Tasmanian Renewable Commodity Synthesis I/O Review

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BELL BAY
ADVANCED
MANUFACTURING
ZONE

Contents

List of Figures

List of Tables

1 Executive Summary

This review provides input/output (I/O) analysis for a proposed Tasmanian Green Hydrogen Hub (TGHH) at Bell Bay, focusing on green methanol production through renewable-powered water electrolysis. The analysis quantifies resource requirements, examines infrastructure readiness, and evaluates operational feasibility for a 250MW facility while considering local context and scaling potential.

Key Findings:

Resource Requirements

- Annual electricity consumption: 2,102,400 MWh
- Total *minimum* water requirement: 1,860 ML/year (575 ML for electrolysis, 1,285 ML for evaporative cooling)
- Biomass consumption: 259,832 tonnes/year
- Capital investment: AUD 980 million (*minimum*)

Production Outputs

- Green methanol: 231,434 tonnes/year
- Oxygen by-product: 365,038 tonnes/year
- CO2 production: 291,623 tonnes/year

Infrastructure Assessment

The Bell Bay Advanced Manufacturing Zone (BBAMZ) demonstrates strong foundational capabilities:

- Existing water infrastructure through Curries River Dam (12,000 ML capacity)
- Planned Tamar Irrigation Scheme adding 12,000 ML/year capacity
- Deep-water port access for export
- Established forestry industry for biomass supply
- Strong renewable energy foundation with hydro, wind, and solar resources

Competitive Advantages

1. Unique conglomeration of required infrastructure within BBAMZ
2. Tasmania's net-zero energy status through hydroelectric generation
3. Strategic port location for Asian markets

2 Overview

This document intends to provide a quantified, high-level, preliminary input/output overview for a ”Tasmanian Green Hydrogen Hub” (TGHH) in Bell Bay. Methanol synthesis utilising renewable powered water electrolysis for hydrogen production is investigated, with the objective of providing insight into the operational characteristics of a renewable commodity synthesis scheme in northern Tasmania, informing supporting infrastructure requirements, areas for industry collaboration within the Bell Bay Advanced Manufacturing Zone (BBAMZ), and the opportunity to scale the emerging renewable commodity industry in Tasmania.

Tasmania is uniquely positioned to become a global leader in the production of green hydrogen and derivative fuels via renewable powered water electrolysis. The largest national hydroelectric scheme, proposed solar & wind developments, reliable water supply, and deep-water port access to synthesis sites positions northern Tasmania’s Bell Bay as a competitive renewable fuel production hub. In the production of renewable fuels, electricity price contributes a significant majority of operational costs. Unpredictable market prices prove to exacerbate the volatile commercial feasibility of such projects with volatile conditions of both the generation costs and sale price of a plant’s produce making long term financial viability difficult to predict.

Consideration of the I/O characteristics will provide a preliminary review of required infrastructure to support the scalability of the scheme as well as an outlook on the quantity of generated resources, and the possibility for collaboration in the surrounding industry. The efficiency of renewable hydrogen production can be used to relate provided power to hydrogen production and is cross-validated with a peer-reviewed journal submission [1].

Whilst this document strives to provide accurate data for input/output characteristics by independently validating applied literature against first principles it must be understood that the outcomes of this study are estimations and a practical implementation may differ significantly due to numerous sensitivities of such a scheme subject to market conditions regarding both system inputs and outputs. The applied techno-economic analysis [1] is particularly subject to this disclaimer, as the referenced study details a scheme in the European Union as of economic conditions three years ago at the time of the production of this document. It is intended that the outcomes of this study will be of the same order of magnitude and ideally within a reasonable percent error of a realised implementation.

3 Tasmanian Green Hydrogen Hub Foundational Operational I/O Metrics

This section introduces and investigates the operational characteristics of the TGHH considering resource requirements of a renewable fuel synthesis scheme. Pratschner et al. [1] detailed the operational I/O & financial metrics of a green methanol plant using alkaline water electrolysis hydrogen production in commendable detail. Findings implicate the majority operational cost contributors to be, in descending order: Electricity, Biomass, electrolysis catalyst and the membrane electrode assembly. Other operational expenses are found to be relatively insignificant, even combined.

Electricity prices largely dominate operational expense, to be expected, as renewable fuel synthesis plants fundamentally convert generated renewable energy into green energy vectors for storage, transportation, and ultimately for use in derivative production, reconversion to electricity or mechanical work via combustion engines. Biomass contributes the next largest share of operational expense, used to produce carbon dioxide for the synthesis of methanol via combination with green hydrogen. As a major chemical constituent of the commodity, it is also predictable that biomass makes up a significant cost percentage of operational expenses. Electrolysis operational costs make up a considerably smaller albeit remarkable share of operational expense. Although alkaline electrolysis generally demonstrates less cost prohibitive degradation compared to other electrolysis methods the acidic nature of hydrogen proton interactions and high oxygen environments instigates unfavourable and unavoidable chemical interactions with the apparatus.

3.1 Renewable Energy

Tasmania's hydroelectric scheme, already accrediting the jurisdiction as a net-zero energy producer, alongside further proposed renewable developments in wind, solar and battery energy storage systems provides a unique opportunity to lead the global renewable energy effort in connecting an already net-zero grid to a large-scale renewable fuel synthesis plant. Such a development implemented efficiently has the potential to provide immense economic benefit to the local region and state. Hydrogen production via renewable powered water electrolysis is at the highest levels of value chains within the global renewable economy, direct applications in transport, manufacturing and as an energy storage medium are achievable with current technology, the synthesis of derivative fuels and use of green hydrogen for ammonia production further strengthen the position for local manufacturing considering agriculture as a key pillar of Tasmanian economic success. Renewable fertilisers and fuels for agricultural applications produced locally would prove resilient to volatile fossil fuel markets.

3.2 Biomass

Tasmania's well established forestry industry produces biomass suitable for producing carbon dioxide required for green methanol production. Biomass, including non-prime waste product, can be combusted to form carbon dioxide, or reacted with oxygen to form syngas constituting carbon dioxide, monoxide and some hydrogen after which carbon dioxide is consolidated and combined with renewable generated hydrogen to form green methanol.

The conglomeration of infrastructure and industries in the BBAMZ provides a uniquely competitive position. Available biomass, deep-water port access, and renewable energy developments in solar and wind firmed by the hydroelectric scheme frame the zone as highly competitive in the synthesis of green methanol.

4 Independent I/O Modelling Methods

This review considers the I/O characteristics for a Tasmanian Green Hydrogen Hub through both a direct electrolysis efficiency relationship and by application of findings from a peer reviewed journal submission on the financial metrics of such a scheme. Results of estimations for operating characteristics regarding consumption and production are within ten percent difference likely validating estimations are certainly within the order of magnitude that would be demonstrated in practical application.

4.1 Application of Direct Alkaline Water Electrolysis Efficiency for I/O Quantification

For modelling the inputs and outputs of a green hydrogen plant, the efficiency of alkaline water electrolysis can be directly related to proposed plant energy consumption to outline hydrogen production mass hence resource consumption and production such as oxygen production and water input requirements. Water consumption calculated by the sum of output product mass (hydrogen, oxygen) provides the mass value of ultra pure water required from which the value of non-purified water supply required can be determined.

The direct efficiency relationship considers the three low temperature electrolysis methods in alkaline, proton exchange membrane, and alkaline exchange membrane water electrolysis systems. Alkaline water electrolysis is the most commercially mature technology with lower-cost membrane electrode assemblies and catalysts, although it demonstrates lower efficiencies and hydrogen purity in comparison to proton-exchange membrane systems. Alkaline exchange membrane electrolysers have shown promise in small-scale applications because of improved safety with low electrolyte concentrations and reduced capital cost, but for large-scale systems the poor efficiency is highly cost prohibitive.

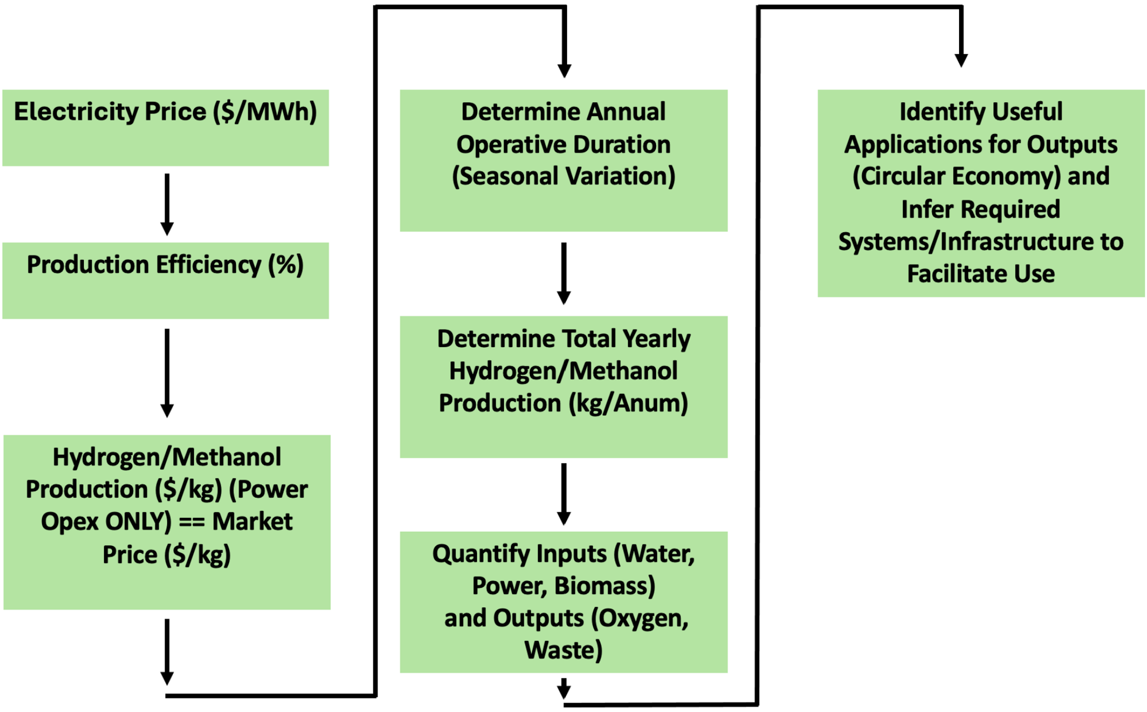

Figure 1: Flowchart of Electricity Consumption to Hydrogen Production through Efficiency Relationship

Table 1: Electrolyzer Efficiency and Output Data

PEM Efficiency	AWE Efficiency	AEM Efficiency
80%	70%	50%

Electrolyser Size (MW)	Annual Energy Consumption (MWh)
10	87,600
50	438,000
100	876,000
250	2,190,000
500	4,380,000

PEM H2 (MWh/Year)	AWE H2 (MWh/Year)	AEM H2 (MWh/Year)
70,080	61,320	43,800
350,400	306,600	219,000
700,800	613,200	438,000
1,752,000	1,533,000	1,095,000
3,504,000	3,066,000	2,190,000

Electrolyser (MW)	PEM H2 (kg/year)	AWE H2 (kg/year)	AEM H2 (kg/year)
10	2,102,610	1,839,783	1,314,131
50	10,513,051	9,198,919	6,570,657
100	21,026,102	18,397,839	13,141,314
250	52,565,256	45,994,599	32,853,285
500	105,130,513	91,989,198	65,706,570

Electrolyser (MW)	PEM O2 (kg/year)	AWE O2 (kg/year)	AEM O2 (kg/year)
10	16,687,472	14,601,538	10,429,670
50	83,437,362	73,007,692	52,148,351
100	166,874,725	146,015,384	104,296,703
250	417,186,812	365,038,460	260,741,757
500	834,373,625	730,076,921	521,483,515

Electrolyser Size (MW)	PEM H20 (kg/year)	AWE H2O (kg/year)	AEM H20 (kg/year)
10	18,790,082.76	16,441,322.42	11,743,801.73
50	93,950,413.81	82,206,612.08	58,719,008.63
100	187,900,827.62	164,413,224.16	117,438,017.26
250	469,752,069.04	411,033,060.4	293,595,043.15
500	939,504,138.08	822,066,120.82	587,190,086.30

4.2 Application of Peer Reviewed Journal Submission of Green Methanol Plant Techno-Economic Analysis

'Techno-economic assessment of a power-to-green methanol plant' [1] authored by Pratschner et al. forms the basis of system I/O and high level cost estimates for a renewable commodity hub at Bell Bay. Resource I/O, Capital investment and operational expenditure is detailed for a 50MW green methanol synthesis scheme in the European Union considering 2022 financial conditions. The proposed system operates as would a scheme in Bell Bay with the carbon dioxide produced by biomass combustion from forestry waste combined with renewable hydrogen generated from water electrolysis to produce methanol. This investigation extrapolates the operational costs considering resource consumption and production to estimate how an implemented strategy may look in a Tasmanian green hydrogen hub development.

The application of this research to predictions around a Bell Bay hydrogen industry has caveats. Firstly, the cited study investigates conditions in the European Union, although the modern global economy largely shares common goals, challenges, opportunity and volatility the local economic conditions certainly introduce variance. Secondly, the study is now three years old which may not completely accurately capture the realised costs, both capital and operational, of a practical implementation at the current time as the pipeline of a TGHH approaches the twenty-thirties. Although, an alternative view could be that considering the scope, accuracy and direct relevance of this study to the Bell Bay developments the relatively recent post pandemic publication is likely still highly indicative of an implementation today. Thirdly, it is likely that a larger scale development in Tasmania than that proposed in the referenced study would benefit from an economy of scale perspective in reducing capital investment.

The process schematic, consumption and production rates for renewable methanol synthesis with 49.6 MW powered water electrolysis are shown in figure 2. The plant is assumed to operate continuously, other than maintenance. Rates are extrapolated over the ratio of electrolyser consumption as all other rates within the plant are directly correlated.

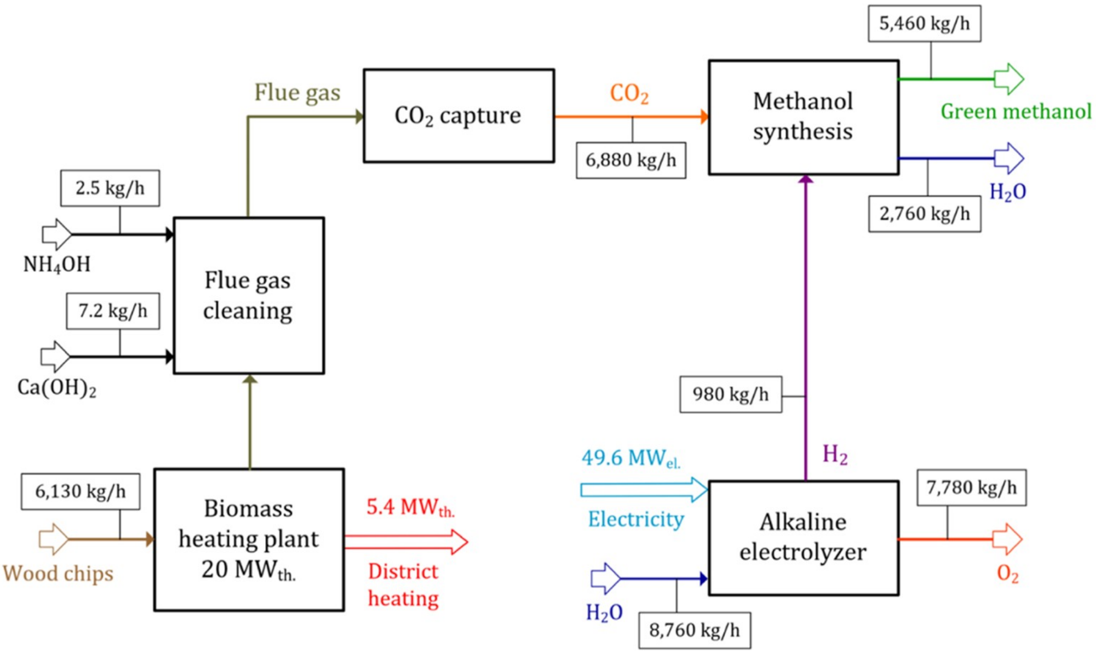

Figure 2: Plant Schematic for Renewable Methanol Synthesis [1]

The tabulated hourly resource consumption and production for the referenced system and linearly extrapolated data for a 240MW powered electrolysis plant is shown in table 2. The production rates for the plant are inherently related by the chemical processes and therefore scale with complete accuracy to the initial techno-economic analysis for I/O.

Table 2: Plant Input and Output Data for Electrolysis, Carbon Process, and Green Methanol Synthesis

Carbon Process	**Plant 1 (49.6 MW)**	**Plant 2 (240 MW)**
Inputs		
NH4OH (Cleaning) (kg/h)	2.5	12.10
Ca(OH)2 (Cleaning) (kg/h)	7.2	34.84
Wood Chip (kg/h)	6,130	29,661.29
Thermal Energy (MW)	20	96.77
Outputs		
CO2 (kg/h)	6,880	33,290.32
Thermal Energy (MW)	5.4	26.13

Water Electrolysis	**Plant 1 (49.6 MW)**	**Plant 2 (240 MW)**
Inputs		
Electricity (MW)	49.6	240
H2O (kg/h)	8,760	42,387.10
Outputs		
Hydrogen (kg/h)	980	4,741.94
Oxygen (kg/h)	7,780	37,645.16

Green Methanol Synthesis	**Plant 1 (49.6 MW)**	**Plant 2 (240 MW)**
Inputs		
CO2 (kg/h)	6,880	33,290.32
Outputs		
Green Methanol (kg/h)	5,460	26,419.35
H2O (kg/h)	2,760	13,354.84

Table 3 provides annual input and output resource metrics for a plant with 240MW of water electrolysis assuming continuous plant operation over an annual duration, in practice a plant requires maintenance downtime and therefore true rates would be lower. The referenced consumption productions rates [1] extrapolated by a ratio of plant size provides the rates for a scaled up system, as proposed for a TGHH in Bell Bay.

Table 3: Plant Input and Output Data for 240 MW Electrolysis Annual Production

Carbon Process	**Plant 2 (240 MW)**
Inputs	
NH4OH (Cleaning) (kg/year)	105,967.7419
Ca(OH)2 (Cleaning) (kg/year)	305,187.0968
Wood Chip (kg/year)	259,832,903.2
Thermal Energy (MWh)	847,741.9355
Outputs	
CO2 (kg/year)	291,623,225.8
Thermal Energy (MWh)	228,890.3226

Water Electrolysis Hydrogen Production	**Plant 2 (240 MW)**
Inputs	
Electricity (MWh)	2,102,400.00
H2O (kg/year)	371,310,967.74
Outputs	
Hydrogen (kg/year)	41,539,354.84
Oxygen (kg/year)	329,771,612.90

Green Methanol Synthesis	**Plant 2 (240 MW)**
Inputs	
CO2 (kg/year)	291,623,225.8
Outputs	
Green Methanol (kg/year)	231,433,548.4
H2O (kg/year)	116,988,387.10

5 Bell Bay Green Commodity Hub Water Consumption

Water must be highly purified prior to use in electrolysis; even minimal electrolyte concentrations in contact with cell materials accelerate degradation, reduce efficiency, and lower the quality of the hydrogen produced. The purification of feed water for electrolysis therefore raises the gross water consumption as compared to idealised water consumption based purely on hydrogen production as a function of power consumption and efficiency.

For a 250MW electrolyser, under continuous operation, the annual ultra-high purity water consumption for electrolysis alone, without cooling or general facility usage, would be on the order of 400 million kg or litres per year, equivalent to 400 thousand metres cubed or 400 mega litres annually.

The volume/mass loss of water purification is difficult to precisely quantify without engineering design and apparatus specifications due to the high variability between systems. Highly water efficient purification would increase capital investment and likely maintenance cost which may be less economical than a less water efficient purification system if water is supplied at a low cost. A generous 1.4m^3 per 1m^3 of ultra-high purity water concession is assumed as would be required for ground water to electrolysis use, this recovery rate is assumed from Henrik Tækker Madsen's article 'Water treatment for green hydrogen: what you need to know' [3] .

6 Thermal Management, Heat Rejection & Water Consumption

Thermal management and water consumption are a critical consideration in engineering design, supporting infrastructure requirements, and financial feasibility of a green hydrogen and derivatives synthesis project strategy. Sub-processes within a renewable fuel synthesis plant, including water electrolysis, biomass conversion, compression, and power electronics, produce heat that must be rejected from the plant. Plant cooling has two extremities of design philosophies, wet or dry cooling, with a myriad of configurations in between.

Wet cooling capitalises on the phase change of water between liquid and gas to first exchange heat with the water due to the temperature gradient between plant and fluid. The temperature gradient draws heat out of the system and once water reaches the temperature of evaporation the thermal energy absorbed by the water from the plant disperses into the atmosphere and is physically removed from the apparatus.

Dry cooling exchanges heat with a thermal sink, be it the atmosphere through air-finned coolers or a body of water with a heat exchanger. Whilst dry cooling still uses internal working fluid, the process is considered 'dry' as no mixing of working fluids occurs.

The implications of design philosophy dictate that a dry cooling system will require greater power consumption due to fan motor draw and energy to pump internal working fluid through the heat exchanger. However, a wet cooling plant will need significantly greater water supply due the evaporative nature of the cooling. Current economic conditions naturally favour plants that minimise electricity consumption due the considerable contribution to operational expenditure, as such plants situated in areas of abundant,low cost water supply show the greatest financial viability.

Given that in current practical implementations of a renewable commodity synthesis process, the product is not cost competitive with traditional methods of non-renewable production, further increasing production cost by implementing dry cooling does not support the financial viability of developments in this emerging industry. Although the production cost of renewable fuels is highly dependent on electricity cost and usage, the potential to reduce water usage through dry cooling methods at higher operational and capital expenditure would facilitate the development of much more electrolysis hence hydrogen and derivatives production.

Matjaž Matošec quantifies the power and water consumption parameters in the article 'Thermal management in green hydrogen production: design considerations' [2]. The Tabulated operating parameters for a dry, wet and hybrid cooling system are shown in tables 4-7 below for a 100MW electrolyser.

Table 4: Air Fin Cooler (AFC)

Parameter	**Value**
Installation	12 bays, 2 bundles per bay, tube length 15m
Min. Process Temp.	39°C
No. of Fans	36
Total Plot Space	80x15m (1200m^2)
Motor Power	1330kW
Annual Electrical Consumption	100%
Annual Evaporated Water	N/A
Annual Water Usage	N/A
CAPEX Factor	100%

Table 5: AFC (Spray System)

Parameter	**Value**
Installation	6 bays, 2 bundles per bay, tube length 15m
Min. Process Temp.	39°C
No. of Fans	18
Total Plot Space	40x15m (600m^2)
Motor Power	666kW
Annual Electrical Consumption	50%
Annual Evaporated Water	6395m^3
Annual Water Usage	6395m^3
CAPEX Factor	65%

Table 6: AFC (Adiabatic Pads)

Parameter	**Value**
Installation	6 bays, 2 bundles per bay, tube length 15m
Min. Process Temp.	39°C
No. of Fans	18
Total Plot Space	40x15m (600m^2)
Motor Power	900kW
Annual Electrical Consumption	70%
Annual Evaporated Water	6395m^3
Annual Water Usage	8527m^3
CAPEX Factor	85%

Table 7: Cooling Tower

Parameter	**Value**
Installation	4 cells, 8.7m x 8.7m
Min. Process Temp.	29°C
No. of Fans	4
Total Plot Space	8.7x37.8m (329m^2)
Motor Power	300kW
Annual Electrical Consumption	25%
Annual Evaporated Water	385,440m^3
Annual Water Usage	514,212m^3
CAPEX Factor	25%

Extrapolating the water consumption for a 250MW wet cooling system and combining electrolysis water consumption, the *minimum* aggregated water supply required for a wet-cooled methanol synthesis scheme is calculated. It must be noted that values are a preliminary and not local climate specific to northern Tasmania, meteorological variation in temperature and humidity will highly influence the evaporative water consumption to maintain nominal process temperature. The first principles relationship differs slightly from the referenced quoted annual water consumption [1] due to a slight deviation of estimated operational efficiency, the first principles energy relationship assumes 70% efficient alkaline water electrolysis although the quoted study demonstrates less consumption due to lower efficiency for power to hydrogen conversion.

The water purification required for electrolysis increases the unpurified water supply requirement, a raw supply of $1.4m^3$ is assumed to be reduced to $1m^3$ following purification. Purification of only the electrolysis feed water is assumed, although some demineralisation of evaporative cooling water benefit system longevity.

Table 8: Total Aggregated Annual Water Consumption (Wet Cooling)

Consumption Type	**Value**
Ultra-High Purity First Principles Water Consumption (Electrolysis)	411,033,060 kg
Ultra-High Purity Quoted Water Consumption (Electrolysis) [1]	386,782,258 kg
Non-Purified Water Consumption (Electrolysis)	575,446,284 kg
Extrapolated 250MW Wet Cooling Consumption [2]	1,285,530,000 kg
Total Annual Water Consumption (SUM)	**1,860,976,284 kg**
Total Annual Water Consumption (SUM)	**1860 ML**

A plant with 250 MW of alkaline electrolysis, validated by the independent methods, will require on the order of 400 ML annually subject to individual electrolyser efficiency and operation duration. With a generous concession for purification loss, the total electrolysis water requirement is around 575 ML. An implemented system with wet cooling would require 1285 ML of water annually, highly dependent on local plant conditions regarding ambient temperature and humidity. The total, likely minimum, unpurified water consumption would be around 2000 ML. The calculated 1860 ML does not account for general plant water usage required for industrial cleaning or other non-identified plant processes.

7 Preliminary, Extrapolated Approximate Financial Metrics

Preliminary financial estimates for capital and operational expense are extrapolated from the work by Pratschner et al. [1]. The extrapolated financial data from 2022 European Union economic conditions is not highly indicative of an implemented scheme in northern Tasmania due to high disparities in local economic conditions and supply chains, although it informs the likely realised cost of an implemented scheme on the same order of magnitude. The average 2022 exchange rate between the Euro and Australian dollar is applied at 1.517 Euro/AUD and inflation is factored at 3% annually over three years. This conversion provides a reasonable degree of accuracy although the Australian dollar has further fallen as of 2025 in the face of economic conditions in China.

Table 9: Subprocess Capital Cost

Apparatus	**50MW Electrolysis**	**250MW Electrolysis**
		Capital Cost (AUD, 2025)
CO2 Production	$52,416,901	$262,084,505
CO2 Capture	$48,117,723	$240,588,615
MeOH Synthesis	$30,259,599.00	$151,297,995.00
Alkaline Electrolyser	$56,054,667.00	$280,273,335.00
Grid Connection	$9,259,768.00	$46,298,840.00
Total	$196,108,658.00	$980,543,290

8 Review of Combined Wind & Solar Energy Intermittency in Northern Tasmania

Renewable powered water electrolysis demonstrates excellent promise in northern Tasmania with proposed developments in solar and wind infrastructure reinforced by the hydroelectric scheme. However, combined solar and wind generation may present difficult intermittent generation conditions because of conglomerate generation assets operating under the same local climate conditions. Solar farms have predictable periodic generation with daily and seasonal variation, as well as high-accuracy generation forecasts, although, during non-solar hours, and in periods of low wind speeds it is highly unlikely that an appropriately sized system for peak generation conditions could reliably power water electrolysis.

It is highly advisable that for a directly coupled fuel synthesis plant with renewable generation systems both generation capability and plant size be meticulously designed with consideration of the highly intermittent nature of renewable assets. Back fitting of proposed operational characteristics is highly recommended to ensure that generation asset performance is not highly correlated due to related local climate conditions. This effect is likely most severe between solar farms due to the nature of weather systems

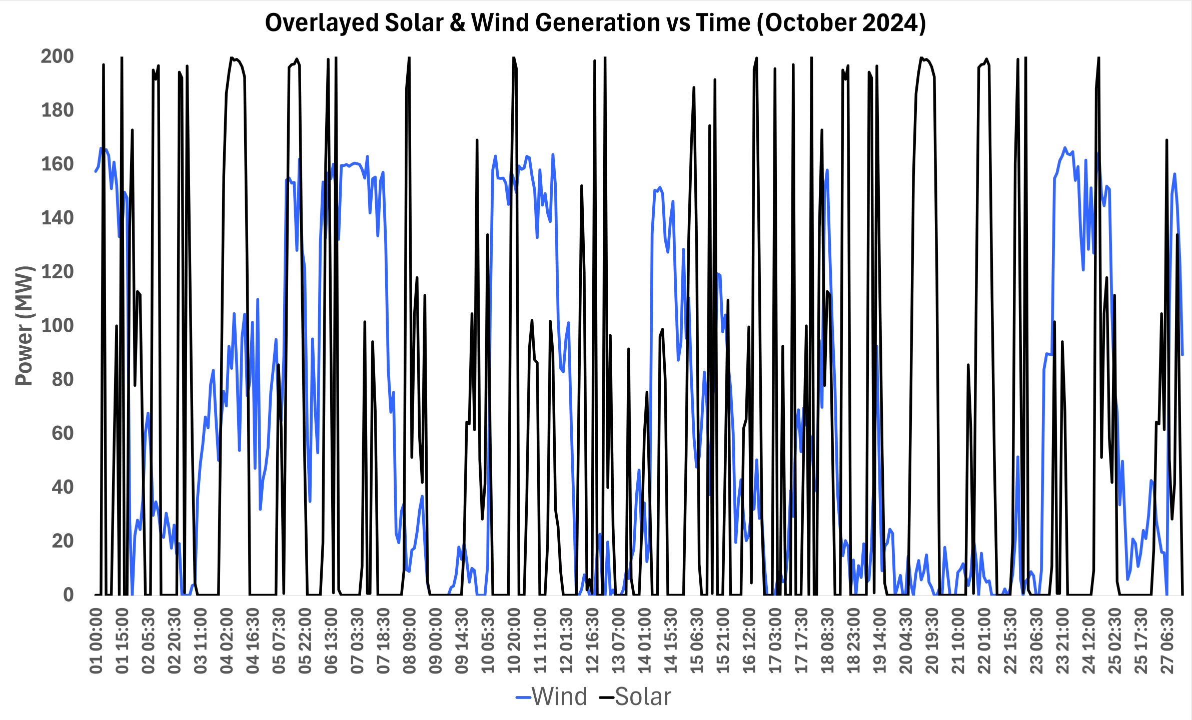

Figure 3: Overlayed Wind & Solar Generation Time Series..

The example combined 350 MW wind and solar in Figure 3 is summed over the time series to demonstrate a conglomerated generation scheme and shown in Figure 4. This demonstrates that a combined renewable source generation profile of 350 MW has large intermittency and faces challenges in servicing a constant 200 MW load for electrolysis. Whilst larger systems will assist in improving average generation values to required electrolysis power the excess generation becomes excessively massive which is unfavourable. It is therefore highly recommended that an analytical approach to optimise the power provision be undertaken regarding the best combination of sources and respective locations.

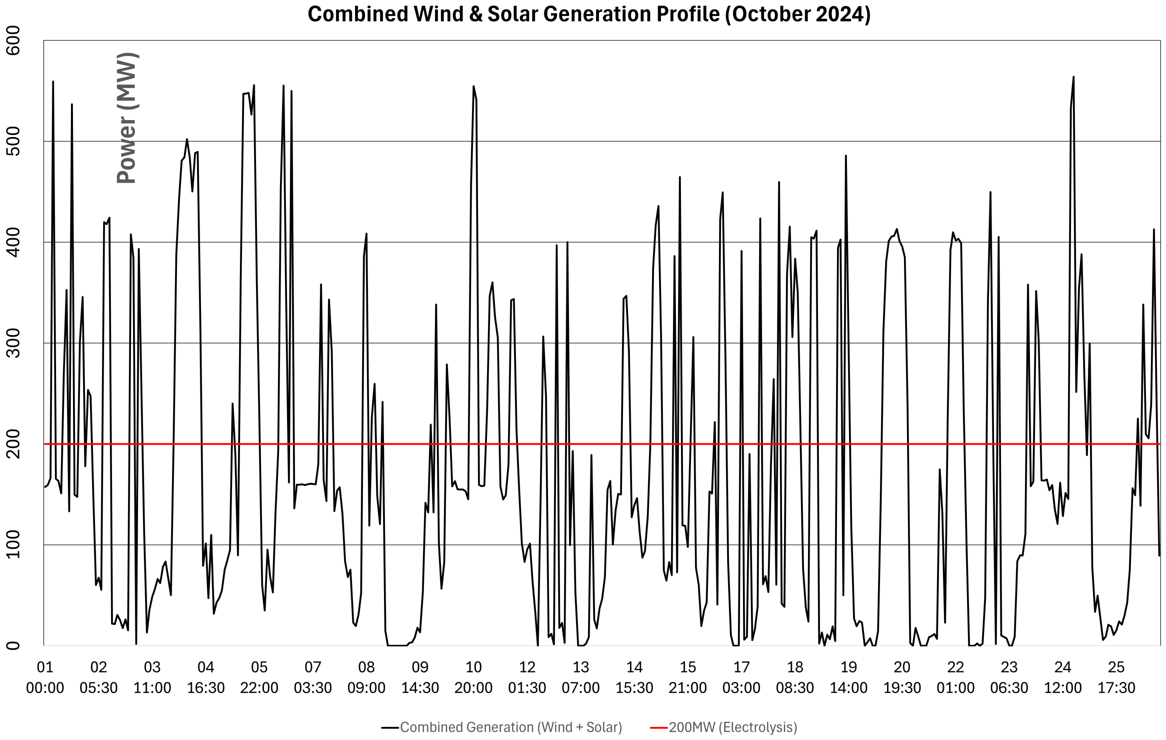

Figure 4: Combined Wind & Solar Generation Time Series.

Table 10: Average Monthly NEM Price (2024)

Month (1-6)	Ave. RRP ($)	Month(6-12)	Ave. RRP($)
January	$47.82	July	$180.76
February	$81.86	August	$128.69
March	$69.65	September	$22.51
April	$73.35	October	$49.80
May	$141.03	November	$95.86
June	$178.25	December	$90.48

9 Results, Interpretations & Local Infrastructure Context

This section contextualises the findings of the I/O review against infrastructure capacity in the proposed Bell Bay TGHH. A summary of plant input and output metrics for consumed and produced resources is presented with investigation of water, biomass and energy with consideration of current infrastructure. Cost approximations for a proposed 250MW scheme are discussed, with the opportunities for enterprise within the Bell Bay advanced manufacturing zone analysed.

9.1 Water Requirement, Current Supply & Infrastructure

This high-level preliminary I/O review for a 250MW TGHH has determined approximately 575 ML of water is required for renewable-powered electrolysis, assuming 400 ML of ultra-purified water is needed for continuous operation and that a conversion ratio of 1.4 to 1 is required for turning raw water into ultra-pure. It has also been determined that substantial additional water will be required for plant cooling, with a minimum of 1285 ML of water being assumed for evaporative cooling. Therefore a minimum total water usage figure of 1860 ML should be assumed, although this does not include a concession for general plant usage, which would increase this figure.

The proposed 250 MW renewable-powered electrolysis facility necessitates a reliable and substantial supply of high-purity water. The current water infrastructure in the Bell Bay region is primarily serviced by the Curries River Dam, with a storage capacity of 12,000 ML, providing a reliable supply of both raw and treated water to existing industries. This supply is delivered through a main pipeline network, with pipe sizes ranging from 100 mm to 450 mm, currently serving both heavy and light industrial facilities. The Tamar Irrigation Scheme (TIS) is an infrastructure development underway to meet growing demand for water in the Bell Bay area and the wider Tamar Valley. The TIS, underpinned by 130km of new pipeline infrastructure, is planned to draw water from Lake Trevallyn and deliver 12,000 ML per year to industry in the region. The project will also supplement the water capacity of the Curries River Dam, to provide additional reliability and capacity.

Thermal management and water consumption are closely linked in a plant of this nature. The facility will produce waste heat from various sub-processes, including electrolysis, biomass conversion, compression, and power electronics, and this heat must be rejected from the plant. Cooling systems, therefore, will be essential, and can be either wet or dry cooled. Wet-cooled systems are more water intensive, relying on the phase change of water, with an estimated evaporative water requirement of 1285ML per year for a 250MW system, but they typically require less electrical energy to operate than a comparable dry-cooled plant. Dry-cooled systems rely on air-finned heat exchangers but will require substantially more electrical energy to pump the internal working fluid, although they do not require any evaporative water. Whilst current economic conditions favour lower electrical energy consumption it is also essential that operational resilience and long term scalability of the water supply be considered, therefore a hybrid cooling approach may be a viable solution. The specific type of system implemented will have a substantial impact on the total volume of water required.

9.2 Biomass Consumption, Supply & cost

A green methanol synthesis plant with 250 MW of water electrolysis will require 259,832 tonnes of dry wood chip or equivalent biomass. This is a considerably large resource requirement, although the highly established timber industry in the BBAMZ likely could facilitate this supply, an investigation into local capacity is required. If the local industry could supply this resource the combination of biomass, renewable energy and deep water port access in Bell Bay provides a highly competitive conglomeration of resource requirements for renewable methanol synthesis which likely would be competitive on a global stage. Challenges transporting biomass to the plant, or synthesised methanol to the port would be greatly reduced in complexity, time and cost compared to non-conglomerated industries - a key competitive advantage that cannot be understated.

9.3 Oxygen Production, Export Potential & Local Industry Use

The oxygen byproduct from continuous operation for 250 MW of water electrolysis would be on the order of 365,038,460 kg annually. For example, stored at 200 bar and assuming a storage temperature of twenty-five degrees Celsius this mass of oxygen would require 28,294,693, 50 L pressure vessels to contain. Whilst it would be highly unadvisable to store or transport such as large amount of oxygen in such small vessels, the requirement to identify uses for local industry within the BBAMZ or investigate export potential is demonstrated. The produced oxygen is of remarkable value, and the optimal use the resource must be determined.

10 Recommendations

The recommendations provided in this section aim to address the key challenges and opportunities identified in the Tasmanian Green Hydrogen Hub (TGHH) I/O review. These recommendations focus on optimising resource utilisation, ensuring long-term sustainability, and enhancing the economic viability of the TGHH. Emphasis is placed on water resource management, market analysis, infrastructure development, and innovative approaches to maximise the value of byproducts.

10.1 Water Resources

Completion of the Tamar Irrigation Scheme (TIS) & Investigation of Scaled Electrolysis Water Consumption. The successful completion of the TIS ensures a reliable water supply for the TGHH. Further investigations into water usage figures for a scaled TGHH should be made in anticipation of the scheme's long-term water requirement, considering climate change, to reduce growth challenges.

Investigate Dry Cooling for Water Conservation for Long Term Scaling of TGHH. Given the substantial water requirements of evaporative cooling systems, constituting around three-quarters of annual water usage, and considering the potential risks associated with climate change around water security, the TGHH could explore the feasibility of encouraging proponents to implement water-efficient cooling technologies, such as dry or hybrid cooling systems. A detailed cost-benefit analysis of thermal management systems, factoring long term water security may be beneficial to the long term strategy of scaling a TGHH. It is highly likely that proponents will strongly oppose dry cooling systems, the capital and operational expense is much greater than for evaporative technologies but such a cost-benefit assessment would help shape the long-term vision and viability of the project to scale water usage for electrolysis rather than cooling long term in the face of climate change induced drought and water scarcity.

10.2 Thorough Investigation of Market Appetite for Renewable Commodities and Renewable Price Premium

Empirically Validate Financial Viability of Hydrogen or Derivative to Maximise Value. A much higher resolution techno-economic assessment determining the most economically viable renewable commodity is recommended to determine current market appetite and provide a vision of the future renewable commodity market. What is the price premium consumers are willing to pay for a 'green' commodity?

The Methanol Opportunity. With renewable electricity, biomass, and deep-water port access within the BBAMZ, green methanol shows excellent promise and competitive advantages within the zone due to the proximity of supporting infrastructure. It is likely that renewable hydrogen synthesis schemes will begin to rapidly emerge globally with the opportunity to decarbonise industries at the highest level of value chains. The transport requirement for cryogenic hydrogen will be a difficult cost prohibitive barrier to overcome in long distance transport from Tasmania, an area where liquid methanol transport would require far less technical challenges. The proximity of abundant biomass at the proposed site looks to be a key competitive advantage that may distinguish the cost per kilogram of green methanol compared to other renewable commodity synthesis schemes globally.

11 Investigation of local Oxygen Use Cases & Export Potential

Market Analysis for Industrial Applications. Conduct a comprehensive market study to identify local and regional industries within the Bell Bay Advanced Manufacturing Zone (BBAMZ) and Tasmania that could utilise high-purity oxygen. Examples include steel production, wastewater treatment, and medical-grade oxygen supply.

Collaboration with Local Industries. Explore opportunities for collaboration with industries in the BBAMZ that could benefit from a consistent and scalable supply of oxygen. This would reduce the need for these industries to produce or procure oxygen independently, offering both cost and logistical advantages.

Export Potential. Assess the feasibility of exporting surplus oxygen to neighboring regions or countries, considering logistics, storage, and transportation infrastructure. Options for bulk oxygen export should be analyzed to determine economic viability.

12 Renewable Energy

Reliable Renewable Energy Supply. While the existing hydroelectric system provides a low-carbon energy base, additional dedicated renewable energy generation is required to power the TGHH. This should be prioritised through the implementation of firming technology to smooth out the intermittency of wind and solar. This firming can be delivered by Hydro Tasmania pumped hydro storage or battery implementations.

Complete REZ Development. Development of projects within the planned Renewable Energy Zones (REZs) should be a priority to provide the scale of new generation necessary for the TGHH. This is especially true of the North East REZ which is in close proximity to the BBAMZ.

Investigate Transmission Infrastructure Requirements. The existing grid infrastructure should be able to service the proposed scale of a first-stage TGHH development, however, further developments will require additional transmission capacity.

13 Port Infrastructure

Develop Flexible Export Infrastructure. Plan for flexible export infrastructure, starting with a prioritisation of shared infrastructure where possible as this will reduce capital investment and will assist in building investor confidence in the hub. This infrastructure should cater to the most likely form of hydrogen export, as determined from a detailed economic assessment of market demand. The exact needs of the hydrogen export market are currently difficult to predict the infrastructure should be designed to be adaptable for all export methods - liquid hydrogen, ammonia, and methanol.

14 Conclusion

This input/output review has established the foundational resource requirements and operational characteristics for a Tasmanian Green Hydrogen Hub (TGHH) in Bell Bay, with specific focus on a 250MW water electrolysis facility for green methanol production. The analysis reveals both significant opportunities and key challenges that must be addressed for successful implementation.

The resource requirements have been independently validated through two methods, providing confidence in the order-of-magnitude estimates. For a 250MW facility, key annual requirements include:

- Approximately 2,102,400 MWh of electricity
- Minimum 1,860 ML of water (575 ML for electrolysis, 1,285 ML for cooling)
- 259,832 tonnes of biomass for carbon dioxide production
- Renewable energy supply & grid connection capable of handling 250MW continuous load

The Bell Bay Advanced Manufacturing Zone (BBAMZ) demonstrates several competitive advantages for green methanol production:

1. Unique conglomeration of required infrastructure (deep-water port, renewable energy access, biomass availability)
2. Existing and planned water infrastructure through Curries River Dam and Tamar Irrigation Scheme
3. Established forestry industry capable of providing biomass feedstock

4. Strong renewable energy foundation with hydro, wind, and solar resources

However, several critical challenges require attention:

1. Water security and management, particularly given the substantial cooling requirements
2. Renewable energy intermittency and the need for firming capacity
3. Economic viability given current market conditions and high operational costs
4. Infrastructure scaling requirements for future expansion

The review has also identified significant opportunities for value creation beyond primary production:

- Annual oxygen production of approximately 365,038 tonnes presents opportunities for local industry utilization
- Integration potential with existing BBAMZ industries
- Export capabilities through existing deep-water port infrastructure
- Potential for Tasmania to establish early-mover advantage in renewable commodity markets

In assessing financial feasibility, while capital costs are substantial (estimated at AUD 980 million for 250MW capacity), the long-term viability will depend heavily on:

- Electricity costs and reliability of supply
- Market premium for renewable commodities
- Biomass supply chain efficiency
- Operational optimization
- Water security and management strategies

Looking forward, the successful implementation of a TGHH will require:

1. Detailed technical and economic feasibility studies
2. Strategic infrastructure development planning

3. Strong collaboration between industry, government and stakeholders
4. Clear policy framework supporting renewable commodity production, reducing red tape where practical, safe and in the interest of the community
5. Careful consideration of scaling pathways, particularly regarding water usage

While significant challenges exist, particularly around resource management and economic viability, the fundamental attributes of the Bell Bay location position it as a competitive site for renewable commodity production. The combination of existing infrastructure, renewable energy resources, and export capabilities provides a strong foundation for development, provided that the identified challenges can be effectively addressed through careful planning and strategic implementation. If renewable methanol synthesis is to be commercially viable, an implemented scheme in Bell Bay looks to be in an excellent position.

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