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9 January 2025

Committee Secretary
Senate Economics Legislation Committee

Dear Committee Secretary

Re: Submission to the Senate Economics Legislation Committee - Future Made in Australia (Production Tax Credits and Other Measures) Bill 2024

I refer to your correspondence on 10th December 2024 inviting the Heavy Industry Low-carbon Transition Cooperative Research Centre (HILT CRC) to make a submission on the Future Made in Australia (Production Tax Credits and Other Measures) Bill 2024.

The HILT CRC was established in November 2021 to support the decarbonisation of the Australian iron/steel, alumina, and cement/lime sectors. Since commencing operations, HILT has co-developed a groundbreaking research program to develop new technologies and address non-technological barriers and enablers to heavy industry decarbonisation, in collaboration with over 60 partners from industry (including heavy industry, end users and technology providers), government, academia, and non-governmental organisations. One aspect of HILT's ongoing mission is to pave the way for a prosperous, net-zero Australian heavy industry sector by providing high-quality, evidence-based information for decision-makers.

The HILT CRC supports the stated objective of the Hydrogen Production Tax Incentive (HPTI) to "support the growth of a competitive renewable hydrogen industry and Australia's decarbonisation."[1] Further, the proposed HPTI is aligned with the following findings based on HILT CRC's research and stakeholder engagement:

1. Access to low-cost, low-emissions energy and hydrogen is considered one of the most important enablers for heavy industry decarbonisation, and non-partisan policy support is needed to drive investment in hydrogen capacity on the timelines required.
2. HILT analyses indicate that it is likely that the cost of renewable energy and hydrogen will make up a significant fraction of the levelised cost of low-carbon metals and minerals (roughly 50% for green steel and alumina).
3. HILT research on the costs of hydrogen supply for heavy industry suggests that estimates for the near-term levelised costs of renewable hydrogen will continue to exceed the nominal target of USD 2 per kilogram, particularly in remote regions.

Supporting Evidence for these findings is provided below and more information can be provided on request.

Furthermore, the timing of the proposed tax offset period, from 2027 to 2040, broadly aligns with HILT's analysis of indicative pathways and timelines for heavy industry decarbonisation. Industry decarbonisation plans are multi-decadal, with timing determined by capital renewal cycles as well as access to sufficient supplies of net-zero energy sources and carriers (such as hydrogen) and ongoing technology development. Realising net-zero in heavy industry by 2050 will require phased actions deploying *transitional technologies* in existing plant (including partial fuel-switching to hydrogen);

[1] Future Made in Australia (Production Tax Credits And Other Measures) Bill 2024 Explanatory Memorandum, Attachment 1: Impact Analysis – Hydrogen Production Tax Credit

developing and *derisking transformational net-zero technologies* through pilot and demonstration plants; and finally *deploying these transformational net-zero technologies* at scale. Large and ongoing investments will be needed, requiring initial investment decisions to be made in the near-term, pre-2030.

The proposed HPTI will help to close the gap between the current projected costs of renewable hydrogen supply for heavy industry, and that which is needed to make *transitional technologies* like fuel-switching to hydrogen competitive in the near term. Further, encouraging investment in renewable hydrogen will likely accelerate hydrogen cost reduction through learning by doing, which will proportionately reduce the costs of *transformational technologies* that rely on access to low-emission hydrogen as a feedstock and/or fuel.

The Product Guarantee of Origin scheme which underpins the HPTI aligns with HILT findings that certification of embedded emissions should be transparent, accurate, and interoperable to enable trade of new green commodities, particularly those with international supply chains such as iron and steel. We further highlight the need for ongoing development of methodologies and rules that enable accurate emissions accounting without imposing undue regulatory burden and driving up production costs.

However, HILT's research and stakeholder engagement suggests that that **the HTPI will not be sufficient to de-risk heavy industry decarbonisation and must be deployed in conjunction with further government actions to**

1. accelerate the deployment of net-zero emission energy (including but not limited to, renewable electricity) and invest in enabling infrastructure;
2. reduce investment risk and uncertainty for industry, particularly through adoption of long-term, bipartisan policies and incentives;
3. drive demand for low-emission commodities both domestically through demand side incentives, and through ongoing climate diplomacy with existing and potential international trading partners to encourage enhanced global climate ambition; and
4. ensure regulatory and approval processes are efficient, consistent, and co-ordinated across state and federal government.

HILT Program 3 on Facilitating Transformation aims to further assess barriers and enablers and evaluate potential actions. Flagship projects are described briefly below, and more information can be provided on request.

The HILT thanks the Government for the opportunity to comment on the Senate inquiry and looks forward to continued engagement and discussion. If the Committee would like to discuss any elements further I can be contacted via ceo@hiltcrc.com.au.

Kind regards,

Jenny Selway
Chief Executive Officer
HILT CRC Limited

Supporting Evidence

About the Heavy Industry Low-carbon Transition Cooperative Research Centre (HILT CRC)

The heavy industrial sector contributes significantly to the Australian economy, with an annual direct economic output of approximately $180 billion, representing around 9% of the national economy. However, the sector is also carbon intensive, with the iron/steel, alumina and cement/lime sectors alone accounting for approximately 9% of Australia total CO_2 emissions and downstream processing of Australia's resources globally (corresponding to indirect scope 3 emissions) accounting for three times more emissions than all of Australia's direct emissions. While some progress has been made in the decarbonisation of Australia's heavy industries, innovative technologies and transformative processing pathways are required to meet our 2050 net zero emissions targets while maintaining the international competitiveness of these industries.

The Heavy Industry Low-carbon Transition Cooperative Research Centre (HILT CRC) was established as a catalyst to propel Australia's heavy industries towards a sustainable future. Through industry-led research, HILT CRC endeavours to mitigate risks and pave the way for effective decarbonisation strategies with a focus on the iron/steel, alumina and cement/lime sectors. These sectors have a common interest in de-risking the integration of net-zero energy and developing decarbonisation technologies, and face many of the same barriers and enablers, presenting opportunities for collaboration and cost-sharing (see Figure 1).

Since commencing operations in November 2021, HILT CRC has successfully embarked on groundbreaking research in collaboration with over 60 partners. HILT CRC's vision is to facilitate prosperous and thriving heavy industries in the net-zero economy through de-risking the technical pathways to decarbonise, thereby supporting Australia's heavy industry during the transition to low-carbon products. HILT CRC aims to achieve this vision through the implementation of rigorous, targeted, and industry-led research aimed at resolving technical challenges and addressing sector-wide concerns.

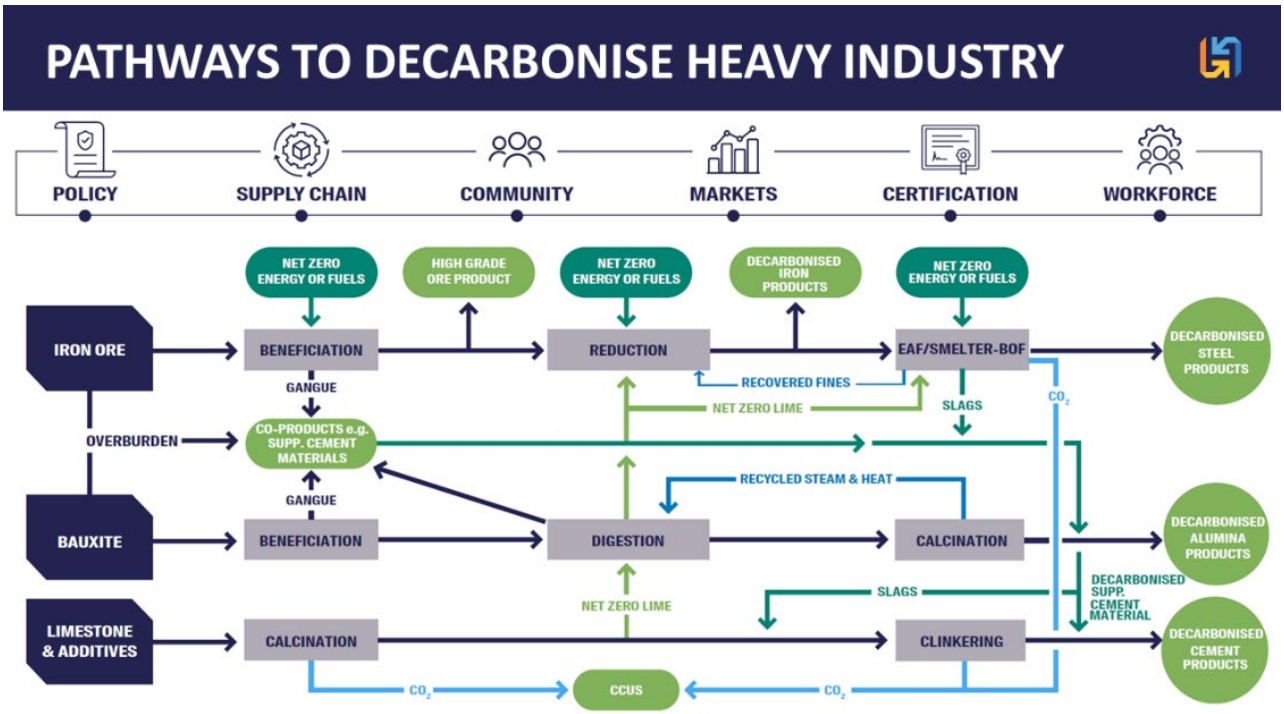

Figure 1: *HILT CRC's vision of the interrelated technology pathways to decarbonise heavy industry, highlighting the shared barriers and enablers*

Pathways and timelines for heavy industry decarbonisation

Reaching net-zero by 2050 for the heavy industry sectors will require gradual but dramatic transformation of processes throughout the supply chain. Many of the required technologies have not yet reached commercial maturity and are at various stages of development and/or require access to large-scale supplies of net-zero energy sources and/or CO_2 sinks at economically competitive rates. Heavy industrial processes for iron and steel making, and the production of cement, lime, and alumina require assets that generally have long lifetimes, meaning that **industry decarbonisation plans are multi-decadal, with timing determined by capital renewal cycles as well as ongoing technology development and access to competitively costed net-zero energy.**

In addition, **heavy industrial plants will need to develop bespoke decarbonisation plans to account for their unique circumstances**. Each individual plant will have been custom designed to process specific ores with properties that vary with geography, using location-dependent combinations of energy sources and supporting infrastructure. Plant-specific decarbonisation pathways will depend on the type and age of existing plant, as well as the unique combination of potential net-zero energy sources and CO_2 sinks available, spanning wind and solar resources, through to natural gas. Each plant will make different decisions as to which combination of technology options are most suitable for near-term, partial decarbonisation which we term '*transitional*'; and which technology pathway will be most effective for long-term '*transformational*' change to net-zero operation. Critically, ***transformational technologies* will need to be developed and derisked in parallel to deployment of *transitional technologies*, requiring ongoing investment from before 2030.**

Figures 2 and 3 illustrate HILT CRC's industry-informed vision of the technology pathways to progressively decarbonise steel and alumina manufacturing, with indicative timings. Required phased actions can be summarised as follows:

1. *Adapt 'transitional' technologies* via retrofits or brownfield installations, to partially decarbonise processes. Examples of transitional technologies can include the use of natural gas in place of coal as a feedstock and/or fuel; the partial or full replacement of fossil-fuel based electricity, fuels and feedstock with low or net-zero emissions electricity, hydrogen, biofuels and/or biomass in processes; and the deployment of carbon capture, use, and/or storage (CCUS).

   The majority of these transitional technologies come with the risk of increased production cost due to increases in the cost of energy and/or reduction in performance, the significance of which typically increases with the extent of decarbonisation. Even where some of these technologies may be commercially available for other processes or applications (i.e. CCS or renewable electricity), they typically require additional integration and/or adaptation for specific processes.

2. *Trial 'transformational' technologies* or low-carbon solutions in retrofit/brownfield installations to de-risk various components of a new production process which will be introduced at a time in the future. Such technologies have not yet reached commercial maturity and are at various stages of development, from the laboratory to pilot or small demonstration scale.

   Transformational technologies offer opportunity as well as risk. Re-designing part of a process to integrate a net-zero energy source, even within a brown-field site, offers the potential to increase process efficiency, and in turn, to offset the higher cost of net-zero energy. Nevertheless, significant risk is introduced due to uncertainty in which transformational technologies will be most cost-competitive, when different options will be commercially ready, and their likely performance in the plant in question.

3. *Demonstrate first-of-a-kind decarbonised production facilities in commercial operation*, to confirm viable, low emissions performance.

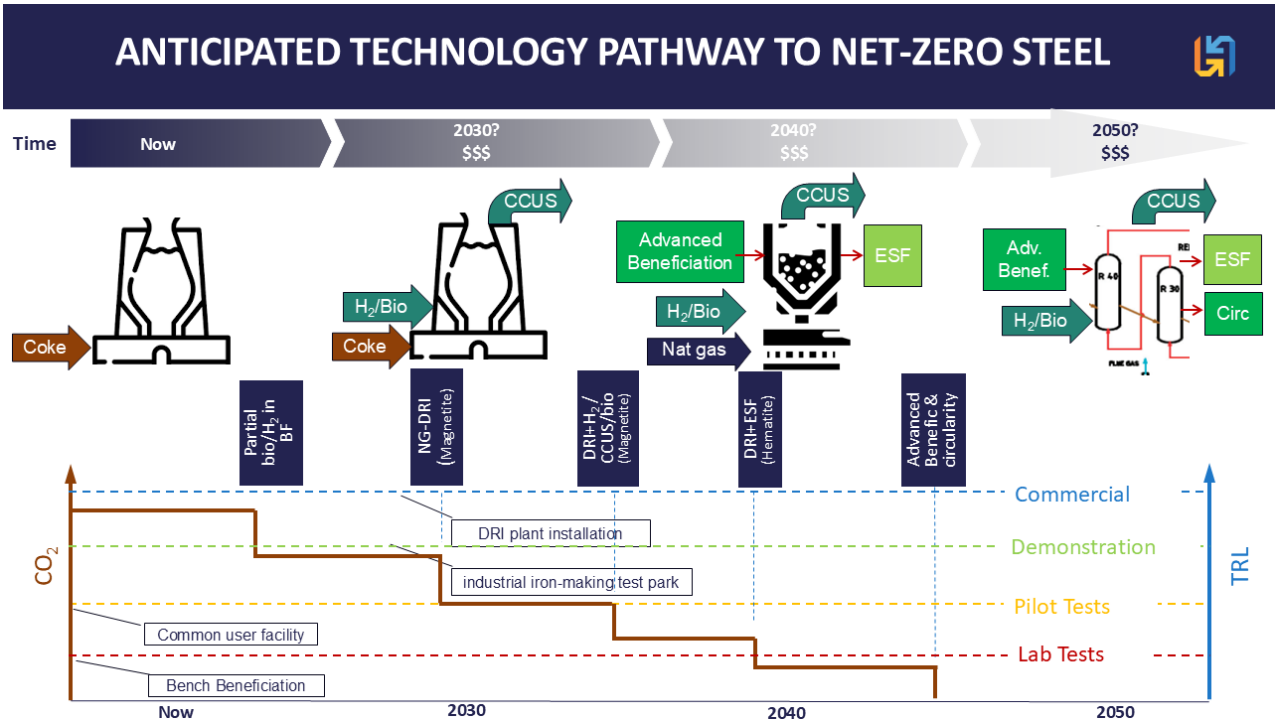

Figure 2: *HILT CRC's industry-informed vision of the technology pathways to progressively decarbonise steel manufacture.*

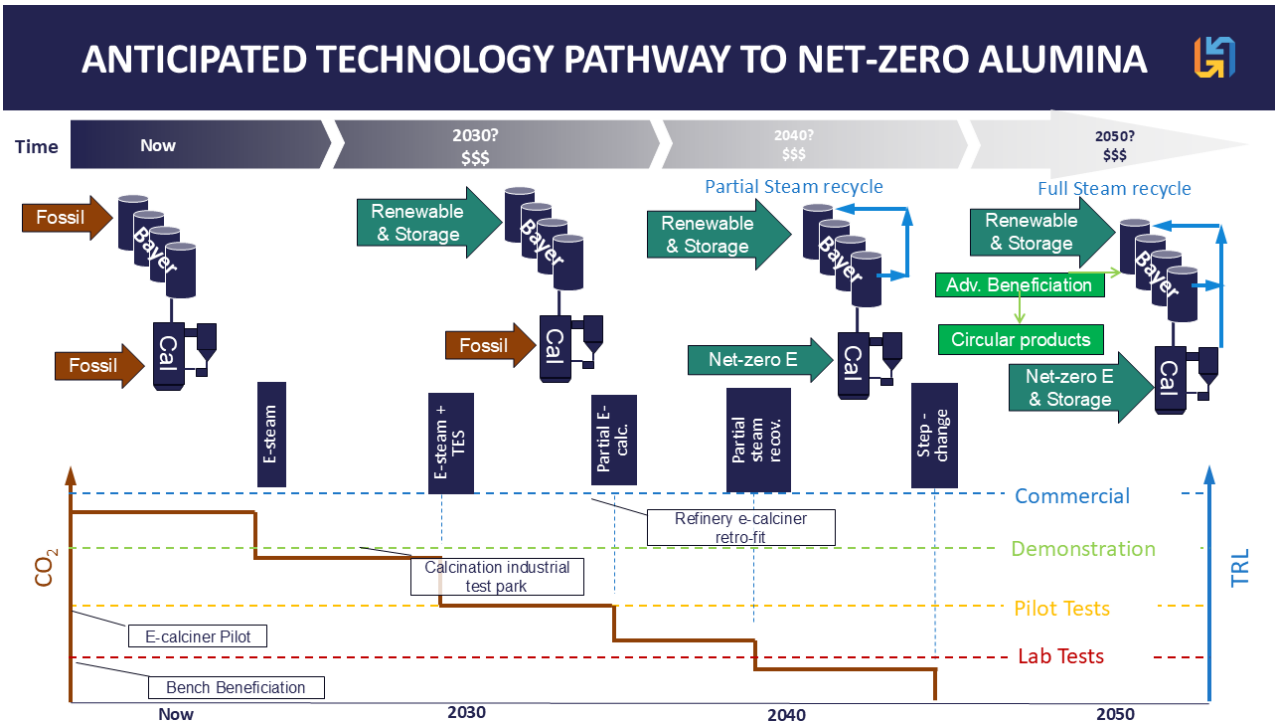

Figure 3: *HILT CRC's industry-informed vision of the technology pathways to progressively decarbonise alumina making*

Despite the requirement for plant-specific decarbonisation solutions, sectors have a common interest in de-risking new technologies and evaluating different pathways, presenting opportunities for collaboration and cost-sharing. **The HILT CRC is undertaking research to inform decision makers, including within industry and government, of the most prospective potential decarbonisation technologies and pathways** for iron and steel, alumina and cement industries, accounting for their various stages of development and commercial readiness.

In particular, HILT CRC is progressively establishing a comparative analysis of the various potential transformational technologies under development using a common set of costing assumptions to provide guidance on the relative commerciality of these alternative potential pathways accounting for region specific differences in energy resources, ore type and processing pathway. More information on this initiative can be provided on request.

Enablers and barriers to heavy industry decarbonisation

The HILT CRC has analysed partner and stakeholder perspectives on enablers and barriers to heavy industry decarbonisation collected through expert elicitations, roundtables, and surveys, as detailed below, as well as ongoing engagement with partners in HILT research projects. The HILT has over 60 partners and a wide network of stakeholders from industry (including heavy industry, end users and technology providers), government, academia, non-governmental organisations and consultancies. **Access to low-emissions energy (electricity and fuels such as hydrogen), and specifically that low emissions hydrogen is not yet economically viable, has consistently emerged as one of the most important concerns.**

HILT research project RP3.005 *Analysis of market, cost and locational factors for green iron and steel in Australia* conducted an expert elicitation of 42 experts to better understand the expectations for green iron and steel in Australia. Preliminary results have identified "availability and cost of renewable energy" and "proximity to renewable energy and hydrogen" supply as the most important local factors to enable green iron and steel. In addition, "renewable energy and hydrogen availability" was ranked as either a moderately (50%) or very (20%) important obstacle for a green iron industry by the majority of respondents. **The "lack of government support and funding" was rated as the most important obstacle for a green iron industry, with all respondents rating it either very (82%) or moderately (18%) important.**

HILT hosted a series of roundtables with stakeholders, including industry partners and government representatives, across Australia in 2023 on "Facilitating Transformation" to discuss non-technological barriers holding back the deployment of decarbonisation technologies (See Appendix A). One of the key themes that was identified was the need for "enabling infrastructure", which included supply of low-cost and low-emissions electricity and hydrogen. Participants also identified the need for "policy signals and enablers" highlighting the **need for long-term (non-partisan) policy commitment and support, commensurate with timescales of heavy industry decarbonisation pathways.**

HILT conducted a survey of partners at the HILT CRC conference in October 2024 to rank the most important topics for discussion on technology and policy developments to facilitate transformation and a green metals industry (See Appendix B). Participants ranked "Hydrogen supply and integration" as a priority, second only to "Accelerating low-cost, reliable electricity at scale".

Critical role of the cost of low emission zero hydrogen for decarbonisation of heavy industry

While the costs of different decarbonisation technologies and pathways are still evolving, **HILT analysis indicates that the cost of renewable energy and hydrogen will make up a significant fraction of the cost of heavy industry decarbonisation.**

HILT research projects RP 1.004/1.005 undertook an end-to-end technoeconomic analysis of green steel making in the Australian context, with an emphasis on understanding the impacts of Australian ore grades on the overall process design[2]. From preliminary estimates of technology costs, the project concluded that the cost of hydrogen made up roughly half of the levelised cost of green steel (assuming hydrogen costs of 3.5 USD/kg), and that green steel was 45-60% more explensive than conventional steel making.

HILT research projects RP1.002/1.007 demonstrated that converting alumina refineries to utilise either electricity or hydrogen at current prices and efficiencies is likely to add approximately 50% to the cost per tonne of product alumina. That would translate to 15% addition to the cost per tonne of aluminium. HILT CRC research activities in new project RP1.013 are aligned with increasing the process efficiencies with optimised incorporation of low-cost variable renewables to minimise the costs of firming of the energy inputs. This research indicates power demand reduction of between 20-25% may be realisable.

Ongoing HILT research project RP3.004 *Intermediate product exports for Australia-China green steel* is evaluating potential opportunities for Australia green iron and steel commodities (including upgraded ores, hot briquetted iron, and steel) in a future decarbonised supply chain between Australia and China. The project has developed an economic supply model incorporating different Australian ore types and potential (ore dependent) processing pathways. Preliminary results show that the outlook for Australian exports of green iron to China depends strongly on the relative costs of green hydrogen in Australia versus China.

Cost of hydrogen supply for heavy industry

HILT has undertaken technoeconomic analysis of renewable hydrogen supply for heavy industry at locations around Australia, corresponding to likely sites for net-zero heavy industry hubs, indicating that the current cost of supplying renewable hydrogen exceeds the nominal target of USD2/kg H2 that is anticipated to be necessary for hydrogen to be economically viable for heavy industry.

HILT research project RP2.006 *Hydrogen supply within HILT regional hubs – H2 cost and synergistic opportunities* developed an energy system modelling tool to estimate the levelised cost of a firmed (continuous) supply of renewable hydrogen to an industrial process, and to identify the optimal combination and capacity of off-grid solar, wind, battery storage, and hydrogen storage plant. Location-specific weather data and constraints due to geography and land availability were included in the analysis. The projected costs of plant were taken from the latest (2023-2024), best-available Australia-specific data provided by CSIRO GenCost project[3], and additional expenditure due to construction in remote regions were accounted for by using locational costs factors developed for the construction industry[4].

The project revealed significant variations in the levelised cost of a firmed supply of hydrogen across different regional hubs (see Figure 4 (a)) ranging from 3.5 USD/kg in Northern Tasmania to 7.96 USD/kg in Port Hedland. These variations were primarily driven by the quality of the local renewable energy

[2] Specifically, the project compared pathways incorporating different ore upgrading processes (beneficiation), low emissions iron making (direct iron reduction via a shaft furnace or a fluidised bed) and steelmaking options (the electric arc furnace or smelter plus basic oxygen furnace).
[3] Graham, Hayward, and Foster, "GenCost 2023-24."
[4] *Rawlinsons Australian Construction Handbook*.

resources as well as the availability of suitable geographical storage sites for low-cost hydrogen storage (in salt caverns or lined caverns), which determined the optimal system configuration and capacity (see Figure 4 (b)). Additional costs associated with construction in remote locations such as Port Hedland and the Pilbara were found to drive up the estimated costs.

The project also analysed how the cost of hydrogen from plants built in future decades was likely to change, based on capital cost projections from GenCost. Figure 4(c) shows that costs in the Pilbara are estimated to r drop significantly by 2030, and then gradually reduce over the coming decades. This suggests that costs will likely remain high for the coming decades, particularly in remote regions, and that additional support will be required to enable heavy industry to access low-cost renewable hydrogen despite the high-quality renewable energy resources in Australia.

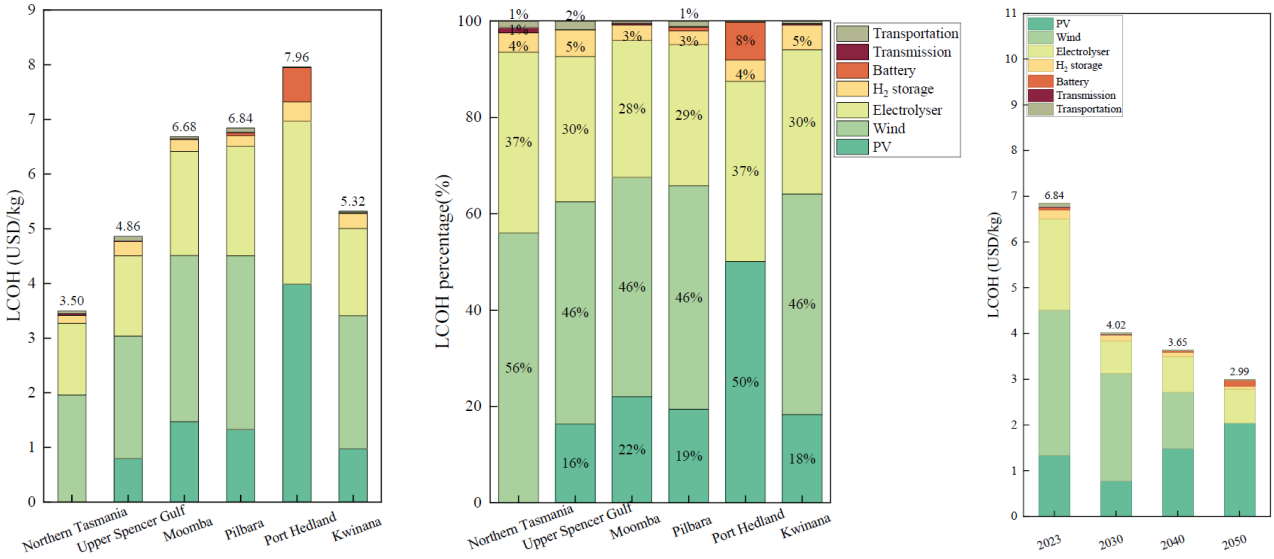

Figure 4: *Levelised cost of hydrogen (LCOH) estimates for all locations, showing contributions from different system components as (a) total costs, and (b) percentage breakdown. (c) Estimates for hydrogen systems built in future years in the Pilbara, showing contributions from different system components.*

HILT is continuing this research to further inform the location-specific energy demand (electricity, heat, and hydrogen) and supply infrastructure required for heavy industry to transition to net-zero in Australia. Flagship HILT project *PR3.007 Unlocking investment in energy infrastructure for net zero industrial hubs* kicked-off in August 2024 and will greatly improve our understanding of the public investment in energy capacity and infrastructure required to achieve net zero by 2050 under a series of scenarios that major stakeholders, including the industry, considers to be plausible. Specific aims include:

1. developing plausible scenarios both for the transition of existing processes and the establishment of new processes needed to reach net zero emissions by 2050 for major industrial hubs in Australia.
2. developing energy system modelling tools to estimate demand for electricity and fuels for these processes, and the capital cost-optimised infrastructure needed to meet these demands.
3. estimating the potential government co-investment that may be required and justified based on future economic benefits, such as employment, royalties/revenues, social/regional benefits and private co-investments.

Certification of green commodities

HILT Research Project RP3.006 *Certification and verification to enable a successful LCT for heavy industry* aims to provide our partners with evidence-based information to enable them to engage in processes around the development of embedded emissions accounting regimes in Australia. This includes options for as-yet unresolved questions around accounting complexity for circularity and co-products. The project kicked-off in June 2024.

Preliminary findings highlight that ensuring alignment and interoperability will enable Australia to seize significant opportunities in developing a net-zero heavy industry, particularly for commodities green metals with international supply and value chains.

Further details of HILT projects and stakeholder engagement can be provided on request.

Appendices

A. "Facilitating Transformation" Roundtable Report

HILT hosted a series of Roundtables with stakeholders, including industry partners and government representatives, across Australia in 2023 to discuss non-technical barriers holding back the deployment of decarbonisation technologies. When considering polling results from all Roundtables the top four ranked themes were:

- Enabling infrastructure
  - *Access to low cost, low emissions energy and hydrogen on required timescale*
  - *Coordination and investment in energy infrastructure and*
  - *Non-energy infrastructure such as roads, rail, water, housing*
- De-risking decarbonisation investment
  - *Ensuring regulations and approval processes are efficient, consistent and co-ordinated and across state and federal government*
- Policy signals and enablers
  - *Co-ordinated trade and industry policy to assist Australian industry in attracting capital investment, in accessing technology, and remaining internationally competitive with their products*
- Trade barriers and market drivers
  - *Developing internationally recognised and interoperable net-zero product certification and verification.*
  - *Driving demand for green commodities domestically and through engagement with existing and potential international*

Text in italics provides more detail and is based on further analysis by HILT program leadership, with feedback from partners.

Clustering analysis of discussion relating to these themes identified five topics that could address these barriers, as summarised in the matrix below.

	Priority Themes			
Common Feedback Topics:	**Enabling Infrastructure**	**De-risking decarbonisation investment**	**Policy signals and enablers**	**Trade barriers and market drivers**
Mapping cross-border impacts of existing LCT policy settings.	✓	✓✓	✓✓✓	✓✓✓
Policy scenario modelling of reaching net zero by 2050.	✓✓	✓✓✓	✓✓✓	✓✓
Harmonising LCT regulation, compliance & certification.	✓	✓✓	✓✓✓	✓✓
LCT stakeholder engagement & collaboration.	✓✓	✓	✓✓✓	✓
Coordinated LCT investment planning & knowledge sharing.	✓✓✓	✓✓✓	✓✓	✓

HILT's Program 3: Facilitating Transformation has the following flagship projects now underway to address these barriers and potential enablers:

RP 3.006: Certification and verification to enable a successful LCT for heavy industry. This project will enable Australian heavy industry to successfully engage with emerging regulatory and market regimes based on embedded emissions account, providing them with competitive advantage and supporting their successful transition to low carbon production – both financially and environmentally.

RP 3.007: Unlocking investment in energy infrastructure for net zero industrial hubs. This project will provide the information required to enable industry and other stakeholders to plan for the transformation of the energy supply system necessary for heavy industrial sectors to a net-zero carbon future.

RP 3.008: A policy roadmap for Australia's heavy industry low-carbon transition. This project will assist heavy industry partners and stakeholders to understand, manage and mitigate risks associated with the transition. It does this by deepening understanding of current and future policy developments at different government levels that directly impact heavy industry.

B. ***Results from HILT CRC Conference, October 2024 in response to the question: Rank the most important topics on technology and policy developments to facilitate transformation and a green metals industry for discussion.***