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November 2024

Australian Productivity Commission
Commission Inquiry – Opportunities in the Circular Economy

Submitted via email: mailto: circular.economy@pc.gov.au

Re: SEATA Submission: *Opportunities in The Circular Economy* *(Commercial in Confidence)*

Thank you for the opportunity to provide a submission to the above Inquiry. Our submission is comprised of this cover letter and the appendices listed further below:

1. **Appendix 1:** SEATA Technology **General High-Level Introduction** (Nov 2024)
2. **Appendix 2:** SEATA Submission to NSW Treasury (Dec 2023) – **Renewable Fuels Scheme (incl Hydrogen)**
3. **Appendix 3:** SEATA Technology - **Technical Introduction** (May 2024)

Additionally, we note that SEATA has also contributed to a **separate joint submission** with the Global Product Stewardship Council and Catalyst Environmental Management that has addressed the Inquiry's specific discussion points in some detail at an industry-level. Accordingly, the intention of this separate individual submission is to provide additional information specifically relating to SEATA's rapidly emerging technology and its potential to *significantly* contribute to the circular economy, economic growth, and critical climate objectives concurrently, rapidly, at scale. This information is contained primarily within the appendices provided.

Introduction and Overview - SEATA Technology:

Australia, like the rest of the world, is currently experiencing a cost of living crisis, inflamed by concurrent energy challenges, whilst concurrently battling increasing climate commitments. Due to the , it is possible the cost of living crisis may be *ongoing*. Solutions to combat the root causes of all these issues present the most important challenges of our generation.

To help address these concurrent challenges, **SEATA Group (SEATA)** has developed a new advanced thermal technology (**already at field pilot in NSW, as pictured below**) designed to continuously produce consistently high quality solid **biochar** and a **storable**, **compressible** (transportable) and concentrated **high energy *syngas*** in a **single stage process**, capable of direct use for energy and/or to economically produce **valuable secondary derivatives** such as **carbon negative hydrogen**, food & medical grade non-fossil CO_2, and a range of renewable **circular fuels / Low Carbon Liquid Fuels (LCLF) including SAF, methanol, biodiesel, green ammonia, olefins etc, at commercial and industrial scale**. We do not produce problematic liquid products at all (tars and resins, oils etc). Instead these are promoted into gas phase for a denser higher energy syngas, which is **undiluted by air** (atmospheric nitrogen) – a critical design aspect required to lower significant plant costs (CAPEX) including, but not limited to, very expensive pollution control equipment.

This is a step change from historical syngas technologies such as air blown gasifiers. To provide an indication of the potential for **hydrogen production** via SEATA technology, as outlined further below a single 5 tph SEATA plant (<40,000 tpa dry infeed) is designed to provide **over 3000 tpa of hydrogen**….for context this is equivalent to the *entire* 2025 hydrogen production target set at a state level by the NSW Government, and at **low cost** with multiple additional co-benefits of the solid sequestered carbon co-product (biochar).

SEATA technology uses Chemical & Thermal Looping (CTL) to overcome constraints to industrial scale production of syngas and biochar historically experienced by conventional thermal treatment plants. These constraints included limited throughput and single-unity scalability, gas quality/storability, and energy balance to be a **significant net *producer*** of **dispatchable** renewable energy. For context, SEATA's syngas is designed to be around **3-4x higher energy content than conventional syngas**, providing a step change in energy balance and exportable dispatchable energy.

SEATA technology is designed for industrial scale deployment **up to 40 tph infeed** (this is ~8-40x larger than any conventional pyrolysis plants globally to date), and in theory can provide significantly larger capacities with potential to economically compete in scale with full combustion incineration (WtE) plants, but at a fraction of the cost with far improved environmental performance.

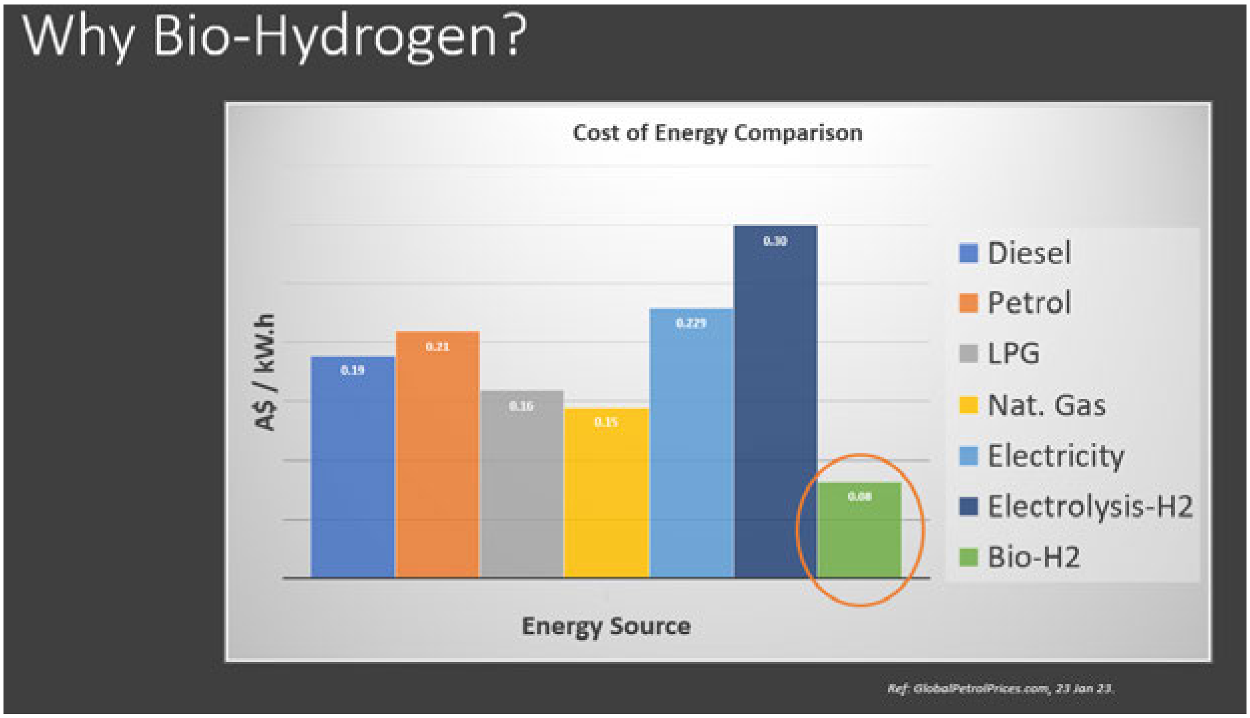
SEATA syngas is designed for use directly into *gas engines* with minimal cleanup, avoiding conventional combustion needs to *boil water* (steam) to produce electricity, **significantly increasing energy conversion efficiency** well above best available combustion technology systems (e.g. combined cycle gas turbine), and at a *fraction* of the carbon emissions of combustion/incineration, whilst concurrently also providing *drawdown* (CO_2 Removal) via sequestered solid carbon to aid progress toward Net Zero targets, at low cost. This could provide a genuine renewable and sustainable alternative superior to conventional large combustion and incineration systems for both distributed and dispatchable peaking or baseload energy, at a fraction of the cost and with many environmental, economic and social benefits. As such, SEATA technology represents a major step change in both technical and economic performance from conventional thermal technologies, and also from conventional *biological* biogas systems (e.g. AD) which can suffer from speed, stability and scalability issues resulting in marginal economic viability which can require ongoing government subsidy. A general introduction to SEATA technology is provided in **Appendix 1**, with introductory illustrations in figures below. A technical introduction is provided in **Appendix 3**.

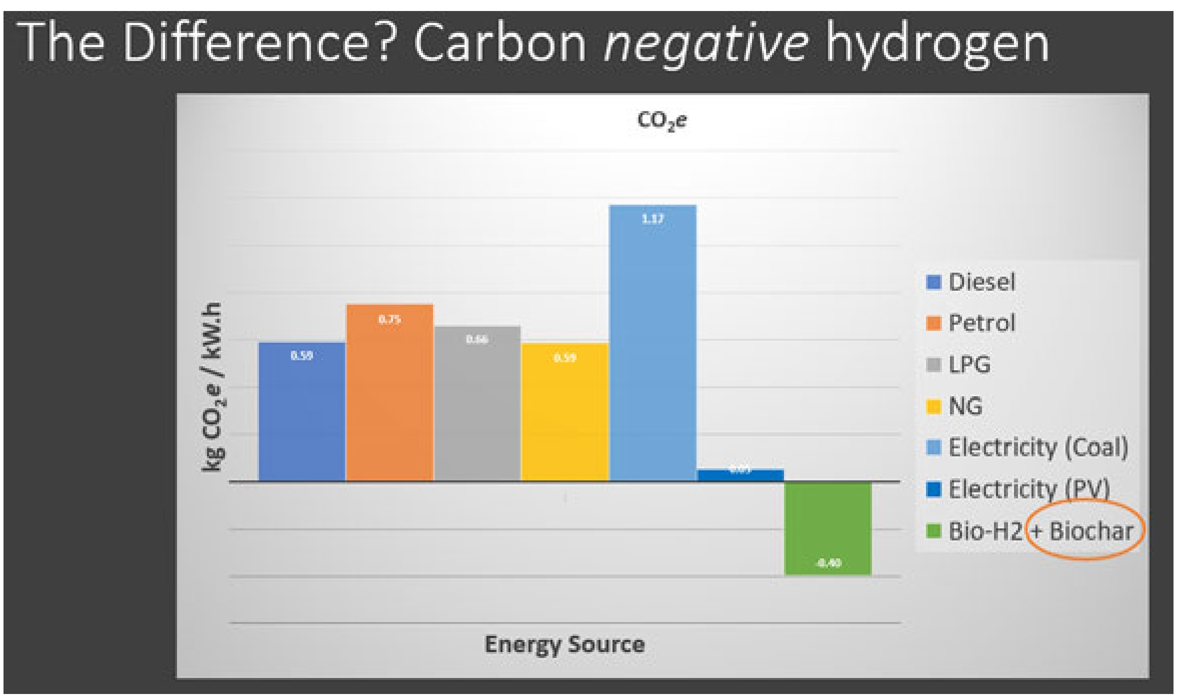
SEATA strongly supports the initiatives of the NSW Renewable Fuels Scheme and the Consultation Discussion Paper **in relation to the opportunities for bioenergy to assist decarbonisation throughout the economy**. Due to the unique nature of our Australian technology outlined above, we are also writing to inform the NSW Government of the emergence and readiness this technology which is fully approved and currently hot-commissioned at field pilot scale here in NSW, shovel ready for detailed testing ahead of potential immediate commercial deployment subject to support. A 5tph plant to deliver the NSW hydrogen 2025 target volumes could be operational within 12-18 months in such case.

Above: SEATA Pilot Facility - Clean Energy and Carbon Sequestration R&D Centre, Glen Innes NSW (New England REZ).

Below: Figures 1, 2: "Greener than Green": Carbon-Negative Hydrogen

Please also find enclosed a copy of a presentation based on one by SEATA at *Bio360* in France in January 2023, *"Hydrogen with Benefits – Carbon* ***Negative*** *H_2"*. Two notable screenshots from the presentation are shown below.





High purity syngas and hydrogen *at low cost* (at scale) facilitates competitive delivery of a range of biofuels including SAF, green ammonia and methanol among many others (refer figure below). SEATA is confident the design of our emerging technology could significantly contribute to **lowest-cost SAF** for Australia over current renewable SAF production techniques. Low cost SAF has been identified in the Consultation Roadmap as the critical challenge to enable decarbonisation of aviation transport. SEATA welcomes further discussion on how we can assist this urgently required transition which could be highly beneficial for Australia (including export).

Figure 3 (below): SEATA Syngas and Biochar from Biowastes

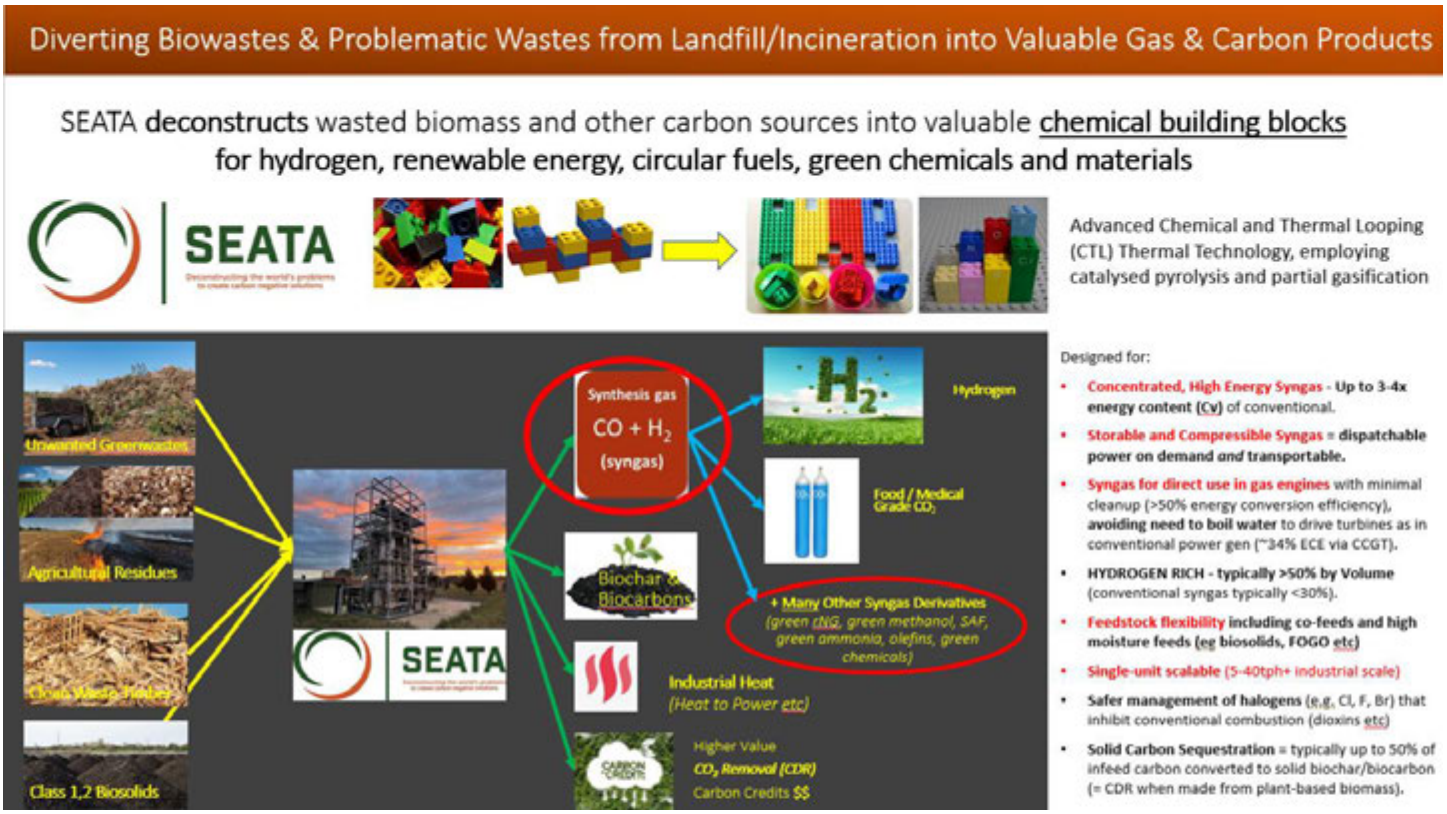


Figure 4: Syngas Derivatives – Bioenergy and Multiple Valuable Biofuels. A key factor for industrial scale deployment of *syngas to liquid fuel* pathways is the need for high purity concentrated syngas without costly cleanup, which is exactly what SEATA technology has been designed to provide. SEATA syngas has a very high energy (Cv) and hydrogen content. All hydrocarbon liquids/tars/resins produced in conventional technologies are transferred to gas phase, and the syngas has no dilution by air (air is ~80% nitrogen and only ~20% oxygen, i.e. 4/5 is costly *waste*).

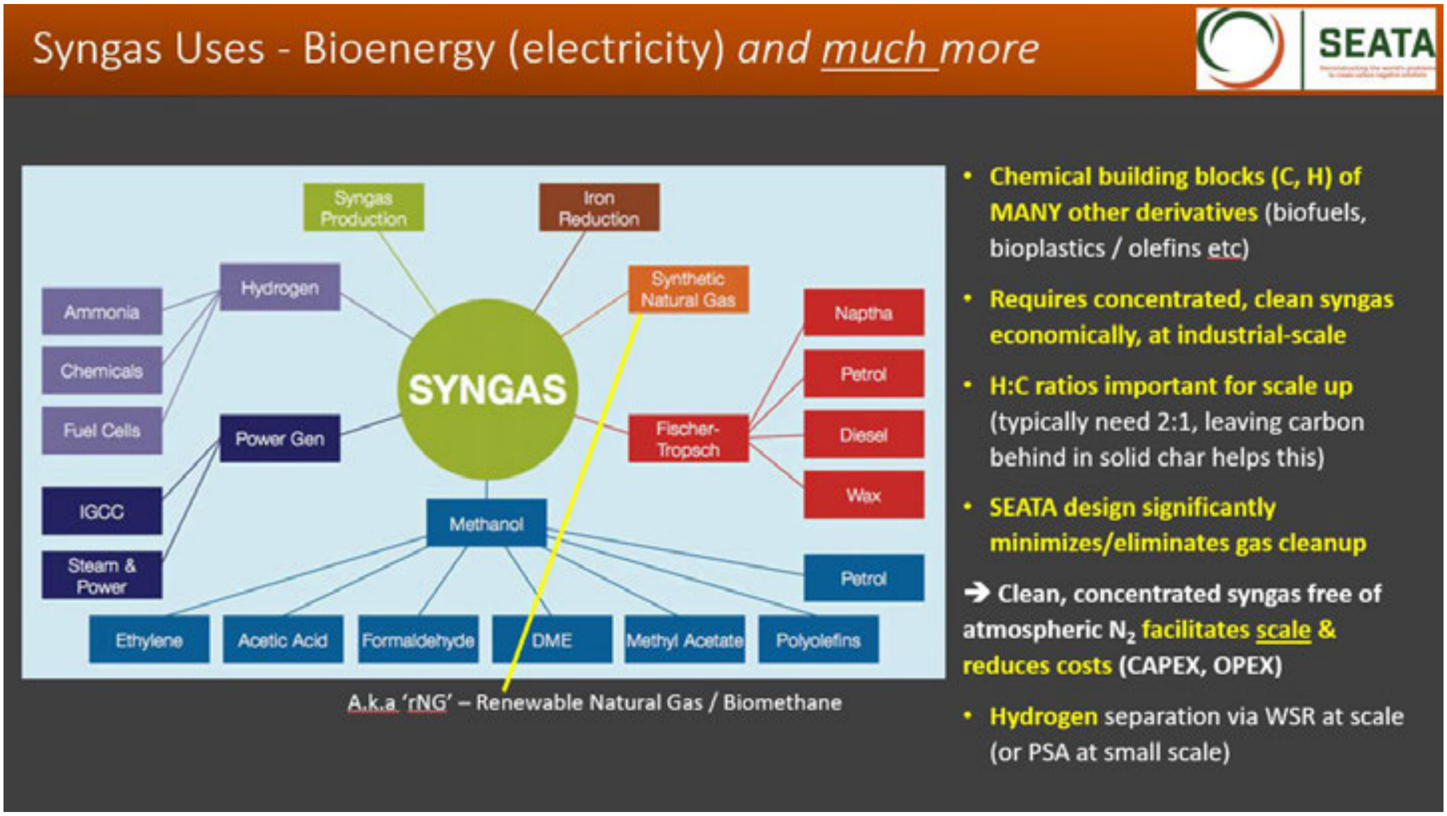


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Figure 5: SEATA production of hydrogen and syngas derivatives for renewable fuels, with carbon sequestration via char

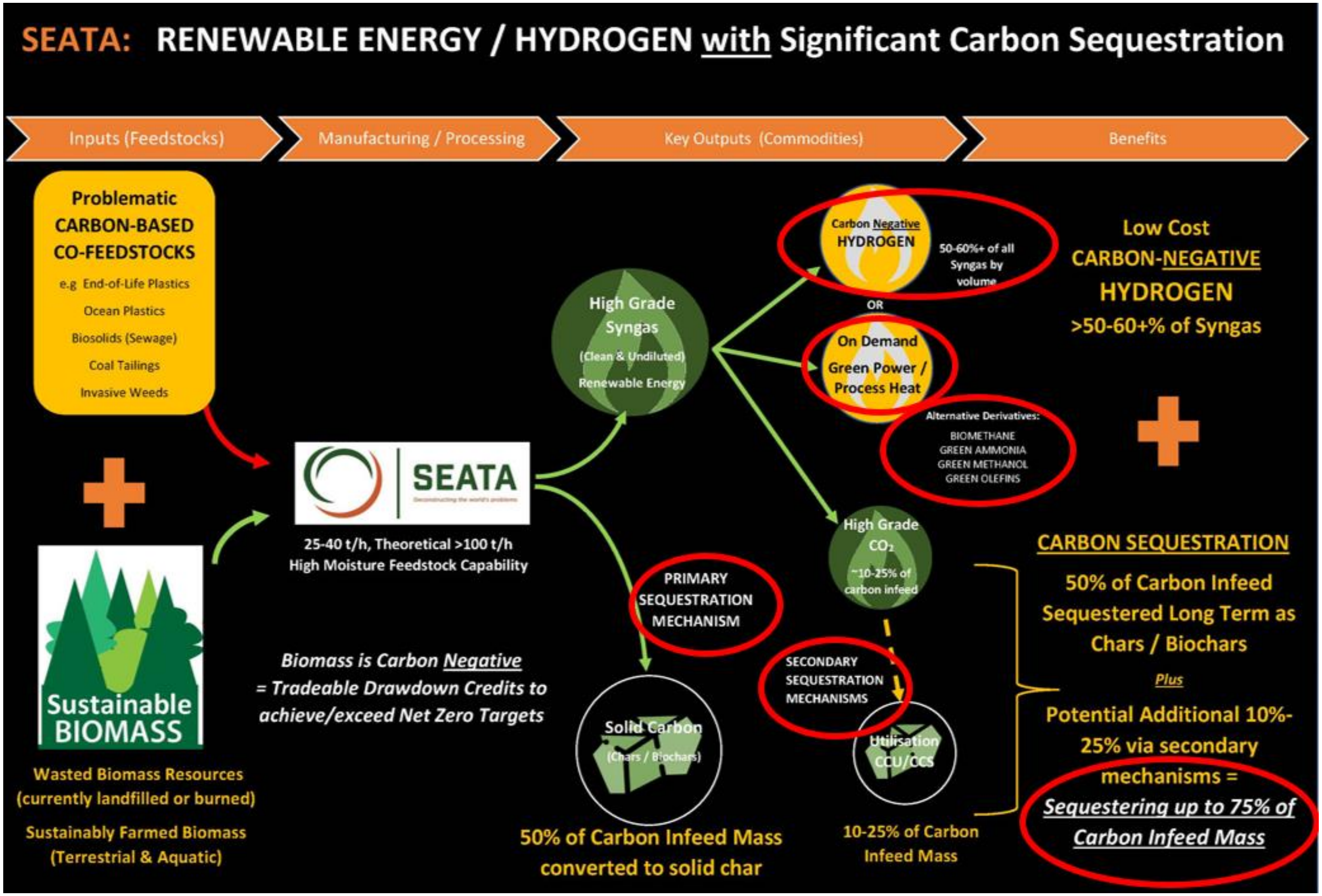

Figure 6: Economic Performance comparison of SEATA technology (CTL) against conventional thermal processes

Combustion Vs Gasification Vs Pyrolysis…Vs SEATA CTL

ECONOMIC PERFORMANCE Design Factors	Incineration* (full combustion, high excess oxygen)	Conventional Air-blown Gasification (partial oxidation) (air-blown, high N_2)	Conventional Pyrolysis (low/no oxygen)	SEATA Catalysed Pyrolysis & Partial Gasification via chemical looping (indirect O_2 transfer from air, low N_2 in syngas)
Economic Scalability & Throughput	**High** (>100's tph per module)	**Moderate** (10's tph per module)	**Low** (~1 tph per module)	**High** (5-40 tph per module current designs, with >100 tph possible in the future)
Target Application	Large Scale, centralised	Med scale centralised	Small scale decentralised	**Flexible small to large scale, central or decentral**
Energy Efficiency (*thermal energy available for other processes, i.e., generation of electricity*)	**Moderate** (50-60%), Using Rankine cycle	**Moderate** (40-65%) Two-stage combustion, plus Rankine cycle	**Moderate** (60%), **with C capture** High parasitic heat losses, only ~1/3 of the input energy available for combustion as syngas, syngas can use in combined cycle gas engines after further cleaning	**High** (70-80%), **with C capture** Lower heat losses due to scale of operation, higher process intensity, high proportion of clean syngas (~2/3 of the input feed) that is ready for use in gas engines, therefore combined cycle power generation possible
Technology Readiness	**Mature**, proven at scale	**Mature**, proven at scale	**Maturing**, proven at small scale	**Emerging** (TRL 6)
Parasitic Load Losses	**Moderate**	**Moderate**	**Moderate**	**Low**
Feedstock Moisture Content Capability (*Technical*)	**High**	**Moderate** Typically, 10-20%, max 50% feedstock pre-drying required	**Low** feedstock pre-drying to 10-20% required, as all heat transfer is indirect	**High** Typically, 20-30%, but can handle up to 70-80%, however net output energy is lowered
Linear Economy Vs Circular Economy	**Linear**	**Linear**	**Circular** (biochar & liquids, syngas for immediate energy only)	**Circular** (Full Potential) (biochar and storable syngas for derivatives/products OR energy on demand)
Feedstock Compatibility / Flexibility	**High**	**Moderate** Limited feedstocks and particle sizing is important	**Moderate**	**High** Good flexibility / versatility
Primary Reaction Temperature in commercial systems	**High** 800-1450°C	**Moderate** 750—1000°C (airblown)	**Low** 350-700°C	**Low** 350-700°C (primary reactor), all syngas from primary reactor treated to 850°C to achieve complete thermal decomposition of all volatile tars and oils.
Atmosphere	Air	Partial Air	Low /No Oxygen	Low Oxygen (O_2 supplied via chemical looping
Pressure (bar)	1	1-10	1	1 (and can be designed in future to be pressurised)
Stoichiometric Ratio	>1	<1	0	0 – 0.2
Principle Outputs (Products) *Products:*	**Heat & Combustion Products only**	**Lean Syngas**	**Char + Liquids + Rich Syngas (dirty)**	**Char + Rich Syngas (clean)**
Gases:	Combustion Products Only (*No Syngas*)	Combustible Lean Syngas	Combustible Rich Syngas	Clean Rich Syngas = economically recoverable products or energy, including energy on demand
Liquids:	No liquid products (*scrubber waste only*)	0-20% Liquid product, (*plus scrubber waste*)	Liquids (products & waste), (*plus scrubber waste*)	No problematic liquid products (*minor scrubber waste only*)
Solids:	High ash waste, No targeted products	Low char, High Ash waste (char <10% of feed by mass)	High quality but expensive biochar (~30% of feed by mass)	Low-cost, high-quality biochar (15-35% of feed by mass)
Principle Gas Components	**CO_2 and H_2O**, O_2, N_2 + Other gases e.g., SO_x, NO_x, etc.	**CO and H_2, N_2, CO_2**, CH_4, H_2O, + Other minor gases	**CO and H_2**, + hydrocarbons, H_2O, CO_2, CH_4 + Other minor gases including nitrogen compounds, dioxins and furans	**High purity H_2, CO**, CO_2 No hydrocarbons dioxins & furans H_2 content >50% by volume.
By-Products / Waste (*throughput inefficiencies*)	Toxic bottom ash or slag to dispose, High volumes scrubber waste	Toxic Bottom Ash to dispose, High volumes scrubber waste	Tars, resins, oils, pyrolysis water (plus, syngas scrubber waste)	Minimal inert scrubber waste only. No Ash/Liquids (no tars, resins, oils)
CAPEX	**High** Due to extensive off-gas scrubbing requirements	**Moderate** Scalable with moderate off-gas cleaning requirements	**High** Due to limited reactor scale-up, requiring multiple units to achieve scale of operation	**Low to Moderate** Good scalability and low gas cleaning duty
OPEX	**Moderate** High cost for gas scrubbing reagents and disposal of the resulting waste streams	**Moderate**	**High** High maintenance and high number of operating personnel	**Low**

SEATA

Deconstructing the world's problems
to create carbon negative solutions

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The combination of a high purity concentrated syngas with biochar that has sequestered around half the carbon (by mass in the feedstock) results in a syngas H:C molar ratio of ~2:1, providing suitable chemical building blocks in an economical single-stage process for synthesis to valuable secondary derivatives including a range of renewable fuels, noting conventional renewable fuel processes are typically multi-stage. When recovering hydrogen from the syngas, the valuable coproduct is high purity CO_2 (medical and food grade) with additional potential for many emerging long term 'sink' processes such as enhanced weathering, building products such as gyprock (via mineral carbonates) and other emerging applications (e.g. polycarbonate bioplastics).

When producing bio-diesel, SEATA's process offers a more efficient alternative to conventional methods with a higher crop yield to diesel ratio in a short carbon cycle with the added benefit of biochar carbon removal. **SEATA is designed for biodiesel /middle distillate production at less than $2/L at scale dependent on feedstocks.** We would be happy to discuss this further with the Government and provide further information if required.

SEATA intends to be in a position to make a Financial Investment Decision (FID) in relation to a commercial scale plant in late 2024/early 2025. With appropriate requisite support (financial, policy/regulatory and market-specific), **SEATA could be ready to produce carbon-*negative* green hydrogen at scale in 2025-26,** providing measurable and early action towards circular economy, hydrogen and other related climate and Net Zero objectives of the government.

As an example, in NSW where SEATA is based the state government has set a green hydrogen production target of **3,000 tonnes H_2 in 2025**. Based on our designs, we expect this goal could be met by **a single** 5 tonne per hour SEATA plant - our *initial* commercial plant design, prior to industrial scale deployment (refer **Figures 7, 8** below). Further, the NSW **2030-2044 target** of 66,667 tonnes of H_2 could potentially be met by just over **two (2)** 40 tph SEATA plants and potentially well ahead of the 2030-2044 target, as indicated in the two screenshots below. The process does not require any significant water inputs, and is synergistic with rural and regional Australia where water is a precious and scarce resource which complicates deployment of conventional electrolysis. Given the recent challenges experienced by electrolysis-based hydrogen projects around Australia (e.g. in the Hunter Valley NSW), the emergence of SEATA's technology could be timely to assist completion of government objectives.

In summary, SEATA has designed, patented, approved, constructed, cold and hot commissioned (high level tested) a field pilot scale plant ready for *detailed* testing. All of that has been *completely self-funded* with no government grant assistance yet to date. We've funded and built it and its ready for immediate detailed trial (e.g. ahead of the upcoming election where nuclear vs renewables appears to be a key election point, which impacts cost of living concerns in the electorate). Accordingly, **SEATA invites the Australian government to come and see the technology, and consider supporting a detailed trial at its earliest discretion to fully validate the technology for its potential to assist critical government objectives outlined earlier above.**

SEATA would welcome the opportunity to engage further with the government on the economic potential of our technology for low cost carbon-*negative* hydrogen and multiple renewable circular fuels and circular carbons (eg biochar) **rapidly** at industrial scale, and invites a meeting at your convenience. **SEATA also invites representatives of the Government to visit our pilot facility in Glen Innes.**

Figure 7: NSW Hydrogen Production Targets (OECC 2023)

Year	Gigajoule	Equivalent tonnes of hydrogen*	Megawatt equivalent**
2024***	90,000	750	5
2025	360,000	3,000	21
2026	890,000	7,417	53
2027	1,780,000	14,833	106
2028	3,200,000	26,667	190
2029	5,330,000	44,417	317
2030-2044	8,000,000	66,667	476

* Assuming lower heating value of 120 MJ per kilogram of hydrogen
** Estimated assuming 140 tonnes produced per year per megawatt of electrolyser capacity.
*** The 2024 target will not be enforced and no penalty rate will be set.

Left:

NSW Govt Targets (OECC)

Figure 8: Potential hydrogen production via SEATA technology (noting 5tph commercial plant against NSW target)

'Drawdown' Potential (CO_2 Removal) – Removing carbon from the atmosphere to address Climate Change, at scale.

Plant Infeed Size (DM):	RDSM Pilot <300 kg/h	5 tph Infeed Commercial Plant	Up to 40 tph Infeed Industrial Scale Plant
Locations	*SEATA R&D Centre, Glen Innes NSW, Australia*	C&I Site (Elsewhere) (interstate?) (TBC)	Industrial Site (TBC)
Potential Design Infeeds (DM) *(@7,500 hrs/yr, ~85% use)*	2,250 tpa	37,500 tpa	300,000 tpa
Potential Carbon Yield *(@~25% yield per tonne of infeed)* *(can customize to <10 to >35%)*	~560 tpa	Up to ~9,400 tpa	75,000 tpa *(current total Aust production <20,000 tpa)*
Indicative Drawdown Via Biochar *(using plant biomass feeds only)* *(+ ~25% more if CO_2 gas also sunk into CCUS (commercial scale)*	**~1,400t** CO_2e/yr *(assuming net ~2.5 tCO_2e per tonne of biochar after LCA)*	Up to **23,500t** CO_2e/yr *(assuming net ~2.5 tCO_2e per tonne of biochar)*	Up to **187,500t** CO_2e/yr *(assuming net ~2.5 tCO_2e per tonne of biochar)*
Design H_2 Yield (as % of infeed)	Flared Initially, (expected ~7% by mass)	7-10% by mass (recovery via PSA or WSR)	**10% by mass** (Recovery eg via WSR)
Potential Annual H_2 Yield *(tpa, uncompressed)*	Nil (no energy recovery)	**2625 – 3750 tpa**	**30,000 tpa**

- **SEATA technology has potential to remove CO_2 from the atmosphere at very significant rates to combat climate change whilst *concurrently* also significantly reducing/avoiding new emissions by assisting energy and fuel transition.**
- Scenarios are theoretical potential pending approvals, funding and successful deployments. Bankable Feasibility Studies to be completed following pilot trials, ahead of commercial plant.

Direct Air Capture + CCS (DACCS) Context:
Project Orca Iceland (operational) = **4,000 tpa (8 x 500 tpa units)**
Project Mammoth (const) = **36,000 tpa (72 x 500 tpa units)**

Left:
SEATA Design Targets

Figure 9: Example scenarios to address green waste residues (e.g. compost 'overs' (reject), PFAS/plastic impacted etc)

Example Potential Scenarios For Urban Green Waste to Bio-Hydrogen

(A) Pilot Scale Demonstration (Hydrogen Trial): Indicative example for a local government area

- SEATA Field Pilot Plant (Glen Innes R&D Centre): Design Annual Infeed (dry) = ~2,250 tpa infeed (@85% utilization)
- SEATA Pilot Scale Potential Annual Hydrogen Yield = ~7% of 2,250 tpa infeed via PSA = **157.5 tpa of hydrogen**
- Council Hydrogen Garbage Truck Demo H_2 Requirement = **~35 tpa of Hydrogen** (~22% of SEATA's pilot scale annual yield)

(B) Indicative Example @ Commercial Scale: 5 tph SEATA Plant *(~120 tonne / day, ~3x 40t truck loads)*

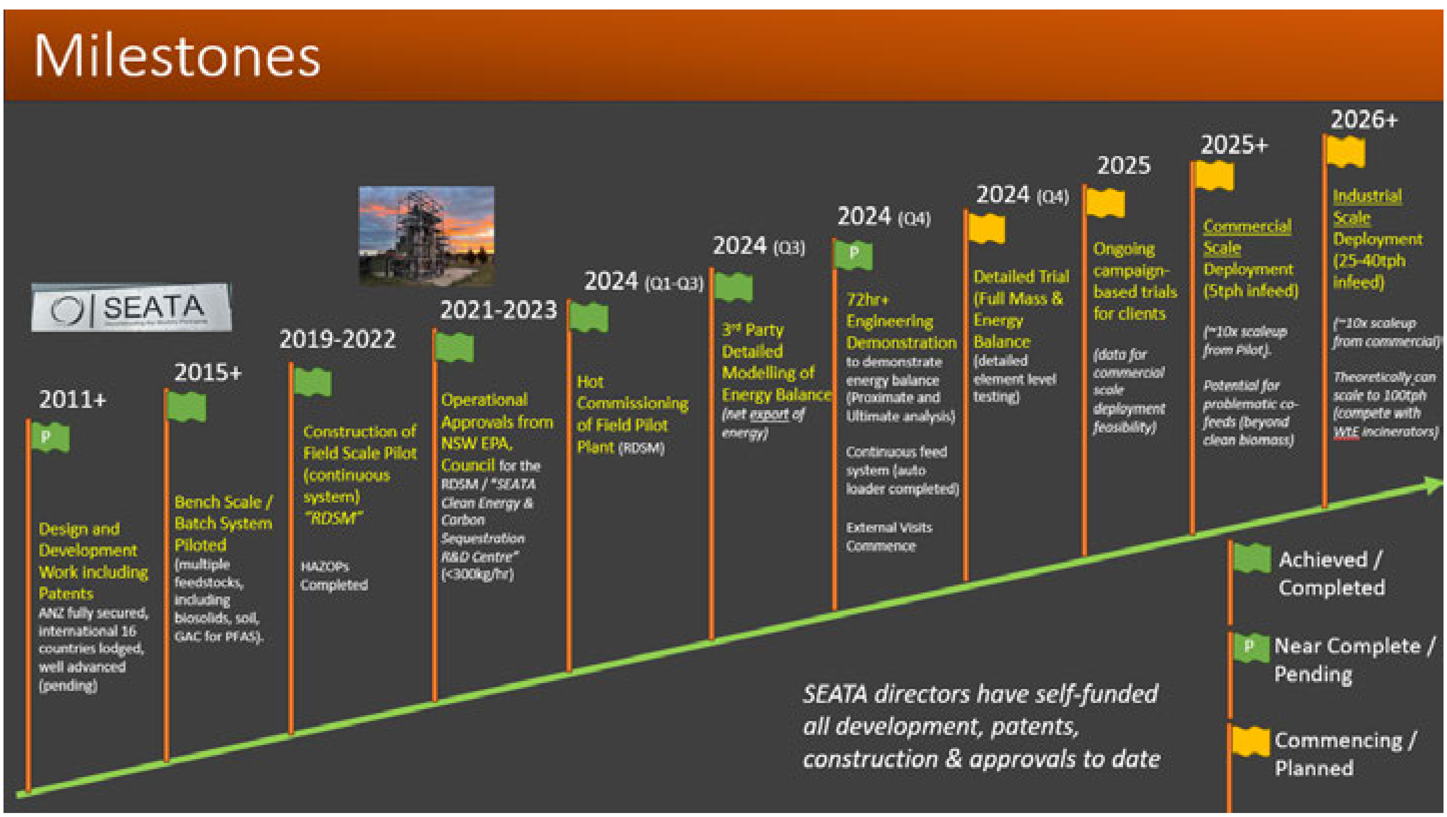
- **~37,000 tpa design infeed** (@85% utilization)
- **~10 tonne / day H_2 (via PSA)** *(current market value >AUD$5,000/t)*
- **~19 tonne / day Biochar** *(current market value ~AUD$600/t)*
- **~19,800 tonnes CO_2e / year Carbon Draw Down** *(current CDR credit value USD>$100/t CO_2e)*

Example Context – Council LGA Green Waste Residues (alone):

- Green waste Generation (Example Council Area) = ~49,000 tpa (dry tonnes per annum)
- ~40-50% Residues (beyond current management/market capacities) = **<24,500 tpa feedstock (to SEATA plant)**

➔ Potential H_2 recovery from 24,500 tpa greenwaste infeed (e.g. via PSA) = ~7% of 25,000 tpa infeed
= 1,750 tpa H_2 hydrogen (from unmanaged greenwaste residues alone, excluding other potential feedstocks)

Figure 10: Staged Development of SEATA Technology – Key Milestones



SEATA has separately provided detailed responses and recommended actions for Circular Economy Opportunities within our separate **Joint Submission** with the Global Product Stewardship Council and Catalyst Environmental Management (please refer for details). **Additionally, we suggest the following recommendations could enhance Circular Economy and accelerate decarbonization efforts:**

- **Increase government procurement** of low carbon products and services (including those using CDR) across the economy, including transport and associated infrastructure. Government created demand through targeted decarbonisation mandates reducing fossil carbon content would drive confidence and certainty for a new biochar/LCLF/biofuels industry. Design of a mandate, low carbon fuel standard, targets and/or other demand options should all include requirements for a certain proportion of fuel use be drawn from *Australian-produced* LCLF/biofuels - creating demand for Australian produced LCLF within Australia would be the main reason for developing a local industry, 'Made in Australia' for Australia. At present the vast majority of aviation fuel and diesel is *imported* (90% and 87% respectively) – it would be prudent to strategically target a progressive reduction of reliance upon imports (perhaps staged). Perhaps consider 40% reduction in the initial 5 years followed by 30%, 20 % and finally 10% over the following decade to becoming a net *exporter*.

- **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.
    - **Incentivize ER and CDR achievement**, with base line incentives for minimum targets (with support granted where increased actions are *completed* toward targets), and higher incentives for above-target emission reductions and CDR.

- **Adopt the proposed Biochar ACCU Methodology** which could help government agencies and private sector companies to procure low carbon CDR products and services (including carbon *negative* hydrogen and LCLF) that can measurably assist their decarbonisation and Net Zero commitments (government agencies would benefit highly from ACCUs as policies may inhibit use of Voluntary Carbon Market credits, unlike the private sector).

- **Develop enhanced mechanisms to provide low-cost capital** into the renewable fuels, biochar bioenergy sector. In particular for new and emerging innovation to aid commercialization. This should include a range of:

    - low/no interest loans

    - advocation for significant and rapid tax incentives (state/commonwealth)

    - grants with alternatives to matched co-funding, recognition of existing capital investment by proponents and ability for founding directors to work on grant projects, and alternatives to academic partnership requirements which currently inhibit private sector take-up. Grant funding currently appears to dominate into inefficient long term research-driven programs compared to more efficient, outcomes-driven private sector demonstration and commercialization. Increased focus on the latter for balanced funding could potentially realise more rapid commercialization for genuine decarbonization outcomes for Australia.

- **Offtake support** - It would be most advantageous if proposed projects could be guaranteed commercial viability/offtakes *for a stipulated timeframe* through government support mechanisms ("cradling"). Feedstock price and offtake price could be set to ensure commercial viability to encourage further development and scale up. Projects would still need to raise capital but could do so in an environment of *certain profitability for a set timeframe* – recognising a necessary timeframe of steady returns on the capital outlay. Government procurement could also be integrated and utilized to help facilitate this. Sound technologies, well managed would thrive in such environment and advance relatively quickly, shining a light on the best pathways and technologies.

- **Support commercial scale demonstrations in all states** of low carbon renewable fuels, products and services (including those using CDR) throughout the economy.
  - **SEATA technology is well positioned to facilitate demonstration and commercial scale up of renewable fuels and soil and non-soil applications of biochar/biocarbons requiring high volumes of char at lower cost** (currently a supply-limited and cost-limited market), maximizing CDR outcomes for Australia. For soil applications, we believe that composting, spraygrass/hydromulch, and agricultural uses are the largest available markets. For industrial applications (industrial grade biochars), we believe that roads (particularly sub-base stabilisation) are currently the largest available *long-term* sink, with concrete rapidly emerging (particular non-structural uses initially until standards are certified). Biocarbons to displace fossil-carbon in steel production (avoidance ER, no long-term CDR) is currently the largest demand overall. High-volume char markets require low cost supply to be competitive. Biochar systems which **maximise the value of syngas co-products** (particularly through high value derivatives such as biohydrogen, methanol, biodiesels, SAF etc) have the highest potential to deliver this. SEATA technology has been specially designed to provide this. Government support to both production and use of biochar can significantly accelerate scale up and hence ER and CDR outcomes for Australia (along with all the other benefits these provide).

- **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 for associated national/International standards and certifications where relevant.

- **Establish a climate and sustainability ranking methodology** for circular fuels technologies (eg LCLF/biofuel) to facilitate comparison on climate and sustainability performance. This should prioritise highly circular, regenerative and carbon-negative technologies over linear, low / carbon-neutral or carbon-positive approaches, and reward industry innovation toward higher priorities.

- **Consider and support additional low-cost feedstocks for Circular Fuels / Low Carbon Liquid Fuels (LCLF) –**
  - One area that shouldn't be ignored is the opportunity for low-cost feedstock supply on marginal land, farming through a regenerative cropping methodology (see related comments immediately below). A whole of industry approach including feedstock security will be required for a successful LCLF industry. That said incentives should be short term and easy to administer and access, a *per-litre-produced* approach may present the simplest option.
  - Biochar bioenergy technologies can help widen the available feeds for renewable fuel generation, including green waste (aiding other government objectives for diversion from landfill); woody weeds and woody biowastes (lignin-based feeds) releasing infested lands for higher value use; purpose-grown biocrops on marginal lands that are not currently croppable (such as the successful NSWDPI native woody biomass trials under the Biomass for Bioenergy program which has significant potential to help regenerate marginal lands); and seaweeds and algae as fast growing regenerative feedstock.

- **Support and enhance awareness and education** of low carbon products and services (solids, liquids and gases) using biochar CDR and bioenergy, including case studies and business cases to leverage and showcase commercial scale demonstrations (noted separately above). Support for public messaging **to build 'social licence'** regarding the benefits of local circular fuels/LCLF/biohydrogen/biochar industries that includes regenerative farming, marginal land cropping, jobs for rural Australia, cleaner plane travel and independent **fuel security and resilience** for Australia.

- **Advocate for re-direction of existing *fossil fuel* rebates** (e.g. fossil diesel rebates) from major fossil industries into renewable LCLF/biofuels, biohydrogen and biochar could significantly assist with supporting uptake of these sustainable low carbon commodities in lieu of traditional fossil fuel. Different rates of incentive could be utilized to prioritise alignment and timing if/as desired (e.g. biodiesel and biohydrogen, then SAF, then others). These should be mindful of the same technologies also producing the chemical building blocks for many 'green chemicals' (e.g. methanol, olefins) for other sectors too which could be enhanced (or inhibited) and should be concurrently considered.

- **Support ANZBIG and the *Australian Biochar Industry 2030 Roadmap*** – 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.

SEATA's vision for Australian rural towns is a genuinely *sustainable* economic and employment future via a network of distributed renewable circular biofuel, bioenergy and bio-batteries that utilize agricultural and other organic wastes (including from towns themselves) to produce networks of decarbonization, complementing centralised utility-scale energy systems in the cities where SEATA technology can also significantly assist decarbonization efforts. SEATA has held talks with a small number of rural town councils (including our local council) who have been very receptive to these concepts and recognise the value a circular fuel/LCLF and biochar industry can add to a rural town. SEATA invites further engagement with the Australian Government toward this vision.

We would also like to draw attention to the Government of the related importance of the ***Australian Biochar Industry 2030 Roadmap*** which was recently launched by the ANZ Biochar Industry Group (ANZBIG). **Biochar facilitates carbon-*negative* hydrogen sustainably, with multiple co-benefits across all sectors of the economy, with particular benefits to rural and regional Australia** consistent with multiple NSW and Commonwealth government policy objectives**.** The Australian Biochar Industry 2030 Roadmap has significant potential to facilitate many related aspects for the production of renewable fuels and industrial scale biochar and biocarbons (circular and sustainable carbon) that can assist many hard to abate sectors including roads/transport, agriculture, concrete and steel/metallurgy.

A list of Appendices to our submission is provided further below.

We appreciate the minor extension in timing granted for this submission. SEATA would be happy to clarify or expand on any aspects if/as required.

A standing invitation is extended to the Productivity Commission to visit our pilot facility in northern NSW.

Please do not hesitate to contact us with any queries at all.

Yours sincerely,

Craig Bagnall	John Winter
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Appendices: **(all provided commercial in confidence)**

1. **Appendix 1:** SEATA Technology **General High-Level Introduction** (Nov 2024)
2. **Appendix 2:** SEATA Submission to NSW Treasury (Dec 2023) – **Renewable Fuels Scheme (incl Hydrogen)**
3. **Appendix 3:** SEATA Technology - **Technical Introduction** (May 2024)

Further detailed information (including more detailed technical introductions regarding how the system works) is available upon request.