Transport and Infrastructure Net Zero Consultation Roadmap

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Department of Climate Change, Energy, Environment and Water

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5 First name
Not answered

6 Last name
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Not answered

9 Who are you answering on behalf of?

Organisation

10 Organisation name

Australia New Zealand Biochar Industry Group

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

2302

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?

Not answered

66 Would you like to upload a document?

Yes

67 Have you removed any identifying information from your submission?

Yes

68 Upload a submission

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ANZBIG-Fact-Sheet.pdf

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App3g_3h.pdf

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App3a_3c.pdf

August 2024

ANZBIG Submission: *Transport and Infrastructure Net Zero Consultation Roadmap*

Thank you for the opportunity to provide feedback via this submission on the *Transport and Infrastructure Net Zero Consultation Roadmap (herein referred to as the 'Consultation Roadmap')*. General comments are provided immediately below, and specific responses to the twenty-nine (29) questions posed within the Consultation Roadmap are provided separately further below in **Table 1**.

The Australia New Zealand Biochar Industry Group (ANZBIG) is the peak body for the **biochar bioenergy** industry representing over 200 companies, organisations and individuals across Australia and New Zealand. Our industry patron is Professor Ross Garnaut, renowned economist and author of *Superpower* and *The Superpower Transformation*.

Over 50 Million tonnes of wasted biomass each year is currently being burned, landfilled or otherwise underutilised and decomposing back into the atmosphere beyond natural ecosystem requirements. Alternatively, this could be turned into valuable solid carbon products, bioenergy, biofuels and other valuable derivatives. This could be alternatively seen as a potential resource to be upcycled into biochar bioenergy with potential to remove carbon equivalent to 10-15% of Australia's annual emissions. **Importantly, biochar bioenergy has significant and important differences to conventional bioenergy** (e.g. combustion and liquid biofuels) which can complement and enhance bioenergy's contribution to decarbonisation of the transport and infrastructure sector.

The biochar bioenergy industry could provide significant, positive contributions to the Consultation Roadmap and its objectives (both directly and indirectly) as detailed further within our submission and in the accompanying appendices. In summary these include:

- Concurrently providing **both** emissions reduction (ER) ***and*** carbon dioxide removal (CDR) for measurable action on both key elements of climate action toward genuine Net Zero (refer **Figure 1**).
- Ability to assist with both direct **emissions reduction** (Scope 1, 2), but also in **decarbonisation of supply chains** for indirect emissions reduction (Scope 3) which represent the most significant proportion of emissions globally.
- Provide green jobs in rural and regional Australia, with **complementary circular economy** synergies with agriculture and other important and hard to abate industry sectors, providing maximum 'bang for buck' for government policy support.
- Synergies with **multiple** industry sector net zero plans
- Potential to re-position **roadside vegetation maintenance as renewable and sustainable "carbon farms"** as a source of economic *revenue* rather than just construction and maintenance *costs*.
- Ability to utilise and upcycle biowastes and residues not typically targeted by other forms of biofuel generation, and to enhance food production rather than compete with it, as outlined further below.

- Flexibility for **distributed or centralised production**, with technologies for small to industrial scale.

This can be assisted through the provision of:

- **Biochar** (solid carbon) for CDR and as a commodity used in a wide range of commercial applications to displace fossil carbon and improve technical performance. Biochar (refer fact sheet in **Appendix 1**) is a readily deployable commercial product from biochar bioenergy systems to immediately assist decarbonisation in Transport and Infrastructure and its supply chains, including the following (amongst other applications in **Appendix 2)**:
    - **Roads** (pavements and sub-base stabilisation, low dust high traffic unsealed roads)
    - **Concrete** (both structural and no-structural, with significant and immediate potential for easy deployment in non-structural concrete as 'low hanging fruit)
    - **Batteries** for EVs and other storage of renewable energy (anode materials in Li-ion batteries, sodium carbon batteries and carbon thermal batteries)
    - **Erosion Control and Rehabilitation** (e.g. spraygrass/hydromulching, soil stabilisation and revegetation)
    - **Stormwater treatment and control** (e.g. water filtration – one of the largest markets for biochar in the USA)
    - **Catalysts** for biofuel production and use.
- **Syngas** (a fuel gas comprised primarily of **hydrogen** and **CO**) from biochar bioenergy systems has potential to provide:
    - **Renewable Heat** for conventional power generation and industrial heat processes.
    - **High grade syngas** systems can also provide:
        - **renewable and efficient electricity** (including via gas engines/turbines, avoiding highly inefficient boiling of water used in conventional combustion power generation)
        - **synthesis of biofuels and other valuable commodities** (methanol, SAF, biodiesel, RNG, ammonia, DME and olefins for bioplastics among others, refer **Figure 3**)
        - **biohydrogen** (carbon-*negative* hydrogen which does not require significant water resources in its production, synergistic with rural and regional Australia), and **renewable biogenic CO_2** to displace *fossil CO2* widely used in the food and beverage industry and potentially in making biofuels and bioplastics as detailed further in our responses to the questions posed within the Consultation Roadmap.
- **Liquids (including wood vinegars)** from biochar bioenergy systems can be used to enhance plant growth in agriculture and rehabilitation/revegetation, and bio-oils can potentially be used in displacement of fossil oils in various applications (e.g. bunker oil).

Biochars are produced *'fit for purpose'* facilitated through quality grading via an industry Code of Practice, with properties reflecting feedstock, processing conditions and pre/post treatment.

Following extensive stakeholder and industry consultation over a number of years, in June 2023 ANZBIG released the *Australian Biochar Industry 2030 Roadmap* to strategically accelerate and scale the industry, which we believe is a world first. ANZBIG encourages government to adopt and support the roadmap in its policy development and related strategies, including the *Transport and Infrastructure Net Zero Consultation Roadmap*. Government policy support toward biochar overseas is significant, with the most recent announcement by the government of Denmark of €1.35 Billion to 2045 to help cut agricultural emissions through biochar climate mitigation initiatives. The *Australian Biochar Industry 2030 Roadmap* is seeking only 1/10th of that level of support.

What is Biochar?

Biochar is *"a carbon rich, charcoal-like product made by heating any form of organic matter (biomass) in a controlled process with limited oxygen. This product is called "biochar" when it is used as a soil amendment or for other* ***uses that store the carbon in a durable form"*** (ANZ Biochar Industry Group (ANZBIG), 2023). A fact sheet is provided in **Appendix 1** and a link to a brief introductory video *"What is Biochar?"* provided *here*. Further detail is provided in presentations in **Appendix 4** introducing the Australian Biochar Industry 2030 Roadmap and the potential for the industry to concurrently assist the economy and government decarbonisation objectives.

Sustainable biochar production is a powerful tool recognised globally for its potential to produce clean renewable energy, sequester CO_2 from the atmosphere, improve soil health, and support sustainable agriculture and decarbonised materials. The circular and low-carbon footprint of biochar can be used to displace fossil carbon currently used in a wide range of industries across the economy, with scores of fully commercialized soil and non-soil/industrial applications already available here and overseas, from minimising fossil-based synthetic fertilizer use through to water filtration, roads, bioplastics and concrete among many others as outlined in the *ANZ Biochar Industry Roadmap*. Additionally, the carbon product can be used in other *oxidative/fuel uses* to displace fossil fuels (providing no CDR but avoiding fossil carbon emissions) such as reductants to help hard to abate industries transition such as steel, with BlueScope Steel seeking to use volumes equivalent to several times current national production of biochar (further information can be provided upon request). Accordingly, there is significant demand and potential for biochar and bioenergy to help decarbonize multiple industries, providing jobs and significant economic stimulus into regional and rural Australia.

Why is Carbon Dioxide Removal (CDR) important alongside Emissions Reduction?

The recent IPCC 6th Assessment Report (AR6 WG3) states that limiting warming to 1.5C by 2100 will on average require deployment of around **3 Gt CO_2/yr** of permanent removals **by 2050** and **10 Gt CO_2/yr by 2100**. Even with *best-case-scenario* emissions reduction, CDR will be a critical component of the portfolio of technologies required to get the world to Net Zero by 2050 and net negative thereafter.

Biochar has been identified by the IPCC as one of the key CDR technologies available, with the potential to remove up to 6.6 Gt/yr of CO_2e (or the equivalent of 10-15% total annual global GHG

emissions) sustainably *without* competing with land for food production. Using biochar in agriculture can also *enhance* food production yields, and the waste residues from food production (straws, husks etc) can return for more bioenergy and biochar production in a circular and sustainable manner, improving degraded soils and providing green jobs in regional and rural Australia.

Converting biowastes to biochar for use as a soil amendment (or other non-soil uses that store carbon in the long term), provides climate change mitigation by:

- Storing carbon for centuries to millennia
- Reducing nitrous oxide emissions from soil
- Avoiding GHG emissions from energy generation
- Avoiding GHG emissions from biomass handling, use and disposal
- Stabilising existing and new soil organic matter ("negative priming")
  (Joseph et al 2021)

An EOI for the establishment of an Australian Carbon Credit Unit (ACCU) Methodology specifically for biochar carbon dioxide removal has recently been developed and lodged by a cross-industry working group including ANZBIG and other industry sectors, which has significant potential to assist government agencies and private sector companies to meet their Net Zero targets and accelerate decarbonisation through the production and use of biochar.

Sustainability, Circular Economy, and Other Co-benefits

Biochar provides multiple **co-benefits,** bringing valuable solid carbon back out of the atmosphere down into soils and materials where we need it most, concurrently displacing use of fossil carbon and improving the technical and environmental performance in applications. Biochar bioenergy can positively contribute to 14 of the 17 of the Sustainable Development Goals (SDG's) established by the United Nations (UN).

A submission by the Water Services Association of Australia (a peak body for the water industry) recently made a detailed submission to the **Circular Economy Ministerial Advisory Group (CEMAG)** to Minister Plibersek entitled *Help Us Help You*, which included a key section on biochar .

The South Australian Government undertook a Parliamentary inquiry in 2023 into opportunities with biochar via its Natural Resources Committee. A copy of the report findings and recommendations is available via the NRC website and a Ministerial response letter from the inquiry and another to ANZBIG are provided in **Appendix 5**.

The biochar bioenergy industry is 'shovel-ready' for rapid expansion in Australia with appropriate policy support, which is also occurring globally experiencing compound annual growth rates (CAGR) ranging from 50-90% in recent years (e.g. Global Biochar Market Report 2023 (IBI/USBI); European Biochar Market Report 2023-24 (EBI 2024).

Figure 1a: Biochar CO_2 Removal For Net Zero

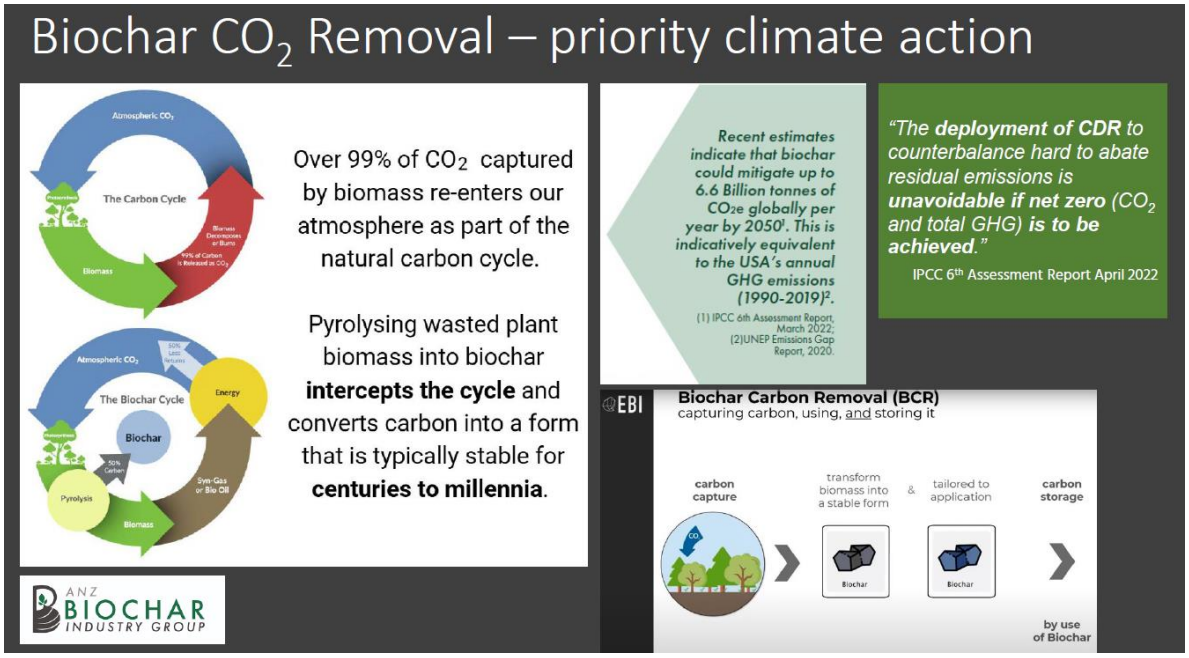


Figure 1b: Net Zero with ER then CDR (Swiss Re, 2021). Swiss Re are one of the largest insurance underwriters in Europe.

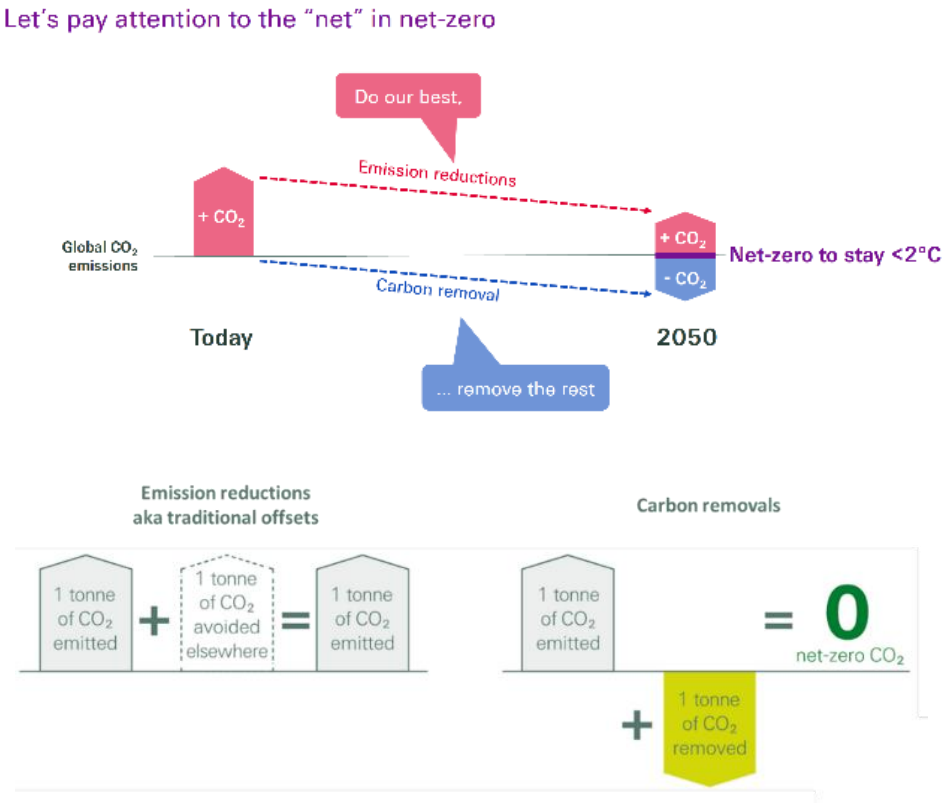


Figure 2: Biochar Bioenergy production

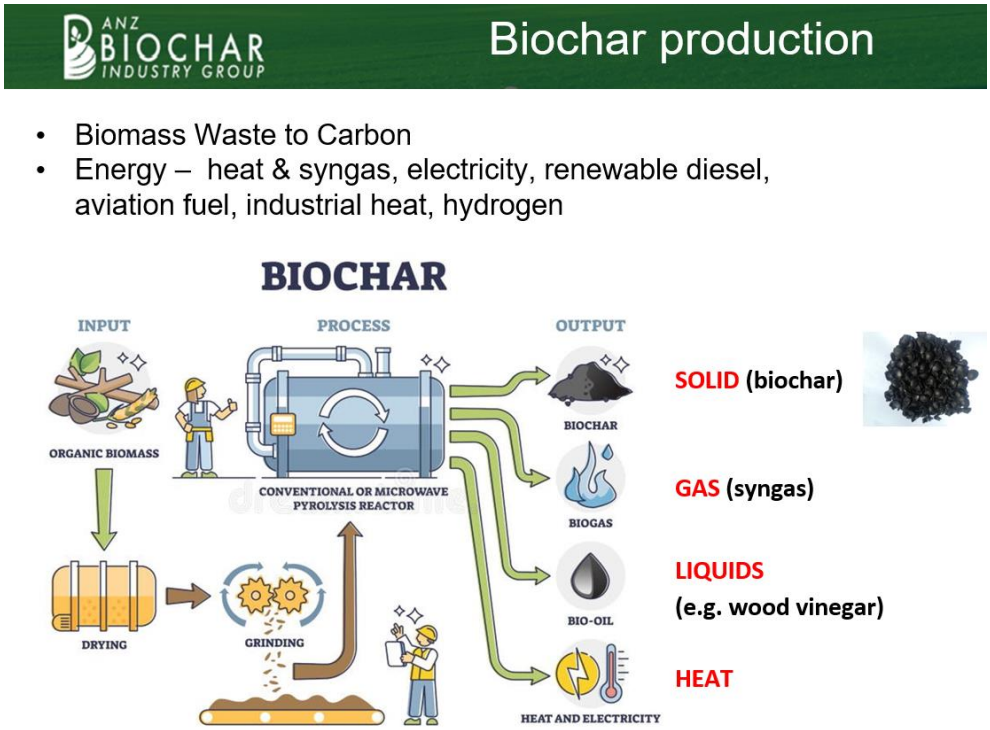
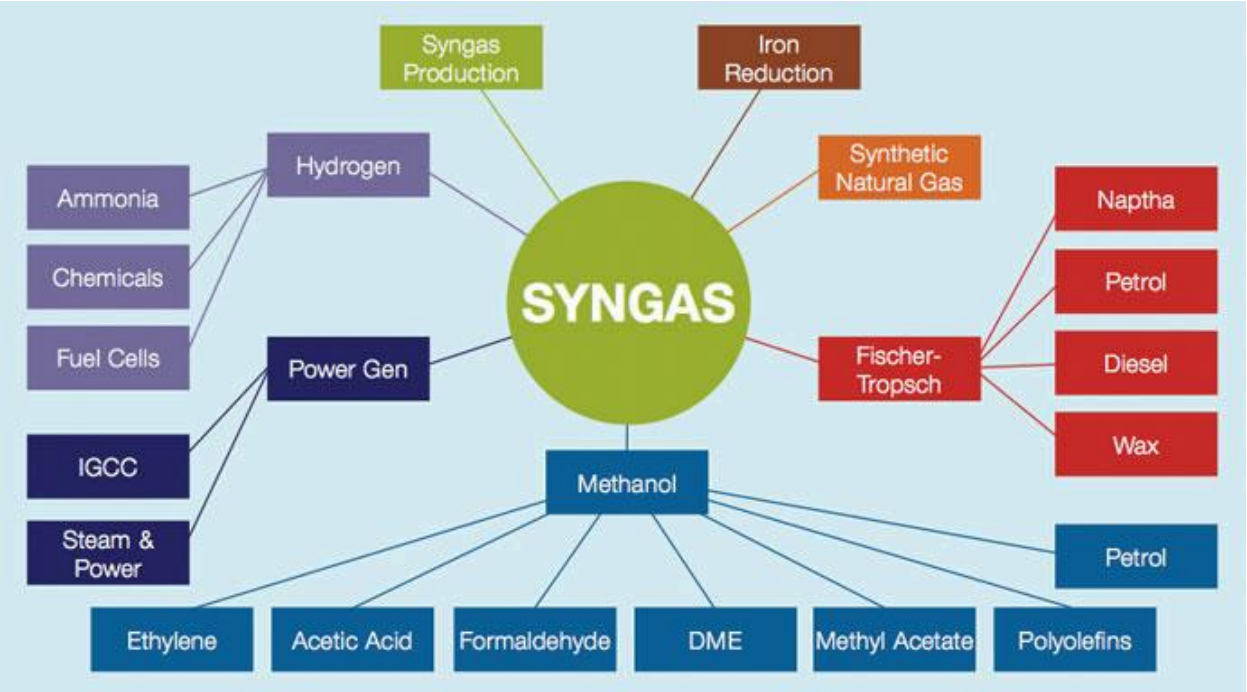


Figure 3: Syngas – Bioenergy and much more



Thank you for the opportunity to provide this submission which can be publicly exhibited if/as required. Should you have any questions or require further clarification or information at all please do not hesitate to contact us. We look forward to further discussion.

On behalf of the ANZ Biochar Industry Group (ANZBIG)

ANZ Biochar Industry Group (ANZBIG)

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List of Appendices:

- **Appendix 1:** Biochar Fact Sheet
- **Appendix 2:** Figures showing markets and applications for soil and industrial uses of biochars and biocarbons
- **Appendix 3:** Example Commercial Applications in Transport and Infrastructure
- **Appendix 4:** Introduction to the Australian Biochar Industry 2030 Roadmap (presentations)
- **Appendix 5:** Letters from South Australian Government Parliamentary Inquiry into Biochar
- **Appendix 6:** Australian Biochar Industry 2030 Roadmap V1.1 (ANZBIG, 2023)

Table 1: Responses to 29 Questions Posed within the Consultation Roadmap

Note: We have answered each question as if it could be read independently in isolation to others if required. Whilst we have tried to cross reference when appropriate we apologise for any resulting commonalities and repetition.

Roadmap Consultation Questions	Responses
Chapter 1 - Introduction	

s1.2 The Approach (pg16)
Q1. Do you agree with the proposed guiding principles?
 	
1. Maximise Emissions Reduction
2. Value for Money
3. Maximise Economic Opportunity
4. Inclusive and Equitable
5. Evidence-based
	We support the five guiding principles, but would also advocate for the following:
	• **1. Maximise emissions reduction (ER) and carbon dioxide removal (CDR)** – the two critical elements for climate action to reach 1.5 degrees targets. ER (reducing new emissions each year) and CDR (removal of existing excess atmospheric CO_2) put downward pressure on atmospheric CO_2 concentrations to reduce and (in time) reverse the effects of climate change. Both aspects require strong advocacy in the #1 guiding principle. This will aid genuine *Net* Zero. It is also important to note that **the IPCC have stated that ER alone is no longer sufficient to meet Net Zero:**
	  ○ *"The deployment of CDR to counterbalance hard to abate residual emissions is unavoidable if net zero (CO_2 and total GHG) is to be achieved."* IPCC 6th Assessment Report, April 2022.
	• Include additional guiding principles that leverage investment and support via the roadmap to meet **multiple policy objectives** of the Australian government concurrently with decarbonisation:
	  ○ **6. Improve Transition from Linear to Circular Economy** –higher circularity also commonly reduces carbon footprint.
	  ○ **7.Enhance Sustainability** – in line with the UN Sustainable Development Goals and inbound financial disclosure reporting for sustainability
	  ○ **8. Seek Co-benefits** – across multiple facets (e.g. environmental, economic, social and policy among others). This includes positive contribution toward other government policy objectives (such as those listed on pages 13-14 of the consultation roadmap) **and other industry sectoral plans:** *the Built Environment; Agriculture and Land; Electricity and Energy, Resources; Industry*. This encourages "bang for buck" in government action and resourcing.

Q2. Do you support the use of the *avoid-shift-improve* framework as a tool to identify opportunities for abatement?	As currently defined on page 15 of the consultation roadmap, we do not believe that "all available opportunities for abatement" will be identified as intended. Indeed, many (if not all) of the opportunities raised in our submission likely would not fall into the existing definitions. Just one example is decarbonisation of embodied carbon within transport infrastructure. Commercial 'shovel-ready' opportunities to displace fossil carbon are available with more emerging (e.g. concrete, asphalt, erosion control, water management etc). We also note that whilst *avoidance* of new emissions is strongly supported, we support strategic measures to **both** (i) rapidly and significantly **reduce new emissions**, and (ii) **remove** existing CO_2 from the atmosphere (CDR). **The roadmap could be significantly enhanced regarding the latter**. Biochar CDR and bioenergy can help decarbonisation of supply chains through **displacement of fossil carbon currently used in products and services** used in construction and operation of transport and infrastructure (at all levels of government and in public-private partnership projects such as motorways). For examples, refer figures provided in **Appendix 2**. Biochar bioenergy systems provide immediate "shovel-ready" solutions to assist the Australian Government to achieve both these measures. For more information please refer to our website www.anzbig.org and the ***Australian Biochar Industry 2030 Roadmap***.
Chapter 2 – Rethinking Transport Networks & Systems	
s2.1 Movement of People: promoting active and public transport (pg32) Q3. Do you agree the development of a national policy framework for active and public transport will support emissions reduction?	Yes. Policy frameworks are critical to facilitate public and private sector investment and procurement. We advocate strongly for recognition and inclusion of biochar bioenergy within the roadmap to guide national, state and local government best practice in emissions reduction and carbon dioxide removal to mitigate climate change and decarbonise/de-fossilise transport and infrastructure networks.
Q4. What should be included in a national policy framework for active and public transport and how should it be developed?	Public transport typically involves heavier vehicle modes such as buses and trains. Biofuel substitution for diesel and biohydrogen technologies can greatly assist decarbonisation of heavier transport modes where electrification is otherwise difficult/inhibited. Biochar bioenergy technologies can assist this transition whilst concurrently (and likely uniquely) providing CO_2 removal (drawdown).
Q5. 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?	We suggest the following actions could significantly accelerate • **Support commercial scale demonstrations in all states** of low carbon products and services (including those using CDR) in transport and associated infrastructure. • **Increase government procurement** of low carbon products and services (including those using CDR) in transport and associated infrastructure.

	• **Establish Carbon Dioxide Removal (CDR) targets to complement Emissions Reduction targets in government policy** to drive investment in CDR applications to accelerate decarbonisation toward genuine Net Zero by 2050. This should include setting **interim targets** for 2030 ahead of Net Zero by 2050. • **Support adoption of a Biochar ACCU Methodology** which could help government agencies and private sector companies to procure low carbon CDR products and services that can measurably assist their decarbonisation and Net Zero commitments. • **Support and enhance awareness and education** of low carbon products and services for the transport and infrastructure sector using biochar CDR and bioenergy, including caste studies and business cases to leverage and showcase commercial scale demonstrations (noted separately above). • **Support innovation pathways and government/3rd party independent testing** to validate and accelerate new low carbon technologies, products and services used by the transport and infrastructure sector that would otherwise arrive to market far later without such support. • **Support ANZBIG and the Australian Biochar industry 2030 Roadmap** – *"help us to help you"*. The biochar bioenergy sector and its roadmap for industry scale up to help Australia decarbonise is yet to receive any significant government support. This outlines 10 key Initiatives and supporting actions (some of which contribute to the dot point recommendations earlier above) to scale the industry to potentially reduce Australia's net carbon emissions by 10-15% and provide up to 20,000 permanent jobs, including in rural and regional areas. We welcome and encourage further engagement with the government on this.
s2.2 Movement of goods – Decarbonising freight and supply chains (pg38) Q6. The Australian Government has already engaged in consultation on the 2023 review of the *National Freight and Supply Chain Strategy* and those consultations will also inform the final Roadmap and Action Plan. 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?	Australia is seeking transition to non-carbon polluting transport, which is challenging in heavy freight systems and supply chains. **Biofuels** can provide significant assistance for transition. Biofuels made by biochar bioenergy processes additionally provide CDR concurrently, and can process woody biomass (lignin-based) not commonly targeted by other forms of biofuel production (i.e. biochar bioenergy is also complementary to existing technology investments). Some biochar bioenergy systems also have capability for low-cost and **carbon-*negative* biohydrogen** for carbon-free transport fuels of the future. Biohydrogen from biochar bioenergy systems is not currently discussed within the roadmap (only AD and electrolysis). Syngas from biochar bioenergy systems is comprised

	primarily of hydrogen and CO as the chemical building blocks to facilitate synthesis of a range of other important biofuels and biochemicals (e.g. methanol, ammonia, olefins etc) as illustrated on **Figure 3**. **Biochar** to displace fossil carbon in products and services can also be used throughout **supply chains** and in transport **infrastructure (e.g. greener concrete, steel, asphalt, stabilisation and water treatment among other aspects). Every tonne of biochar typically contributes 1.9t-2.5CO_2e CDR per tonne of biochar used in applications where the carbon is stored in the long term**. **Displacement of previously used fossil carbon products and services can also provide additional *avoided* emissions along with CDR within the biochar itself.** Refer figures showing many example applications for circular carbon with CDR via biochar in **Appendix 1,** and commercial examples including winners of the *Australian Biochar Users Awards* in **Appendix 3.** Over 50 Million tonnes of biomass is currently being burned, landfilled or otherwise decomposing back into the atmosphere beyond natural ecosystem requirements. **Accordingly, the biochar bioenergy industry represents significant opportunity for Australia and should be supported in addition to existing actions within the consultation roadmap.** Ten (10) key initiatives and supporting actions to support rapid scale up of the biochar bioenergy industry are identified in the *Australian Biochar Industry 2030 Roadmap* (ANZBIG, 2023) which can concurrently be supported to leverage benefits. Please also refer to responses to **Q5, Q28 and Q29, and 6.2 below**.
6.2. How would these actions address the identified challenges and opportunities for emissions reduction in the movement of goods?	A number of the challenges identified in the consultation roadmap relate to applications where the triple bottom line benefits of circular carbon and biochar bioenergy can play a positive role in the economies of both urban and regional/rural areas. In addition to benefits of particular applications (e.g. cycleways as outlined below), a number of **positive co-benefits** provided by biochar bioenergy industries can help provide important green *and interesting* jobs and help stem the tide of people (particularly young people) moving away from the regions, helping build a better future in rural and regional Australia just when it so critically needed. This can be significantly encouraged through positive government policy and greener procurement for public transport infrastructure to stimulate those industries and jobs. Just one example of many includes public transport **cycleways** in Perth which have incorporated biochar into the pavement (including colours), providing a lower carbon cycleway that enhances circular economy and safety. There are numerous opportunities for such synergies across active and public transport. Accordingly, biochar bioenergy should be included within policy and regulatory frameworks to encourage circular low carbon products and services in transport and infrastructure.

	This includes the ***Infrastructure Procurement Statement (IPS),*** the ***National Urban Policy*** and the ***National health and Climate Strategy***, among others. The *Australian Biochar Industry 2030 Roadmap* was prepared following extensive stakeholder and industry consultation over a number of years, including a national summit specifically for the roadmap development held in Adelaide in 2022. Consultation identified ten (10) key themes requiring action to address current hurdles hindering accelerated scale up of the industry, these included: **1. Collaboration and partnerships** **2. Communication of Economic Value and Benefits** **3. Accelerate Markets** **4. Encourage Policy Recognition and Support** **5. Standards and Certification** **6. Harmonise Regulatory Frameworks** **7. Encourage Investment** **8. Focus innovation and Research** **9. Facilitate Industry Scale Up** **10. Funding and Resourcing Support** To address these key themes, ten (10) specific **initiatives** with supporting actions were developed within the roadmap. These are outlined in the supporting presentation provided in **Appendix 4** to our submission. ANZBIG encourages further engagement with the Government to discuss these initiatives and potential collaboration to support scale up to assist decarbonisation within transport and infrastructure.
Chapter 3 – Net Zero Pathways for each Transport Mode	
s3.1 Road – Light Vehicles (pg45) Q7. Do you agree with the proposed net zero pathway for light road vehicles?	In general support the proposed approach. We would also draw attention to rural and regional Australia where distances between charge points are significant. Policy incentives for hybrid **bio**diesel-electric vehicles could be considered to encourage substitution of diesel 4WDs commonly used in agriculture and mining, helping to further decarbonise those important industry sectors too.
Q8. 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*.	• Electrification (including hybrid biodiesel-electric vehicles) and hydrogen fuel cell technologies can both benefit from biochar bioenergy systems.

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?	• **Sustainable batteries** using carbon from biochar bioenergy systems (instead of fossil carbon black) represents a **significant opportunity for concurrently improving circular economy, climate action and resilience (economic/geopolitical) in a profitable manner, generating jobs** and enhancing objectives consistent with a *'Future Made in Australia',* providing fast charging (and discharging), high performance at low temperatures and a renewable, scalable, sustainable battery solution:
	  ○ EV market share of sales is to reach >40% by 2030 and >75% by 2040 (Bloomberg NEF, 2024)
	  ○ Demand for EV batteries increased 40% in 2023 from 2022 alone.
	  ○ Battery carbon demand (graphite) is expected to 3.1M tonnes by 2030 (S&P Global 2024)
	  ○ The vast majority (>90%) of EV batteries come from China (IEA Global EV Outlook 2024).
	  ○ Biochar is already being used commercially in Li-ion battery technology in Europe, including partnerships with vehicle manufacturers toward climate neutral vehicles.
	  ○ The Australian water industry (via WSAA) is researching battery opportunities via their collaborative *"biochar 2 batteries"* project with RMIT and Deakin Universities and partner water utilities.
	• Biodiesel and biohydrogen from biochar bioenergy systems can also assist light vehicle decarbonisation as noted separately earlier in this submission.
	• Biomass bioenergy is also **dispatchable on demand** to provide **nighttime generation** to complement conventional daytime renewables (via **heat to power** and **syngas to power**), to leverage investment through lower cost 24/7 generation.
	• There are opportunities to decarbonise supply chains all the way up to manufacturing of *vehicles themselves.* For example, BMW and Audio are backing a biochar-bioplastics company in Germany to help decarbonise the automotive industry, this could be replicated in Australia too, among many other applications for circular carbon in transport and infrastructure. Globally, the race is on to profitably use CO_2 from capture technologies (DACCS, BECCS, PYCCS etc), as the chemical building blocks for constructing **biofuels (including SAF) and bioplastics**. Companies like Twelve are partnering with Mercedes Benz and others to develop **biofuels, SAF** and **polycarbonate** applications.

8.2. How would these actions address the identified challenges and opportunities to reduce light vehicle emissions?	The identified challenge of circularity and sustainability of batteries can be significantly aided via biochar carbon batteries. Improved charging of synthetic biographite (relative to fossil graphite) can aid the identified challenge of availability and reliability through enabling faster charging and reduce time and increased throughput for charging stations. Production of biodiesel and biohydrogen can aid decarbonisation of more challenging heavier SUV and 4WD markets. Displacement of fossil carbon to reduce emissions and provide CDR may also aid marketing for EV transition via important action on climate change. Potential co-benefits include enablement of circular regional economies for new green jobs in regional Australia.
S3.2 Road – Heavy Vehicles (pg52) Q9. Do you agree with the proposed net zero pathway for heavy road vehicles?	We note and support key points raised including a mixture of hydrogen / LCLF (e.g. renewable biodiesel) and battery electric approaches; addressing regulatory barriers, and providing charging infrastructure (especially in regional Australia), addressing road pavement issues, and providing finance mechanisms to help address up front costs for emerging technology solutions. ALL of these aspects have relevance to biochar bioenergy to assist decarbonisation of heavy vehicle transport, especially in regional and rural Australia.
Q10. 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. (why did you rank them in this order?)	See also related response for Q8 earlier above. Circular carbon via biochar is already emerging commercially for an important role in displacing fossil carbon black in anodes for **batteries** to decarbonise storage systems and complement deployment of conventional renewables (e.g. StoraEnso Li ion batteries in Finland, who are partnering with automotive companies). Australian water utilities are also partnering with multiple universities to investigate biochar for sodium carbon batteries, and other companies are investigating biochar for carbon thermal batteries. This is a significant synergy with the roadmap. **Biohydrogen** from biochar bioenergy systems have potential to provide carbon *negative* hydrogen for fuel cells for heavy transport. Refer Q12 for further details. **Biofuels**, including *drop in fuels*, have the potential to be synthesised from syngas from biochar bioenergy systems. Refer details below in Q12. As such, the biochar bioenergy sector can readily and rapidly assist **all three pathways**. We do not have a preference in ranking as they vary depending on basis of ranking (e.g. climate benefit

	biohydrogen would be ranked highest but least in commercial network readiness). Our industry stands ready to assist in any and all three cases.
Q11. What role should low carbon liquid fuels play in heavy vehicle decarbonisation?	We advocate for the inclusion of both **biofuels** in decarbonisation of heavy vehicles. Importantly, we note that thermal bioenergy systems such as pyrolysis and gasification can also produce syngas for making biofuels, with the benefit of additionally and concurrently providing CO_2 Removal (CDR) and processing biomass feedstocks not commonly targeted by other conventional biofuel pathways (e.g. lignin-based feeds, weeds etc). This is potentially also the only carbon-*negative* way to generate biofuels (and carbon-negative hydrogen too). As such, it could be recognised in the consultation roadmap. We would be pleased to provide further information/discussions to support this if required.
Q12. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce heavy vehicle emissions?	Biohydrogen and biodiesels(+battery electric hybrid systems) are emerging as potential decarbonisation solutions for heavy transport. Much of our heavy transport moves through rural and regional Australia, including those servicing our agricultural and mining industries as well as regional cities and towns. Biomass waste in Australia is dominated by agricultural residues. There is high potential for biochar bioenergy to process agricultural and other biowaste residues across Australia (particularly in areas where water for electrolysis is more precious for food production) to help service these decarbonisation fuels (biohydrogen, biodiesels and carbon for batteries) and to complement conventional renewable power generation with dispatchable power for 24/7 generation (assisting charging networks among others) as noted earlier in this submission). Roads constructed with biochar-based pavements are commercialised in Australia now and are indicating increased strength and reduced maintenance, with reduced water ingress to underlying sub-base (further information on this can be provided on demand, ANZBIG has recorded webinars available for example). The *Australian Biochar Industry 2030 Roadmap* outlines 10 initiatives and actions the Australian government can support to accelerate industry scale up to assist decarbonisation across the economy, including the transport and infrastructure sector. Addressing regulatory barriers (as also identified in consultation roadmap) and undertaking commercial scale demonstrations across the country to foster rapid innovation, uptake and scale up are just two of those initiatives which can be supported. We welcome further engagement on how we can collaborate on this.
12.1. How would these actions address the identified challenges and opportunities to reduce heavy vehicle emissions?	• Regional and rural processing of agricultural and other biowastes to provide: ○ distributed biofuel and biohydrogen generation to assist low cost decarbonised fuel distribution.

	○ Dispatchable 24/7 power generation in regions to complement conventional 'daytime renewables' to assist regional energy decarbonisation, charging networks and biohydrogen fuel networks. ○ Biohydrogen is the only carbon-***negative*** hydrogen (with CDR), critical for climate action, and does not require significant water resources (excellent for inland regional Australia). • Improved road pavements and sub-base stabilisation to assist increased road mass on road pavements identified as a challenge in the consultation roadmap.
s3.3 Rail (pg58) Q13. Do you agree with the proposed net zero pathway for rail?	We support the consultation roadmap statement that "*decarbonisation of our rail sector requires the roll-out of* ***infrastructure to support hydrogen and battery-electric trains***". We note also that existing rail infrastructure can also benefit from biochar bioenergy in regards to circularity through upcycling of used treated timbers (railway sleepers etc) into industrial grade biochars for use in industry including *roads*.
Q14. 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. (why did you rank them in this order?)	Refer related answers for Q10 earlier above.
Q15. What role should low carbon liquid fuels play in **rail** decarbonisation?	Noting the identified challenge in the consultation roadmap of LCLF *energy density* for use in rail, in future *high grade biodiesel* made from the chemical building blocks in syngas generated by biochar bioenergy systems may provide a suitable solution for drop-in replacement fuels for conventional diesel.
Q16. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce rail emissions?	As per other sections, help us to help you - enhancing the Australian biochar bioenergy sector will help aid decarbonisation of the transport sector. Refer actions under the *Australian Biochar Industry 2030 Roadmap*. We encourage support for innovation and development to accelerate rapidly emerging options including biofuels for drop in substitutions for conventional diesel in rail.
16.1. How would these actions address the identified challenges and opportunities to reduce rail emissions?	Syngas pathways for chemical synthesis of biofuels have potential for high energy LCLF's to address the low energy density issue faced via conventional LCLF pathways. We encourage further government innovation pathway support for these avenues, as well as related circular options in rail to aid other transport decarbonisation such as treated timber wastes to industrial chars for roads etc.

s3.4 Maritime (pg64) Q17. Do you agree with the proposed net zero pathway for maritime?	We are supportive of biohydrogen and biofuels/LCLF to aid the transition of maritime fuels, including hydrogen-derived fuels (ammonia, methanol etc). We advocate for additional inclusion and recognition of biohydrogen (for biomethanol etc) in addition to electrolysis (e-hydrogen) for e-methanol etc. We would welcome further engagement with government to discuss economic and technical rationale for its inclusion.
Q18. 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?	There is significant potential for biochar bioenergy to produce biofuels and biohydrogen (and related derivatives such as biomethanol noted above) in addition to the current roadmap focus on e-hydrogen production alone. Significant maritime companies such as Maersk have identified *green methanol* as a preferred low carbon fuel. Conventional green methanol production can be challenged by social licence issues associated with potential to threaten food security (food vs fuel debate). Biochar bioenergy has the potential to *enhance* food security by increasing crop yields through its use, and biochar can be made from organic residues and other biomass sources that don't compete with cropping land for food production (and even potentially enhance it through native Australian species grown on marginal land to aid land restoration), and accordingly enhance positive social licence.
18.2. How would these actions address the identified challenges and opportunities to reduce maritime emissions?	This has been outlined in Q18 above.
s3.5 Aviation (pg71) Q19. Do you agree with the proposed net zero pathway for aviation?	We support transition via SAF and LCLF. Syngas from biochar bioenergy systems has the potential to provide the chemical building blocks for SAF and other LCLF as illustrated in **Figure 3**. Biochar bioenergy also has the potential to (quite uniquely) generate carbon-***negative*** biohydrogen for emerging hydrogen-based aviation, playing a beneficial role toward net zero objectives domestically and internationally (noting the ICAO's objective of net zero carbon emissions by 2050).
Q20. 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. 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?	Australia could be a world leader in this space, including for SAF, biodiesel and C-negative hydrogen with CDR via biochar bioenergy. Establishment of an Australian carbon credit unit (ACCU) method for biochar could significantly assist the aviation transport sector. ANZBIG has previously received enquiries from a major aviation company regarding potential for ACCU carbon credits from biochar bioenergy. Additional actions to

	accelerate the industry are outlined in the *Australian Biochar Industry 2030 Roadmap*. ANZBIG welcomes discussions on how we can collaborate to deliver this.
20.2. How would these actions address the identified challenges and opportunities to reduce aviation emissions?	Other pathways to make SAF and LCLF can be challenged by feedstock (including competing with productive food). Biochar bioenergy provides maximum feed flexibility by also processing woody lignin based feedstocks, including woody weeds (e.g. prickly acacia) and short rotation native species on marginal (non-cropping) land which require no watering after planting trialled by NSW DPI, potentially opening up massive tracks of degraded land for beneficial restoration (syngas for SAF and biochar for soil restoration). Biochar bioenergy can also utilise problematic urban feedstocks such as FOGO (food organics and garden organics) currently searching for diversion pathways from landfill as they aren't expected to be readily absorbed by composting/landscaping markets alone (and also face other challenges). Valuing co-benefits of biochar bioenergy for SAF generation (including CDR for ACCUs) could potentially also lower the net cost of SAF which the roadmap identifies as critical.
Chapter 4 - Supporting Transport's Net Zero Pathways	
s4.1 Transport Infrastructure Q21. Do you agree with the proposed net zero pathway for transport infrastructure?	We noted the Consultation Roadmap's recognition that globally infrastructure consumes more than half the world's materials annually (GHub 2021), and that emissions associated with **infrastructure across the energy, transport, water, waste, digital communications and building sectors is related to 79% of all greenhouse gas emissions globally** (UNOP 2021). Emissions associated for transport infrastructure alone represent 3% of Australia's total emissions. **Embodied carbon** in materials such as **concrete, steel, roads and aluminium** is significant. We support the roadmap's recognition that "***the main emission reduction pathways are through materials"*** *(to use low-carbon input materials such as green steel, concrete/cement, asphalt, aluminium and low carbon recycled materials),* ***or by design*** *(****through circular economy principles*** *such as no-build situations, better maintenance, refurbishment, or using more efficient planning, design, and building techniques)".* Biochar and biocarbon bioenergy systems are positioned to significantly assist decarbonisation of these materials and increase circular economy. Major companies such as **BlueScope Steel** have run successful trials (discussed in Q22 below) and presented at the Sydney forum of the rollout of the *Australian Biochar Industry 2030 Roadmap*. Accordingly, we are supportive of the measures within the Consultation Roadmap to **decarbonise materials for infrastructure**, **however identified solutions for this requires significant expansion**

	within the roadmap to include the extensive role of circular carbon via biochar bioenergy. As noted in the summary introduction, biochar and biocarbons can be used extensively to displace fossil carbon across supply chains as illustrated in the figures of **Appendix 2** and commercial examples in **Appendix 3**, and discussed further in Q22 below.
Q22. 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?	Biochar and biocarbons can be used to displace embodied fossil carbon in transport and infrastructure via: • **Road pavements** – biochar has potential for use to improve strength and durability of surface pavements concurrently with sinking carbon in a durable form (refer examples in Appendix 3). Coloured pavements use in cycleways have also been successfully installed (e.g. Perth WA). • **Road sub-base stabilisation** – is a significant opportunity for immediate and significant action (refer examples in Appendix 3), and can use ~10x more biochar than surface asphalt pavements. Further, the ability to use local/recycled material for these applications can result in significant displacement of virgin quarried material being hauled long distances to road projects, avoiding further emissions. • **Unsealed roads -** There are also opportunities for stabilising dust for high traffic unsealed roads, and for improving access productivity on unsealed roads in high rainfall areas (e.g. northern Australia), with successful trials on the latter in northern WA. • **Concrete** (both structural and no-structural, with significant and immediate potential for easy deployment in non-structural concrete as 'low hanging fruit) • **Batteries** for EVs and other storage of renewable energy (anode materials in Li-ion batteries, sodium carbon batteries and carbon thermal batteries) • **Erosion Control and Rehabilitation** (e.g. spraygrass/hydromulching, soil stabilisation and revegetation) • **Stormwater treatment and control** (e.g. water filtration – one of the largest markets for biochar in the USA). Pyrolysed carbon (which makes biochar) is the basis of activated carbon production. Low cost pseudo activated carbons via activated biochar has significant potential for Australian transport systems. Biochar also been used for filtering emerging contaminants in road runoff including microplastics. • **Catalysts** to displace fossil carbon and other catalysts in biofuel production and use. Materials such as **steel** and **aluminium** can be decarbonised via:

	• Displacement of fossil carbon in BF steel making (e.g. as a result of successful trials by BlueScope (ARENA supported), they are now seeking the equivalent of over 10x total national production of biocarbon/biochar per annum), noting further potential use of biochar bioenergy systems for EAF and DRI steel production too. • Circular carbon for Aluminium production, **displacing fossil carbon recarburizers** Example references to support the above are provided in **Appendix 3**, and further supporting information (including webinars on some of these topics run by ANZBIG) can be provided upon request. Additionally, biochar **bioenergy** (and synthesis of biofuels and biohydrogen) can be used to displace fossil energy in production of energy and materials, further reducing Scope 3 emissions. Accordingly, **we recommend that biochar bioenergy be recognised and included within the *Infrastructure Policy Statement*** (IPS) as a key potential solution opportunity. We also recommend that the role of CDR be recognised alongside ER and that associated targets be included and adopted. We encourage support of the *Australian Biochar Industry 2030 Roadmap* to accelerate and scale the industry to support decarbonisation of the transport and infrastructure sector. We also encourage further discussion on collaboration and partnership opportunities for this.
22.1. How would these actions address the identified challenges and opportunities to reduce transport infrastructure emissions?	Positive support for biochar, biocarbons and associated bioenergy (including biohydrogen, biofuels and bioplastics) including the actions in Q21 and elsewhere in this submission have significant potential to help address challenges identified in the Consultation Roadmap including commercial feasibility of input materials, address limited data, measurable track and report on associated ER and CDR, significantly improve circular economy, and assist rural and regional communities in particular who face unique and complex challenges.
s4.2 Transport Energy Use Q23. The Australian Government invited views on aspects of the energy transformation that represent the most material challenges and opportunities for the electricity and energy sector. Submissions closed on Friday 12 April 2024 (AEDT). This feedback will be used to inform the development of the Electricity and Energy Sector Plan and Net Zero Plan. The Australian Government will be undertaking targeted consultation to identify options for production incentives to support the establishment of a	We support the Consultation Roadmap's recognition of the need to displace fossil carbon fuels used heavily in the Australian transport system, and that electrification and LCLF substitutions (including renewable diesel and SAF) will be required and supported. As noted earlier in our submission, the biochar bioenergy industry is positioned to readily support all of these aspects, from **decarbonising batteries** for electrification and storage of renewable energy generation (including distributed systems in rural and regional Australia) to potential use of high grade syngas for biofuels including carbon *negative* **biohydrogen, biodiesels and SAF**, among others. The industry is ready to scale

made in Australia low carbon liquid fuel industry, including through the release of a low carbon liquid fuels consultation paper. Feedback heard through this process will also inform development of the final Transport and Infrastructure Net Zero Roadmap and Action Plan. *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?*	economically to meet the challenge (we are happy to discuss this further) and represents an excellent diversified approach to provide resilience and a large range of co-benefits, whilst also avoiding some limitations faced by conventional bioenergy. We draw your attention to the range of recommendations identified throughout our submission, and to the request for recognition and support to implement the ***Australian Biochar Industry 2030 Roadmap***.
Q24. How should the use of low carbon liquid fuels be prioritised across different transport modes over time to achieve maximum abatement?	It is important that actual transition to non-fossil and **sustainable** solutions occurs to decarbonise the economy. We encourage prioritisation of LCLF which measurably provide maximum sustainability concurrently with climate action. We understand that electrification of light vehicle transport is readily viable, whilst heavy transport is far more difficult Given that rail is already efficient in regards to emissions density (per tonne of cargo), decarbonising heavy road transport should be prioritised first. All measures to assist this should be considered, including those presented elsewhere in our submission where our industry has potential to assist.
Chapter 5 - Achieving Net Zero Together	
s5.1 Travelling in Partnership (pg88) Q25. What are the best ways for the Australian Government to work collaboratively with industry, business, governments and communities to implement the proposed pathways?	*Peak bodies* representing industry (and also in the community) provide excellent forums for consultative engagement, collaboration and partnerships. We would welcome further industry engagement via the ANZ Biochar industry Group (ANZBIG), especially in relation to leveraging the significant synergies with the *Australian Biochar Industry 2030 Roadmap*. Six working groups have been established by ANZBIG to deliver the ten key initiatives of roadmap, including an Innovation Working Group that includes promoting commercial scale demonstrations across Australia.
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?	In regards specially to the biochar bioenergy industry, ANZBIG collaborates extensively with member groups both domestically (states and within NZ), and internationally with the International Biochar initiative (IBI) in the US and the European Biochar Industry Consortium in Europe, among many others globally. Accordingly, ANZBIG is an excellent conduit to global movements in bioenergy with biochar carbon removal and for engaging and partnering within the transport and infrastructure sector. We invite further engagement and collaboration in regards to how we can contribute to the *Transport and Infrastructure Net Zero Roadmap,* including engagement with roadmap authors/managers and other key government groups such the **two decarbonisation working groups** established by the Transport and Infrastructure Ministers' Meeting (ITMM), the **consultation group** for MERNAP, the Jet Zero Council, and the Net Zero Economy Agency/Authority. If appropriate, we

	would also welcome engagement with the range of relevant international partnerships promoting decarbonisation and hydrogen technologies.
25.2. What opportunities can the government leverage to show leadership in Australia and internationally?	The *Australian Biochar Industry 2030 Roadmap* is a **world first** for the biochar industry globally, providing leadership in climate action and sustainability, with all of the roadmap initiatives aligned with specific UN Sustainable Development Goals. ANZBIG and its members are recognised world leaders in research, production and use of biochar in soil and industrial applications. Partnering with ANZBIG to deliver the *Australian Biochar Industry 2030 Roadmap* and the potential benefits it could bring to the transport and infrastructure sector could readily lead the world in multiple aspects (e.g. demonstrations across Australia). We welcome further engagement on this potential.
s5.2 Measuring Success (pg90) Q26. What measures and metrics should be used to evaluate the final Transport and Infrastructure Net Zero Roadmap and Action Plan?	With decarbonisation as a key objective, 'SMART' KPIs for both emissions reduction (ER) and also CO_2 Removal (CDR) should be set within the plan, with associated targets (interim 2030 and 2050) against which they are measured and reported. Due to inherent synergies, sustainability and circularity should also be considered. *The Australian Biochar Industry 2030 Roadmap* includes KPI's for all initiatives and supporting actions, and is aligned over 2/3 of with the UN Sustainable Development Goals (SDG's), a framework Australia reports under. Use of biochar in transport and infrastructure can be readily measured and assisted in relation to both climate reporting (both emissions reduction and CDR) and in sustainability reporting, both of which are focal areas of the new IFRS S1 and S2 standards for financial reporting frameworks. As such, our industry stands ready to measurably assist both decarbonisation and improved sustainability and circularity in transport and infrastructure projects.
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?	As noted above, targets and reporting for CDR need to be included in addition to ER to assess progress toward genuine Net Zero, with monitored reporting providing further insights into the large opportunities for CDR to complement ER across the transport and infrastructure sector. Establishment of an ACCU method for biochar will also help to accelerate decarbonisation opportunities and pathways. Setting targets alongside an ACCU method is also likely to also encourage **new innovation** for decarbonisation pathways yet to be identified/commercialised, further enhancing efforts toward Net Zero. Concurrent targets and reporting of **sustainability** and

	circularity/recycling (including diversion from landfill) will also assist significantly and represent opportunities for enhancement of the Consultation Roadmap concurrent with efforts elsewhere by government and industry on these related aspects. We note that **IFRS S1** and **S2 financial disclosure reporting** for ASX listed companies is expected to be rolled out in the near future which should also be dovetailed with these efforts.
Q27. Do you have any feedback on the proposed review process?	We note that annual updates in reports and statements combined with *detailed review every 3-5 years* is proposed. New opportunities for innovation and deployment are rapidly emerging and the next couple of years have been identified as being critical for climate action (this is the critical decade), noting the global carbon budget is under threat. **We advocate for additional inclusion of innovation pathways** and **rapid deployment mechanisms** (using appropriate checks and balances) to accelerate opportunities as they emerge. This includes opportunities to decarbonise supply chains all the way up to **manufacturing of *vehicles themselves* and beyond.** e.g. in Germany BMW and Audio are backing a biochar-bioplastics company to help decarbonise the automotive industry itself, this could be replicated in Australia too, among many other applications for circular carbon. Circular carbon provides enormous opportunities to accelerate and improve decarbonisation, sustainability and circular economy in a profitable way, generating employment and regional jobs at the same time. Every opportunity to accelerate these opportunities should be encouraged with supportive policy that facilitates rapid development and deployment.
Q28. Do you have any further feedback on the Consultation Roadmap and proposed pathways?	We commend the government for preparing this roadmap toward net zero in transport and infrastructure. We provide the following additional suggestions in the sub-section 28.1 below for improvement and enhancement, and also in Q5 earlier.
28.1. Is there anything missing? Are the sections appropriately integrated? Is the Roadmap appropriately ambitious?	• Whilst its mentioned in places in the consultation roadmap, increased focus on the critical role of **procurement** in decarbonisation is required. For example, inclusion in the government's role in decarbonisation in Chapter 1 among many other areas (e.g. Table 2 "Government's role in Decarbonisation"). Government spending (federal, state and local) is a very significant policy and economic lever for decarbonisation and circular economy which should be given a pivotal role with high focus within the roadmap. Leveraging on well establish actions in the circular economy and recycling industry spaces to assist this should be undertaken (and complements other government policies to accelerate those too). • Government support has been central in rapid development of the Chinese EV and solar/renewable industries over the last few decades that has resulted in them being highly globally competitive to the extent of dominating. Australia could consider a range of intelligent integrated government support mechanisms that provide high 'bang for buck' to foster rapid

	growth in Australian transport decarbonisation. Australia has world-leading technologies and innovation in biochar bioenergy and biochar applications in transport and infrastructure (including roads, concrete and stabilisation among many others) that could be readily 'turbo-charged' here more easily than most places in the world. There is significant opportunity for 'low hanging fruit' with appropriate government support. • *Low cost access to finance* has been central to expansion in renewables in both Chaina and the US (including low and no interest loans in addition to grants systems). Australia commonly requires *matched funding* to obtain most grants which significantly inhibits rapid innovation and commercialisation, particularly for pilot demonstrations. • The USA and the European Commission governments have instigated significant government policy support mechanisms to enhance decarbonisation and investment in renewables and associated technologies. Australia should review and leverage these here, including **tax incentives** (e.g. 45V, 45Q from USA). • The Qld government has just announced potential for government ownership of petrol stations and capped fuel pricing to help address fossil fuel price gouging. This model could be flipped to foster **decarbonised fuels** in particular to help level the playing field with fossil fuels, increasing competitiveness. Trials could be undertaken on this as part of regional circular economy. • As noted earlier above, we would like to see significantly expanded sections for decarbonising transport **infrastructure** within the roadmap, including the many opportunities for decarbonisation via biochar and bioenergy. For example: 1. **Displacement of fossil carbon in infrastructure and supply chains using biochar** – for example greener concrete, asphalt, sub-base stabilisation, erosion control (spraygrass/hydromulching), water filtration and other applications. Refer Figures in **Appendix 2** and example commercial companies offering these in **Appendix 3**. 2. **Carbon farming of roadside vegetation** (both construction/clearing and ongoing operations) to make bioenergy, biofuels, biohydrogen & biochar as a continuous "carbon removal pump" for carbon and energy - ***grow, harvest, biochar+bioenergy, applications/use, repeat***. Rapid decarbonisation through concurrent emissions reduction *and* CDR. 3. **Vegetation clearing for construction** roads and associated infrastructure. In addition to the above mentioned carbon farming of vegetation on existing roads, there are opportunities also for cleared vegetation during construction beyond mulching and composting alone, and also managing **'oversize'** *uncompostable* material. This can make high quality (soil

	grade) biochars for sequestration in multiple uses including rehabilitation, erosion and sediment control, water/air filtration, increased water holding capacity in water infrastructure (drains, basins), and drought-resilient rehabilitation in road infrastructure. Carbon from biochar can also provide significant roles in water holding capacity in green roofs for government buildings Additionally, we note opportunities for upcycling and circular management of previously problematic wastes into higher value products (into industrial grade chars etc): • **Treated timbers (e.g. Railway sleepers, power poles)** – Treated timbers can be managed in a circular, climate-positive way which subsequently also provides industrial chars for use in roads and concrete infrastructure projects. ~ 23 million sleepers each year are replaced in the USA, from the 620 million sleepers across 207,000 miles of rail track, with pyrolysis potentially displacing conventional management by combustion for energy (potentially halving emissions whilst concurrently making a valuable product). Refer research evidence here; an investigation by the US Department of Transport here, and an Australian commercial example here. We would welcome further discussion and engagement regarding the above.
Q29. Is there any further information or documentation that you wish to be considered with your submission?	We would like to see recognition of the significant opportunities with biochar-based bioenergy systems, including cross-referencing of the *Australian Biochar Industry 2030 Roadmap* within the department's Transport and Infrastructure Net Zero Roadmap. The Australia New Zealand Biochar Industry Group (ANZBIG) seeks to collaborate and partner with the government and the transport industry to accelerate these significant opportunities and welcomes further engagement on this to assist decarbonisation of the transport sector.

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