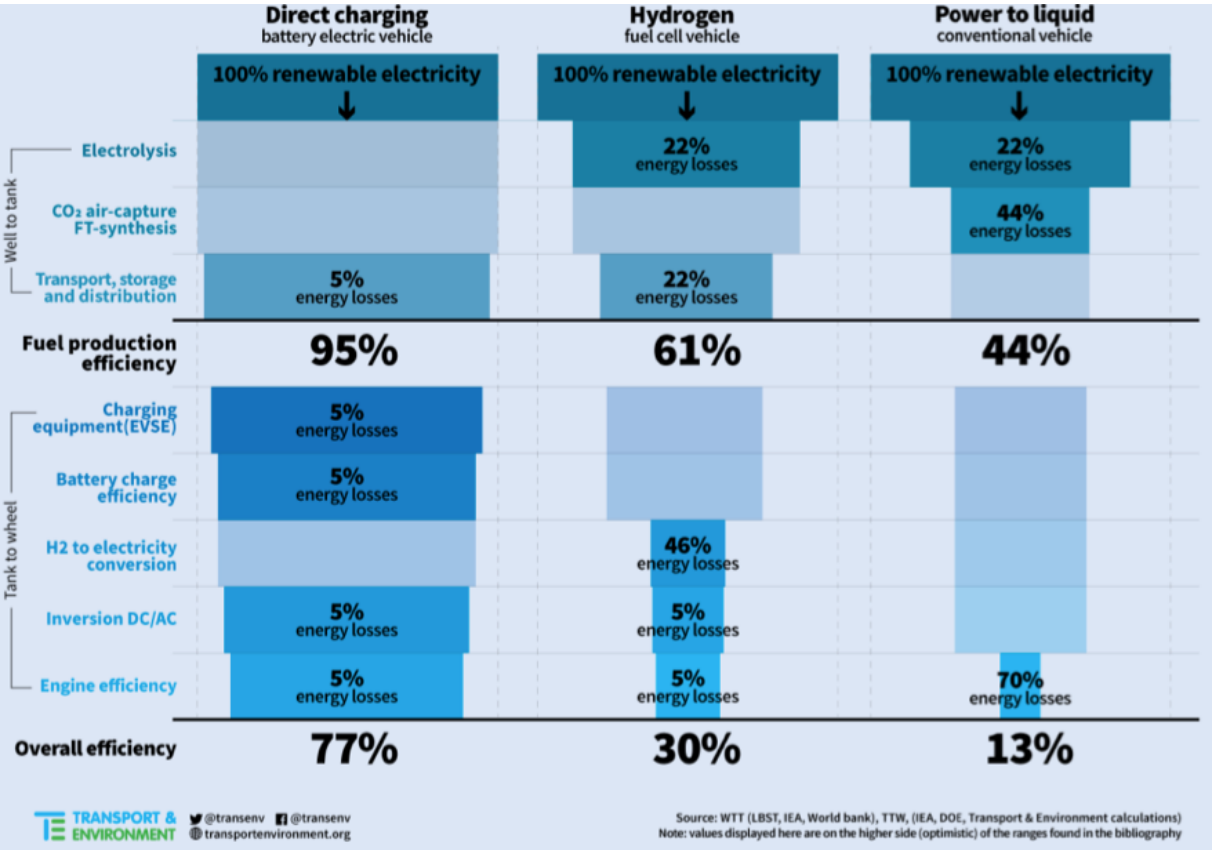
3. Hydrogen is <u>not</u> the solution for transportation

The Transport and Infrastructure Net Zero consultation paper includes the consideration of green hydrogen as a transportation fuel in each of the transport modes including heavy vehicles, rail, maritime and aviation. When we consider hydrogen in the energy transition we are generally talking about the dihydrogen (H_2) molecule. Hydrogen is not a source of energy that can be found in nature but must be produced from other energy sources and is therefore an energy carrier (like electricity).

The primary issue with using hydrogen for transport is that its production has low energy efficiency. Hydrogen needs to be generated, compressed or liquefied, transported and then converted back into useful energy – and each step of the process incurs a substantial energy loss.

As defined in the chart below by Transport and Environment, one of Europe's leading advocates for clean transport and energy, overall efficiency estimates for a Hydrogen fuel cell electric vehicle is 30% compared to a direct charge battery electric vehicle at 77%. [1]

[1] https://www.transportenvironment.org/uploads/files/synthesis_report_transport_decarbonisation.pdf



Source: https://www.transportenvironment.org/uploads/files/synthesis_report_transport_decarbonisation.pdf

Effectively hydrogen vehicles are around three times less efficient than battery-powered electric vehicles when running on hydrogen from renewable electricity. Another way to describe it is that the 'wind-to-wheel' energy efficiency of hydrogen-powered vehicles, from hydrogen's production through to its use in a fuel cell, is just over 30% – compared to around 77% for an electric vehicle.

Practically, this means that hydrogen vehicles would use about three times more electricity, thus requiring significantly more energy-generating infrastructure, and will result in significantly higher costs than battery electric vehicles. In addition, hydrogen vehicles require an entirely new refuelling infrastructure that would add considerable cost to every kilometre driven, as the infrastructure's costs need to be recovered which would be reflected in the resulting price of the (hydrogen) fuel.

This is a very important and fundamental issue that has been too readily overlooked in the enthusiasm for hydrogen fuels. The more energy required for transport, the more renewable energy needs to be generated, and the higher the cost and difficulty to decarbonise the economy rapidly and at scale.

There are valid use-cases for green hydrogen in certain industrial situations where it is used as a chemical rather than an energy source. For example, it has a key role to play as a component in manufacture of green ammonia. It also has an important use as a reductant in the process of making green steel and in deoxygenation of fats and oils feedstock in the

production of RD & SAF fuels. Any green hydrogen made from renewable electricity to replace current fossil hydrogen should be prioritised to decarbonise these applications, and only consider green hydrogen fuel applications in those niche situations that don't have other cost effective, low carbon transport energy alternatives.

4. HEFA and the hard-to-abate market segments

The transportation sector in Australia is heavily dominated by petrol (gasoline) fuelled internal combustion engines (ICE), with diesel-fuelled ICEs occupying an increasing but relatively small share. This predominantly urban transport sector has excellent prospects for high levels of true decarbonisation through adoption of EVs which has already started and is forecast to transition rapidly. Legacy petrol vehicles can also be transitioned to low-carbon intensity ethanol fuels.

However, Australia relies heavily on diesel fuels for agriculture, mining, marine, and rail and on jet fuels for domestic and international aviation (a combined total of approx. 30 M MT/yr). These sectors are much less amenable to electrification and are likely to remain heavily reliant on liquid transport fuels long into the future.

Liquid fuels in these sectors are now able to be replaced with low-carbon renewable fuels, such as biodiesel (BD), renewable diesel (RD), and Sustainable Aviation Fuel (SAF, BioJet), all of which can be made from oils & fats feedstocks using the FAME process (for BD production) or the HEFA process (for RD and SAF production). The HEFA process converts the fatty acid components of fats and oils feedstocks into deoxygenated hydrocarbon products that closely match the structure and provide equivalent performance to petroleum-derived diesel fuels.

5. Does Australia have enough feedstock for FAME and HEFA?

The CSIRO-Boeing 'Sustainable Aviation Fuel Roadmap' report[2] released in 2023 has frequently been cited as highlighting that Australia could meet a large and growing portion of its jet fuel demand through a combination of feedstocks and technologies.

The report estimated that Australia already has sufficient local biogenic feedstocks to produce 60% of local jet fuel demand in 2025, growing to 90% by 2050 through both the expansion of thermochemically-processed crop residue and waste feedstocks and the eventual introduction of synthetic eFuels (Power-to-Liquid) based on green hydrogen and carbon capture. Unfortunately, both of these approaches still have significant levels of technical risk and uncertainty about ultimate commercial viability, and it would be unwise to rely heavily on these technologies (that are unproven at any meaningful scale) for achieving our NetZero objectives within the timelines of current policy and international commitments.

[2] CSIRO (2023) '*Sustainable Aviation Fuel Roadmap*', CSIRO, Canberra

Disappointingly however, the CSIRO report overlooked the significant prospects for expansion in production of HEFA feedstocks by omitting consideration of:-

a) the immediate opportunity to onshore currently high levels of exported surplus canola and cottonseed oil feedstocks,

b) the emerging potential for expanded production of existing oilseed crops and the imminent introduction of new cover-crop oilseeds[3], and

c) the subsequent implementation of recently-developed game-changing Biomass Oil technology[4] that enables the production of high yields of oils in the vegetative tissues of dedicated high-biomass energy crops and in the post-harvest residue (stubble) of food and feed crops.

Taken together, these technology developments could enable the HEFA feedstocks for a sufficiently large-scale production of BD, RD and SAF fuels to meet a large proportion of demand for diesel and aviation fuel replacement (post-electrification) needed to achieve NetZero-2050 targets. A staged implementation pathway for how this could be developed, deployed and scaled-up is provided below (and summarised in the attached diagram).

6. The way forward

Phase 1 (2025-2030) – Accessing and scaling up existing oil feedstocks[5]

- Retaining onshore the currently exported tallow (~550,000 MT) and used cooking oil (~20,000 MT) would provide approx. **0.6 M MT** of renewable fuel feedstock.
- Retaining onshore and domestically crushing the currently exported canola grain (5.4 M MT) and cottonseed (0.6 M MT) would generate approx. **2.5 M MT** of renewable fuel feedstock.
- Australia currently devotes around 13 M HA of its cropping land to the production of exported cereal grains. A significant portion of this could be switched to producing additional oilseed crops for domestic fuel feedstock, a change that would also have desirable cropping systems diversification benefits. Given the range of production regions, a practical target would be to increase cropping of canola or related Brassica crops by around 1 M HA, and to reintroduce minor oilseed crops (such as safflower and linseed/Linola) across approx 0.5 M HA. This could generate approx. 2.75 M MT of additional oilseed, which upon crushing would yielding approx. **1.2 M MT** of renewable fuel feedstock.

[3] Sindelar, A. *et al*., 'Winter oilseed production for biofuel in the US Corn Belt: opportunities and limitations', *GCB Bioenergy* (2017) 9, 508–524, doi: 10.1111/gcbb.12297

[4] Vanhercke T. *et al*. 'Metabolic engineering for enhanced oil in biomass', *Progress in Lipid Research* (2019) 74, 103-129, doi: 10.1016/j.plipres.2019.02.002

[5] Feedstock estimates are annual volumes for currently exported fats & oil volumes (for tallow & UCO) and potential extractable oil yield from currently exported oilseeds.

- The increased domestic oilseed crushing in the above scenario would require an increase of 9 M MT/yr in throughput capacity of the Australian seed crushing infrastructure. New crushing plants would need to be built in strategic locations near to oilseed crop production regions. The crushing activity would also generate an increased output of protein meal for which expanding domestic and nearby export markets are readily available.
- Taken together, the above measures could generate a combined domestic availability of around **4.3 M MT** of renewable low CI oil feedstock, sufficient to generate **3.9 M MT** (= 4.9 B L) of BD/RD/SAF fuels through a combination of FAME & HEFA processes. This is equivalent to almost half the current size of the Australian jet fuel market, indicating that the HEFA pathway alone already has the potential to reach complete saturation of the Australian aviation fuel market within the currently approved blend limit of 50% SAF with conventional jet fuel.
- Build large-scale (>2 M MT/yr) HEFA processing plants on the East coast and West coast for efficient centralised production of RD & SAF.
- Given the lag-time for constructing HEFA process facilities, it is envisaged that the initial deployment of available oil feedstock would be first directed to utilising the existing idle capacity for biodiesel production.
- Prepare for deployment of intermediate oilseed crops ('oilseed cover crops'):
  - develop and deploy Carinata as winter rotation crop within current summer cropping systems (e.g. cotton cropping) and in marginal areas
  - evaluate Camelina & CoverCress in Australian farming systems
- Initiate development of very-high oil content versions of current oil-bearing seed crops (canola, safflower, linseed, cottonseed, lupin).
- Evaluate Biomass Oil technology on multiple crop platforms and ag-systems to determine best deployment options for Australian agriculture, including:
  - dedicated Biomass Oil versions of high-biomass C4 energy crops (e.g. Sugar/Energy-canes, Sorghum, Miscanthus)
  - coproduct Biomass Oil in post-harvest crop residue (stems and leaves) of feed grains and food crops (e.g. dual-purpose feed wheat, triticale & canola)
- Establish/expand plantations of perennial oil-bearing tree crops on marginal lands in Northern Australia:
  - Pongamia, currently under evaluation in Queensland
  - Tamanu (*Calophyllum*) under pilot scale evaluation in Northern Territory

Phase 2 (2030-2035) – Increase oil feedstock supply through sustainable intensification.

- Expand deployment of intermediate oilseed crops (Carinata, Camelina, CoverCress) and oil tree plantation crops (Pongamia & Tamanu).
- Introduce high oil productivity versions of oil crops that do not compete with food crop production:
  - high-oil lupin and cottonseed

- initial Biomass Oil crops (noting that R&D has already commenced on expressing the Biomass Oil trait in vegetative tissues of tobacco[6], sugarcane[7] and sorghum[8]).

- Establish additional (multiple) seed crushing facilities in regions of expanded oil crop production.
- Expand HEFA processing capacity (scale & location) to match the ramp up of feedstock availability.

Phase 3 (2035-2050) – Expand renewable fuel industry to supply full domestic demand for BD, RD & SAF required to meet NetZero by 2050.

- Introduce second-generation Biomass Oil crops.
- Continue to expand oil feedstock production and HEFA processing capacity (scale & location) to meet domestic market demand for renewable fuels.
- If further expansion beyond domestic requirements is viable, develop export markets for RD & SAF fuels within Asia-Pacific region.

7. Lessons from overseas use of hydrogen in transport

It is instructive to learn from the experiences in other countries where they have made significant investments in pursuit of green hydrogen for different transport modes. Australia should take note of these examples where significant investments have been made, only for the projects to fail as a result of economic factors.

Hydrogen for Heavy Vehicles (rigid trucks, articulated trucks and buses)

- French municipality, after 4 years abandons 12 hydrogen buses as too expensive, and plans to replace them with electric buses: https://www.electrive.com/2023/11/13/pau-discontinues-h2-project-and-buys-battery-buses-in-future/

- German city abandons ten fuel cell buses after one year and sticks with electric busses: https://www.hydrogeninsight.com/transport/german-city-to-retire-its-one-year-old-hydrogen-fuel-cell-buses-after-2-3m-filling-station-breaks-down/2-1-1375568

- Liverpool region's 20 hydrogen buses suspended due to lack of hydrogen supply: https://www.liverpoolecho.co.uk/news/liverpool-news/you-havent-seen-merseysides-new-27593505

- French city cancels order for 51 hydrogen buses after realizing electric ones six times cheaper to run: https://www.rechargenews.com/energy-transition/french-city-drops-order-for-51-hydrogen-buses-after-realising-electric-ones-six-times-cheaper-to-run/2-1-1143717

[6] Mitchell, M.C. *et al*. 'Increasing growth and yield by altering carbon metabolism in a transgenic leaf oil crop'. *Plant Biotechnology Journal* (2020), 18, pp. 2042–2052, doi: 10.1111/pbi.13363

[7] Parajuli, S. *et al*. 'Towards oil cane: Engineering hyperaccumulation of triacylglycerol into sugar cane stems'. *GCB Bioenergy* (2020), pp 1-15, doi: 10.1111/gcbb.12684

[8] Vanhercke, T. *et al.* 'Up-regulation of lipid biosynthesis increases the oil content in leaves of *Sorghum bicolor*'. *Plant Biotechnology Journal* (2018), pp. 1–13, doi: 10.1111/pbi.12959

- BHP rejects hydrogen and will go electric:
  https://thedriven-io.cdn.ampproject.org/c/s/thedriven.io/2024/06/26/bhp-rejects-hydrogen-and-hybrids-will-go-straight-to-electric-for-giant-haul-trucks/amp/

Hydrogen for Rail

- German rail operator abandons hydrogen trains - "…operating hydrogen trains is not economically feasible…"
  https://www.autoevolution.com/news/hydrogen-pioneer-abandons-plans-after-one-year-goes-all-electric-219367.html

- Austrian railway scraps plans to replace diesel trains with hydrogen powered options:
  https://www.hydrogeninsight.com/transport/technology-moves-on-austrian-railway-scraps-plans-to-replace-diesel-trains-with-hydrogen-powered-options/2-1-1620507

Hydrogen Vehicle and Infrastructure

- Shell closes hydrogen fuelling stations in California citing "supply complications and other external market factors"
  https://www.autoweek.com/news/a46791348/shell-closes-hydrogen-stations-california/

- Hydrogen Refuelling Station Closures In Multiple Countries
  https://cleantechnica.com/2024/02/08/hydrogen-refueling-station-closures-in-multiple-countries-more-painful-news-for-hydrogen-proponents/

- Hydrogen Cars are Dead As Projects are Scrapped and Refuelling Prices Go Through the Roof
  https://www.autoevolution.com/news/hydrogen-cars-are-dead-as-projects-are-scrapped-and-refueling-prices-go-through-the-roof-221373.html

Prepared 24 July 2024

Should you wish to discuss this submission further, please contact [redacted] at [redacted]

Allan Green
Managing Director
AGRENEW Pty Ltd
www.agrenew.com.au

Cameron Begley
Managing Director
SPIEGARE Pty Ltd
www.spiegare.com.au

Peter Gunthorpe
Managing Director
Low Carbon Solutions Australia Pty Ltd
