From: [redacted]
To: Do-Not-Reply IPCN Submissions Mailbox
Subject: RE: Hills of Gold proposed wind farm SSD 9679-
Date: Thursday, 4 July 2024 9:46:30 AM
Attachments: Office of the Independent Planning Commission NSW clrification July 2024.docx
Office of the Independent Planning Commission NSW June 2024.docx
Solar Hydrogen electricity generation discussion Dec 23.doc

Following discussions with IEAPTET representatives please find attached a revised submission to the Departments invitation for revised public submissions.
Please disregard my earlier submission dated 30/6/24.

Yours Sincerely

John Kite

4 July 2024

Office of the Independent Planning Commission NSW [redacted]

Suite 15.02 Level 15
135 King Street Sydney NSW 2001

Re: Proposed Hills of Gold Wind Farm, Nundle NSW SSD-9679

In reference to the Departments Email 27/6/24 inviting public Submissions based on additional information I would like to offer the following information for the Departments Consideration.

My original submission was an objection based on the determining authority's consideration of a 70 Turbine Wind Farm compared to an alternative **Solar Hydrogen Energy Recovery Gas Turbine.**

	Proposal	**Alternative**
Project	Wind Farm	Solar Hydrogen Gas Turbine
Capacity	420Mw revised 384Mw	80-330 (700Mw capable)
Efficiency (intermittent)	20-40%	51% (controlled)
Turbines	70 revised 62	1
Cut in speed	6-9 Mph	Unaffected
Max Damage speed	55-70 Mph	unaffected
Cost	$750 million	$36 million
Life Span	15 years	Refurbish each 14 years
Land Footprint	6,808 Hectare	0.5 Hectare
Generating capacity	6Mw each	86-330 Mw each
Maximum height	230m	3.0-4.5m
Noise level per turbine	105 dB at 50 m	60db at 60m
Operation requirement	Coriolis dependant	Solar Hydrogen storage
Base load control	No	Yes
Congestion affected	Yes	No
Firming affected	Yes	No
Carbon Offset	Yes	No
Renewable energy zone	Yes	No
End of Life waste	Intractable	Recyclable
Direct CO2 Air capture	No	Yes
Subsidy dependant	Yes	No

Differential pricing	Yes	No
Plastic Nano-micro fibre	Yes	No
Levelized Energy cost	$114 Mwh	$39 Mwh
Carbon manufacture	1,688 tonne	32 Tonne (6.2Turbine)
Bush fire prone	yes	No
Service roads	linked unsealed	Sealed
Dust affected	Yes	No
Hail damage	Yes	No
Freezing affected	Yes	No
Cyclonic Conditions	Inoperable	operational
Earthquake affected	Yes	No
Environmental damage	Yes	No
Deed Rate dependent	yes	No
Social Impact	Objections	Not tested
Environmental Risk.	Air land and water	unaffected
Pollution, causing adverse health impact from plastic Nano and micro fibres operational shedding, habitat destruction including ecosystem damage due to installation activity. Bird impact prone. Pollution and silt water shedding from unsealed service roads including amenity impacts. Studies undertaken into the US West Texan windfarms using satellite data between 2003 and 2011 concluded that wind farms are adversely affecting climate change by causing atmospheric temperature to rise 1.5 to 2.0 degrees Celsius.		Minimal Environmental impact. Impacted land is confined to retrofitting existing hydro electric schemes.
Life cycle	environmental	Continuous life cycle
impact throughout the proposal's lifecycle from raw material extraction to disposal. No requirement to remediate at end of life.		Low carbon manufacture End of life remediation plan
Technology Assessment. Evaluates effect of adopting new technology.		New technology with CO2 capture.
Cumulative Impact. 4,800 turbines in 2021. Proposed additional 21,845 over 30 years. to meet net zero. Renewables require land. the size of 10 Tasmania's.		Sixty-seven installations requires 33 Hectare in total to meet net zero 20 years

Strategic Environmental Assessment. Evaluates the environmental implications of Policies before implementation	Meets net zero policy target.
Cost benefit Assessment. Weighs the costs and benefits of a project involving economic and environmental factors.	Less cost. Base load control. Uses existing transmission corridor's. Not Renewable Zone dependant. EROI (*Energy Return on Investment*) part is satisfied. Addresses existing generators in congested areas from becoming financially unviable because of differential pricing. Balances loads to allow for a congested relief market caused by curtailing to trade with unaffected generators.

Environmental Impact Studies (EIS) prepared for large resource projects under state legislation have an obligation to take into consideration alternative evaluations relating to feasibility, environmental impact, economic viability, and to rigorously explore and objectively evaluate all reasonable alternatives due to its public interest obligation to inform Government decision makers, the project proponent, and the public.

Environmental Impact Statements are required to include a description of any alternatives that were identified or considered, and any alternative's eliminated from detailed study. The applicant is required to provide discussion explaining the reasons for exclusion.

For this purpose, I have attached a comprehensive discussion paper that outlines the competing available power generating options that includes wind turbines for Australia and setting out the parameters that justify the feasibility of the Alternative for the Departments consideration. Please note the Not For Publication restriction is lifted.

Yours Sincerely

John Kite

SOLAR HYDROGEN TURBINE ELECTRICITY

Discussion Paper

Introduction

This document examines the 2023 CSIRO's Gen Cost to construct seventy-one small Nuclear Modular Reactors requiring 2,840 hectares generating 300 Mw each with a 12–15-year construction program for a cost of $387 billion plus nuclear safety costed at $200 million per 100Mw per annum to service Australia needs. The alternative is sixty-five 86-330 Mw Carbon free Solar Hydrogen installations operated from a combined area of 33 Hectares with the ability to variably regulate its power supply according to supply demand for a cost range between $2.4-3.3 billion and construction timeline between three to five years.

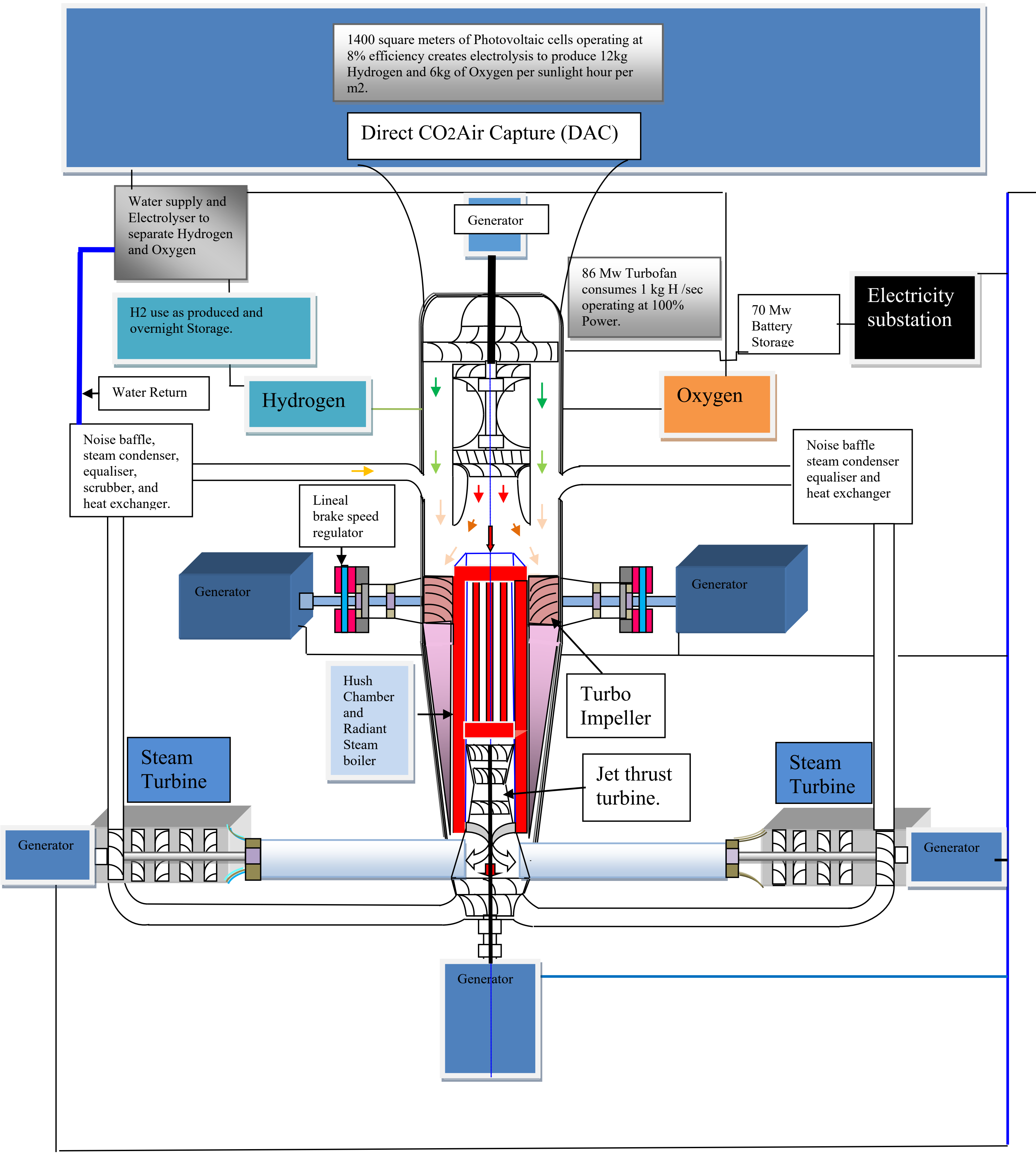
This paper also examines the inefficiencies of **Wind, Solar and Hydro,** and exposes systematic failures resulting in cost over runs, inability to meet targets, energy rationing, over-development, visual pollution, loss of amenity and congestion that contravene planning approvals while allowing energy markets to demand inflated energy prices, creating inflation and cost of living pressures.

The reactive effect of climate change driven by population growth has created a Paradigm shift to examine the advantages of a **Solar Hydrogen Energy Recovery Gas Turbine** and reset how electricity and underground delivery can be economically delivered to address the supply methods and industrial problems that plague Gas, Gas Fracking, Bio Energy, Hydro, Grid Feed, Wind and Solar Farms including Nuclear.

This document also looks at the inefficiencies of land-based wind turbines costing $4 million, requires a 17-Hectare footprint and operational noise level of 105dbl at 50m, including a 1Mw Solar Farm requiring 3 Hectares costed at $1.36 million and the transition to renewables requiring a land area ten times the size of Tasmania.

The alternative 86-330 Mw **Solar Hydrogen Energy Recovery Gas Turbine** plant is costed at $36.5 million, operates at 60dbl at 60m, requires 1,400 sq m of solar panels and operates from an area the size of a football field. Hydrogen produced by electrolysis, combined with the turbines *Variable Frequency Generators* produces sufficient fuel and overnight storage to power the turbine for a 24-hour/365-day period. Comparably a 330 Mw solar farm costs $449 million, requires a land footprint of 990 Hectares and can only operate during sunlight periods.

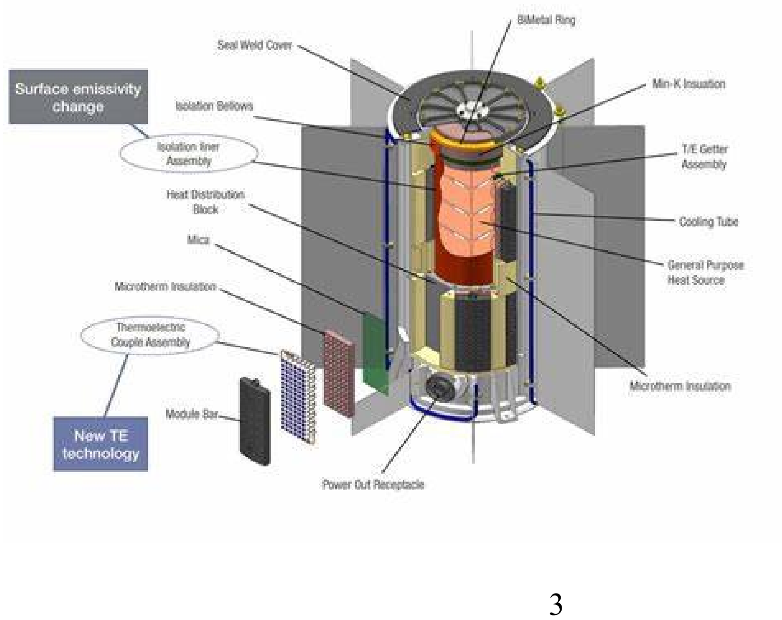
Solar Hydrogen Electricity Generation (nts)



Special Note

If the Australian Nuclear ban was to be lifted, an alternative source to eliminate overnight storage of Hydrogen would be to replace the required 1,400 square meters of solar nuclear fusion panels costing $20,000 in 2023 with 100 grams (approximately the weight of 2 eggs) of enriched uranium to fuel an electrical generating nuclear battery such as a *Radioisotope Thermoelectric Generator* RTG (similar, to the Perseverance Mars Rover) housed within a 45kg containment case for an estimated cost of $75 million and14 year lifespan.
In unison with the Turbines *Variable Frequency Generator* which produces its own renewable energy, the battery would provide the 300 Kwh of electrolysis to produce 6.000 kg of hydrogen per hour to fuel an 86-330Mw installation operating at maximum power for a 24hr 365-day period.
300 Kwh of grid electricity at 0.25c per Kwh in 2023 is costed at $1,800 for 24 hours or $657,000 per annum.
In comparison, 20 Tonne of enriched Uranium would theoretically create a 330Mw RTG as compared to 25 tonnes of enriched uranium replaced yearly at a cost of $2,000 per Kg to operate a 330 MW nuclear fission reactor.
In summary, to provide Australia's entire power needs using the CSIRO's 2023 Gen cost base load requirements to meet Nett Zero by 2050 the following options are available.

1. $1.2 trillion, 30-year renewable plan with a possibility the cost will blow out if a firming guarantee is reliant on natural gas and battery to avoid intermittent supply including an intractable waste stream where wind turbine blades shed micro and nano plastics contaminating air, water and land that impacts human health and requiring an environmentally destroying operational land area the size of 10 Tasmania's while dependant on 28,000km of new and amenity destroying transmission lines to link *Renewable Energy Zones* without any legislative requirement for operational end of life rehabilitation.
2. $387 billion, 12–15-year plan for nuclear fission reactors each requiring $50 million for fuel replacement per annum with an 80-year mining supply plus $200 million safety imposition for each Mw generating 1Gigawatt per annum without any neutralising nuclear waste management technology, requiring 2,840 hectares that will become permanently contaminated but does not require *Renewable Energy Zones.*
3. $3.3 billion, 3-to-5-year plan for a recyclable, pollution and carbon free Solar Hydrogen Energy Recovery Gas Turbine having a 5-billion-year nuclear fusion supply with nationwide linked variable base load control using space and aircraft technology and only requiring an operational land area of 33 hectares without the need for *Renewable Energy Zones* and meeting the Net Zero target 20 years earlier.



Radioisotope Thermoelectric Generator

Power Generation

The world's total power generating capacity in 2018 was according to the IEA estimated at 22,315TWh and estimated to increase by 3.8% PA.

The largest electrical power generating plant is reportedly the Japanese Kashiwazaki-Kariwa Nuclear Power Station having an electrical output 0f 8,212 Mw generated from five 1,100Mw and two 1,356Mw electrical generators.

According to the National Electricity Market, Australia's electricity usage in 2023 was reported for the financial year to be 188.6 Terawatt hours. One Terawatt hr can reportedly fully service 70,000 households for a year.

Solar Hydrogen Turbine Advantages.

1. Makes wind and solar farms, pumped hydro, gas fracking and nuclear fission reactors redundant.
2. Addresses population growth being the primary source driving climate change.
3. Not dependant on operational subsidy.
4. Eliminates corporate dependency.
5. Addresses climate change corporate interest consultancy inefficiencies.
6. British Thermal Rate (BTU) per pound for Hydrogen is 51,500/lb which is substantially higher than comparisons such as aviation fuel 18,550/lb Natural gas 10,377lb wood 9,700lb
7. No operational Carbon footprint.
8. Pollution free.
9. Turbines filtered inlet air plenum used for atmospheric Direct Air Capture of CO_2. (DAC)
10. Not operationally dependant on consumable natural resources.
11. Uses existing shovel ready off the shelf technology.
12. Can be refurbished and fully recyclable.
13. Produces genuine and constant renewable energy.
14. Uses Hydrogen instead of Natural Gas for Cogeneration (CHP) to produce combined heat and power.
15. Eliminates the need for gas fracking.
16. Addresses fuel storage for renewables non-generation periods.

17. *Variable Frequency Generators* under turbine operation manufactures "*use as produced*" hydrogen.
18. Exceeds Solar, Wind, Coal, Gas and Nuclear capabilities for less cost and greater efficiency.
19. Hydrogen fuel produced from renewables to power gas turbine electricity generation is a bankable product.
20. The EROI (*Energy Return on Investment*) part is satisfied.
21. Package convenience to strategically place at pole and wire grid conversion points.
22. Meets Distribution Standard for design and construction of Kiosk electrical substation and switching station.
23. Balances output to avoid intermittent energy interruption with remote aircraft reliability when grid supply cannot service energy demands.
24. Strategically locatable as a package plant where base loads occur.
25. Avoids the need for "*Renewable Energy Zones*" currently requiring a reported 28,000 km of environmentally damaging, visually polluting and amenity destroying poles and wire.
26. Reignites the feasibility of replacing poles and wires with underground transmission to avoid intensifying lighting strikes and storm damage caused from climate change.
27. Manages congestion caused by curtailment affecting 80% of the National Energy Market.
28. Variable Frequency Generators also function as *Synchronous Condensers* to maintain grid stability congestion by supplying reactive power on demand.
29. Addresses energy security risks.
30. Addresses existing generators in congested areas from becoming financially unviable because of differential pricing.
31. Balances loads to allow for a congested relief market caused by curtailing to trade with unaffected generators.
32. Safeguards against the grid becoming a strategic target in the advent of Australia becoming involved in a military conflict.
33. Turnkey operation reduces the vulnerability of the Energy Grid becoming a target for criminal or rogue state hackers.
34. Safe Nuclear Fusion can produce Hydrogen for an estimated five billion years.
35. Uranium is estimated to have an eighty-year extraction reserve.
36. Unlike nuclear fission being a one speed only, non-variable energy provider a solar hydrogen gas turbine provides measured grid energy on demand with aircraft control efficiency.
37. Exceeds the Australia Federal Governments clean energy and renewable projects 2050 net Zero commitment.

38. Solar Hydrogen qualifies for Carbon Credits and offsets.
39. Modern construction methods for Gas Turbine installations reduce operational noise to 60dB A at 60m.
40. Comparably, sixty-seven Installations developed on forty hectares of land will exceed the electricity output of China's Three Gorges Hydroelectric scheme.
41. Futuristic concepts such as Plasma Harnessing, Electric Plasma Jet Engines, Super Collider technology and Nuclear Diamond batteries remain uncertain as to cost, development sustainability, or reliability.
42. The Snowy Hydro Scheme provides the perfect platform to install 18 **Solar Hydrogen Energy Recovery Gas Turbines** covering 9 hectares to produce 6,000 Mw by retrofitting existing Hydro plants and using the existing transmission lines and infrastructure.
43. Prevents Australia from becoming a dumping ground for foreign polluting countries industries seeking carbon offsets from wind and solar farms.

Legislation

A **Solar Hydrogen Energy Recovery Gas Turbine** is an alternative proposal to large scale renewable electricity developments, such as Wind and Solar Farms, Bio Energy, Nuclear Fission, and Pumped Hydro Schemes.

The National Environmental Policy based on the Commonwealths *Environment Protections and Biodiversity Act 1999* is a crucial tool to assess the potential environmental, economic, and social impacts of large resource projects and compelled to explore alternative ways to not only conduct the project to limit its impact but also to consider alternatives.

All Environmental Impact Studies (EIS) prepared for large resource projects under separate state legislation has an obligation to take into consideration alternative evaluations relating to feasibility, environmental impact, economic viability, and to rigorously explore and objectively evaluate all reasonable alternatives due to its public interest obligation to inform Government decision makers, the project proponent, and the public.

Environmental Impact Statements are required to include a description of any alternatives that were identified or considered, and any alternative's eliminated from detailed study. The applicant is required to provide discussion explaining the reasons for exclusion and involves the following.

1. **Social Impact**, such as projects effect on community wellbeing.
2. **Environmental Risk**, including pollution, habitat destruction and ecosystem including amenity and health impacts.
3. **Life cycle analysis**. Includes environmental impact throughout the proposal's lifecycle from raw material extraction to disposal.
4. **Technology Assessment**. Evaluates effect of adopting new technology.
5. **Cumulative Impact**. Assesses combined effect of multiple projects on the environment over the life span.
6. **Strategic Environmental Assessment**. Evaluates the environmental implications of policies before implementation.
7. **Cost benefit Assessment**. Weighs the costs and benefits of a project involving economic and environmental factors.

The due and proper assessment of these points play a crucial role in evaluating sustainable development to assist decision making.
The proposed alternative as it relates to renewables is intended to avoid having to pay more to transition to renewables, not dependant on battery backup, does not require subsidy to operate, nor require renewable energy zones or operational carbon offsets, not affected by congested areas becoming financially unviable because of differential pricing and balances loads to prevent congested relief market caused by curtailing to trade with unaffected generators affecting 80% of the National Energy Market.

One of the unassuming benefits of the concept is that the turbines inlet air flow creates a strong vacuum that is suitable for *Direct Air Capture* (DAC) for atmospheric CO_2 and can be operated on the same principal as Iceland's "*Mammoth*" DAC.
The difference is that instead of using multiple electrical dependant fans for atmospheric capture of CO_2 existing in the atmosphere at 0.04%.
The vacuum created from the turbine's inlet can ingress up to 1,245Kg air/ sec which provides the power source for carbon capture at the volume rate of 814 cu m of air per 100 kilograms for each kilogram of hydrogen fuel.
This benefit in the form of energy recovery addresses the United Nations concerns: *The world was so far behind on reducing emissions that Carbon Capture was unavoidable*.

Precis

To assist the reader in understanding the feasibility of a **Solar Hydrogen Energy Recovery Gas Turbine,** it is best demonstrated by the example shown in the above schematic.
The schematic is an extract from the final working design that uses off the shelf technology to explain how the minimal use of solar panels are used to produce green hydrogen from the Sun's solar fusion combined with the turbines *variable frequency generators* for *use as produced* hydrogen and storage of bypass hydrogen fuel for overnight storage to power and cogenerate recovered heat and thrust from energy waste including captured CO_2 to operate an electrical generating Gas turbine.

The proposal makes renewables, hydro and nuclear fission reactors redundant and uses existing infrastructure without the need for Renewable Energy Zones.

According to the CSIRO, Australia's usable sunlight irradiance has the highest solar coverage of any continent.
Solar coverage is measured by Global Horizontal Radiator and Direct Solar Irradiance measurements.

The schematic example details commercially available solar photovoltaic cells to create hydrogen gas from electrolysis, industrial electrolyser, steam turbine, industrial turbochargers, and electrical generators.

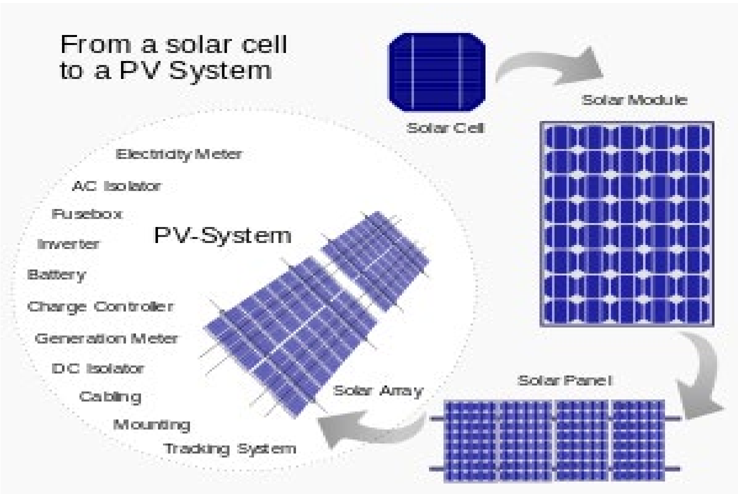
A Gas turbine is essentially a very efficient wind turbine that instead of using natural Coriolis produced air currents it uses natural combusted hydrogen gas to rely on movement to create resultant energy.

A turbine is best suited to service the current and increasing needs for power generation as the turbine's resultant energy is not only proportionally operated to meet its energy demands but more importantly its fuel is carbon free and renewable, equipment can be refurbished, readily maintained by stage isolation without decommissioning and has an end-of-life recycle plan.

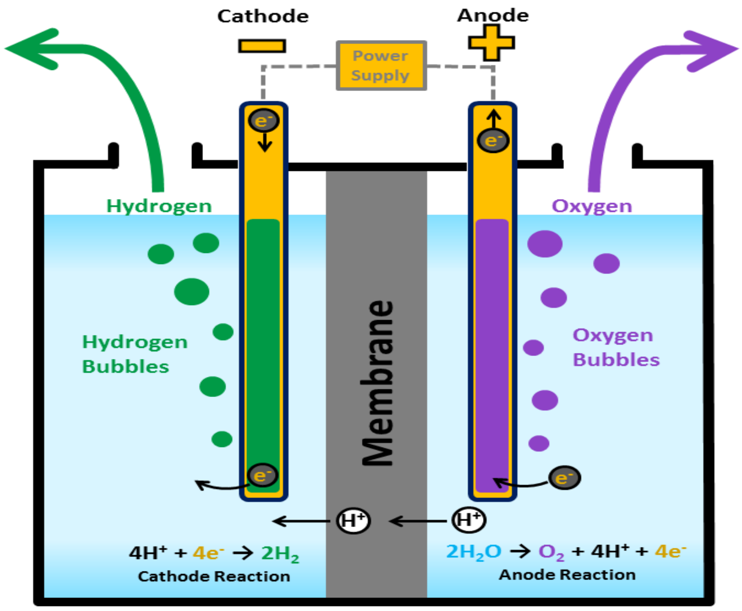
The concept has a significant advantage over conventional electrical generating Natural Gas turbines in that the operational thrust and unwanted heat generated from the peak power band, instead of venting as waste it is harnessed in a *cogeneration* closed loop recovery design to recover waste and amplify energy from 86Mw up to 330 Mw. A package

plant can be operated on a parcel of land as small as a football field with noise level as low as 60dBL at 60m.
The design is compact, draws on proven historical technology enhanced with Artificial Intelligence to deliver a fully recyclable platform with a genuine sustainable outcome for the natural and built environment.

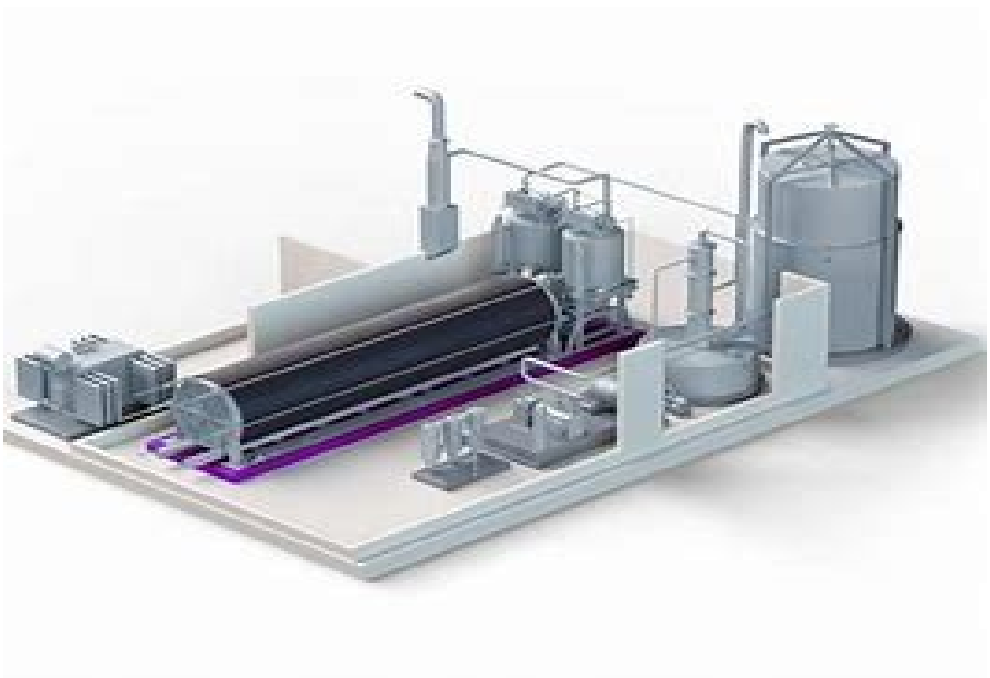
The technology for Gas turbine electricity generating developments and Solar Hydrogen farms already exists. They have been individually constructed in isolation but never combined. The present operational designs for gas turbines and overuse of solar panels leave significant room for improvement.



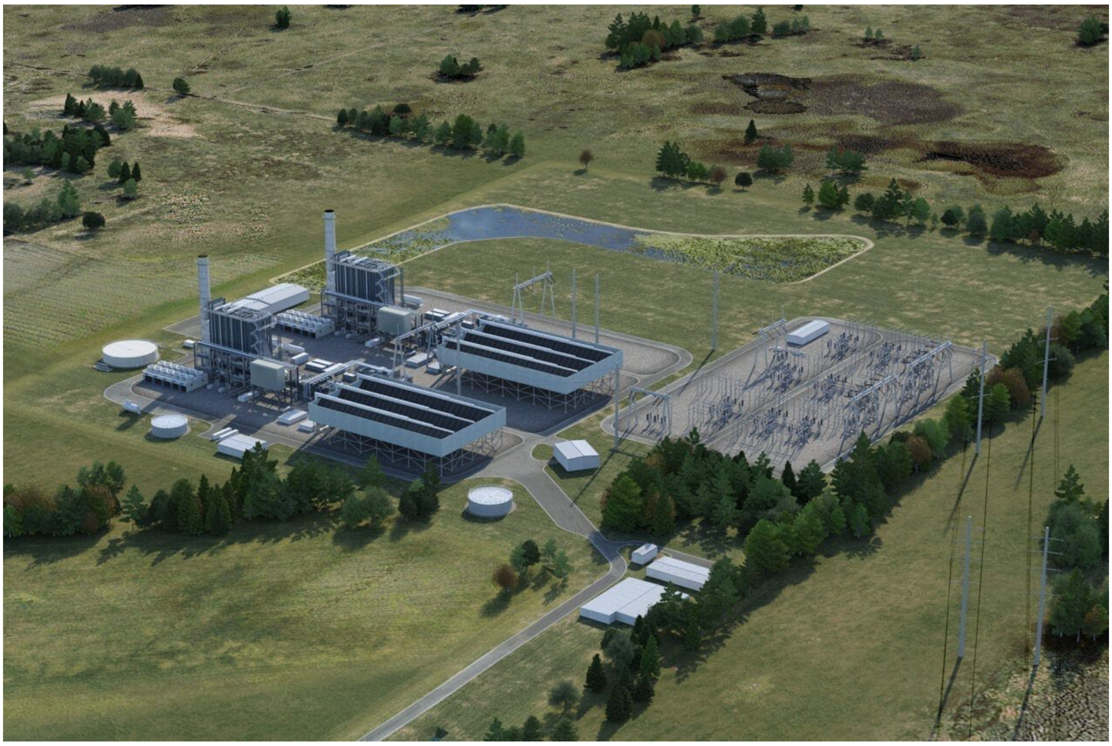
SOLAR CELL



ELECTROLYSIS



INDUSTRIAL ELECTROLISER



Gas Turbine Plant

Solar Hydrogen Plant

Process

Gas Turbines are the forerunners to turbofans which are normally associated with modern aircraft propulsion.

Land based Gas Turbines are currently used to generate electricity from greenhouse producing natural and fracked gas supplies.
Expended but recoverable exhaust thrust and heat from the present-day technology is traditionally by-passed and vented as environmental impacted waste which creates noise and amongst other, releases NOx and Carbon Dioxide. Certain types of Gas turbine incorporate heat recovery steam generators but are only capable of operating between 25 and 35% efficiency due to the fuels BTU.

The Hydrogen Turbofan concept has a significant design advantage over conventional gas turbines as the waste stream is not only harnessed and controlled as recovered energy but more effectively used with controlling variable vanes in a closed loop process to control heat and thrust with calculated efficiency. Turbofans are fuel efficient and quieter because they produce significantly less exhaust noise with greater exhaust thrust.

Comparably, operational procedures that aircraft technicians deal with daily are essential for safe reliable air travel. The development of modern aerospace Hydrogen fuelled Gas Turbines have gone through significant developmental stages to overcome technological developments that are problematic for aircraft however, when used for land- based operations to generate electricity rather than propel aircraft the air-based problems become land-based energy solutions.

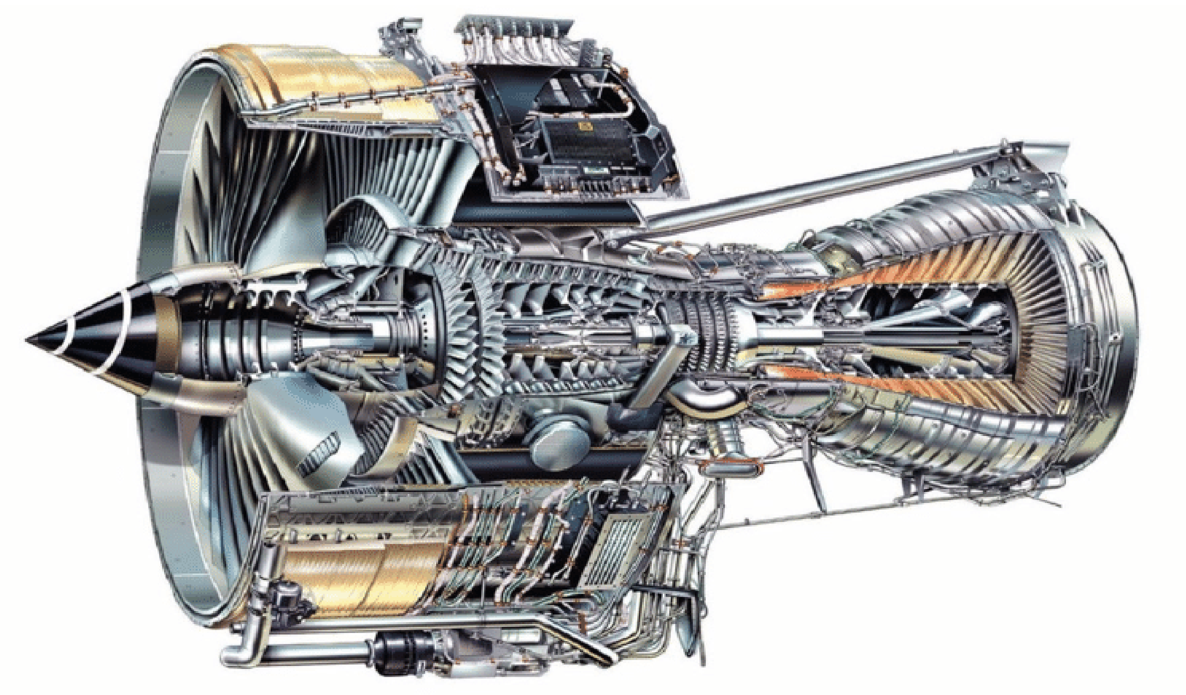
Energy produced from sunlight fusion progressing to Hydrolysis for Hydrogen production has progressed from roman times to amongst other researchers, Albert Einstein being awarded the noble peace prize in 1921 for explaining the *photoelectric effect* being a forerunner to modern solar panels.
Presently, Photovoltaic solar panels are over developed and underutilized to the extent they are now affected by congestion. The industry is now asking for subsidy and contributing to the over-development of operational land when they can be used more efficiently in minimal concentrations to create electrolysis for hydrogen production rather than direct grid energy feed.
The1,400 square metres of solar panel area to produce hydrogen for the 86 Mw turbine can only generate during sunlight periods a maximum of 301 Kw/Hr at 40% efficiency for direct grid feed.

The package plant uses off the shelve technology to harvest the suns nuclear fusion to produce Hydrogen and Oxygen by electrolysis to fuel the most efficient and reliable energy generator the Hydrogen Gas Turbine.

Modern turbine engines are the most efficient and reliable power plants used today. When used with magnetic bearing technology and Oxygen by-pass injection, service intervals can exceed 80,000 hours.
The cost of certified aircraft turbine engines is high. However, these costs are significantly reduced when airworthy certification is not required.

To avoid going into the technicalities of the purpose design and to explain the concept in nonexpert terms, this discussion paper for comparison reasons has adopted the Rolls Royce "*Trent*" Turbofan 900 platform that powers the familiar A380 Airbus.
This platform will not only demonstrate the concepts feasibility, but also its design parameters have a commonality to other power sources referenced in this paper.

The "Trent" Turbofan owes its success to the rigorous experimental and testing program that produced a modern marvel of science, technology and engineering that unassumingly serves its daily airworthy assignments with remarkable efficiency and reliability.



TRENT 900

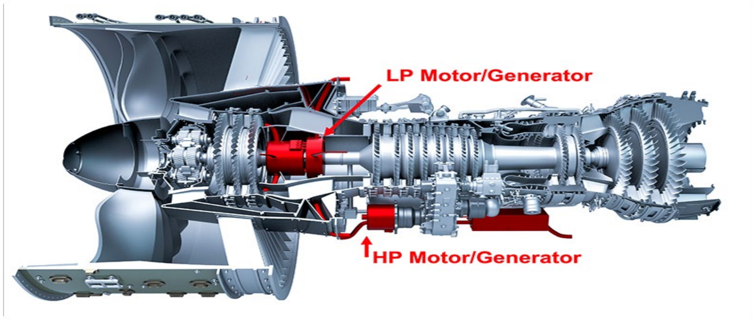
The “Trent” 900 aviation certified engine in 2023 costs Au $25 Million, (uncertified $8.2 million) weighs 6.5 tonne, measures 5.4 m long and 3.0 m in diameter. The Turbine is rated at 86 Mw at an operating efficiency of 51% and consumes aviation fuel at 1 Kg /sec at 100% operation. Maximum thrust range is 374Kn, exhaust temperature can reach 1700 C with exhaust speed exceeding 2000Kph.
(Theoretically, Thermoelectric energy harvesting is possible by generating voltage from temperature gradient above 1700 C.)
(A similar power plant is the GE 9X Turbofan, rated at 112 Mw has a thrust capacity of 490 Kn, and air certified list price in 2023 was $41.4 million.).

The Trent Turbofan has a reported service life of 37,000 cycles equivalent to 14 years of continuous operation. Complete air certified refurbishment is reportedly US $7 million.

The noise level for the Planetary gearbox design is so whisper quite that the manufacturer has demonstrated a mobile phone conversation taking place next to a fully operational test engine at full power. This design was developed to overcome noise congestion at airports and scheduled to power the next generation aircraft.

An added advantage is that Turbines for reliable aviation purposes come equipped with *Variable Frequency Generators* up to 1400Kva amps.
The generators are powerful efficient compact high frequency switching solid state circuitry that generates DC power for whichever frequency is optimal for the application and allows the required power to be generated more effectively.
In effect an operational Turbine produces its own renewable energy.
These generators can be used to serve a dual role. Firstly, as *Synchronous Condensers* to maintain grid stability and manage congestion by supplying reactive power on demand.
Secondly, their production of voltage during turbine operation for land-based operation can be combined in multiple series to generate *use as produced* hydrogen based on the equation that electrolysis requires a minimum of 1.229 volts to create 285 watts/hr. Electrolysing between 39 to 50 watts/hr is sufficient to create one litre of Hydrogen and 0.5 litres of Oxygen.
The theoretical calculation for electrolysis of water is as follows.
Electrolysis of 1 kg water yields 237.13 kj of electrical energy input to disassociate each mole.
Each mole of water gives 2 grams of Hydrogen and 16 grams of Oxygen.
Energy Calculation to electrolyse 1 kg of water to release 55.55 moles.
(237.13 x 55.55 =13.173 MJ

The energy density of hydrogen is 141.86Mj/Kg.
Energy released by Hydrogen combustion 0.002g x 55.55m x141.86MJ/Kg =15.76 MJ.
(The Faraday constant of electrons is 1 amp flow for 1 second to create 1 *coulomb (F=Le)* establishes the quantity of electricity.)



VARIABLE FREQUENCY GENERATORS

In the example selected, non-operational components for essential air travel are excised from the design. This combined with a geared Turbofan planetary gearbox allows fuel consumption and noise to be significantly reduced as the calculations are based on the variation of an aircraft mass exceeding six hundred tonnes being accelerated through the atmosphere. Without an equation that can calculate mass and velocity together the capability of the engine for sole electricity power generation is significantly optimised.

In addition, Hydrogen fuel is rated at twice the BTU of aviation fuel and approaches 90% efficiency to convert thermal and thrust power to electricity.

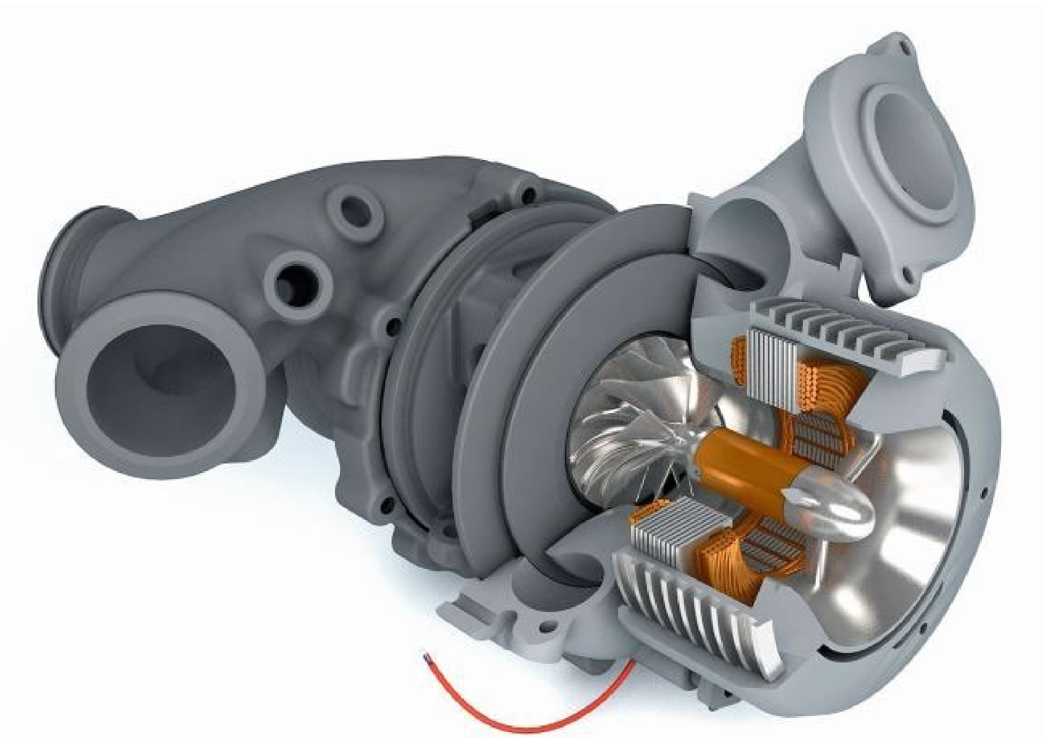
The equation used to convert coal fired thermal power to electricity is calculated at 33% based on the following formula.

3 MT coal produces 1 MWe with heat and thrust being vented as waste.
The calculation can be gauged by W= $K + U + \Delta Eth$ Δ Δ
where W can change Δ =a systems potential energy (*K*=Potential energy) (*U*=Thermal energy) (*Eth* = any combination of the three) or W=Fad (W=Work) (F=Force measured in Newtons) (d=displacement)

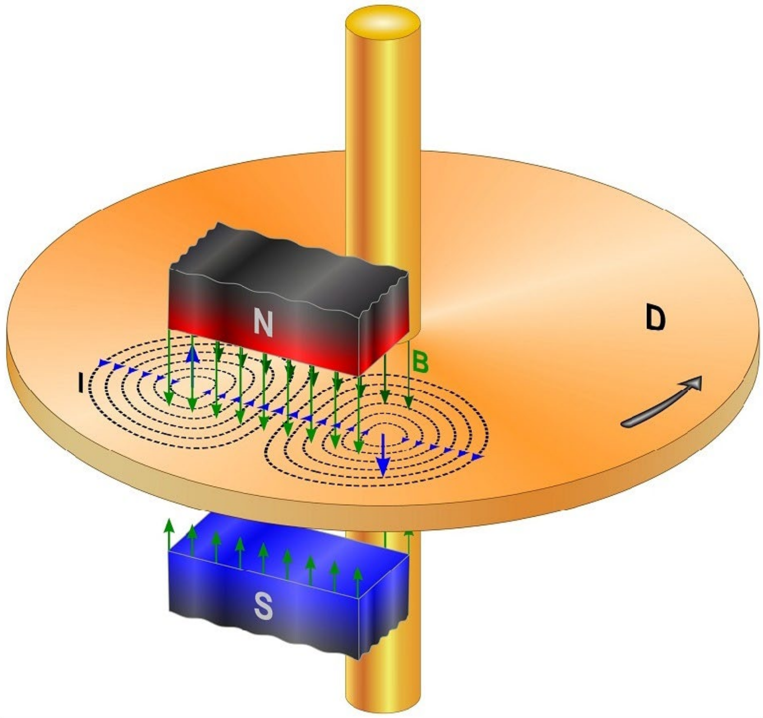
In comparison one Metric Tonne (MT) of Hydrogen produces 33MWe from current Alkaline or PEM Electrolysers operating at only 67%.

The following images gives a perspective of the auxiliary operational equipment to meet the concepts objectives.

INDUSTRIAL TURBOCHARGER

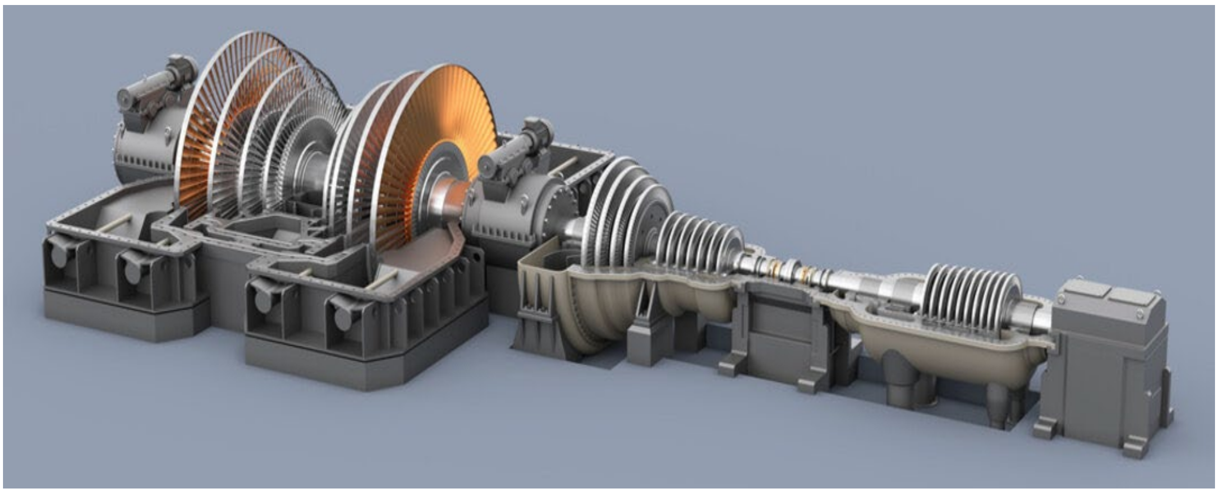


CUT AWAY TURBO CHARGER SHOWING ELECTRICAL GENERATOR

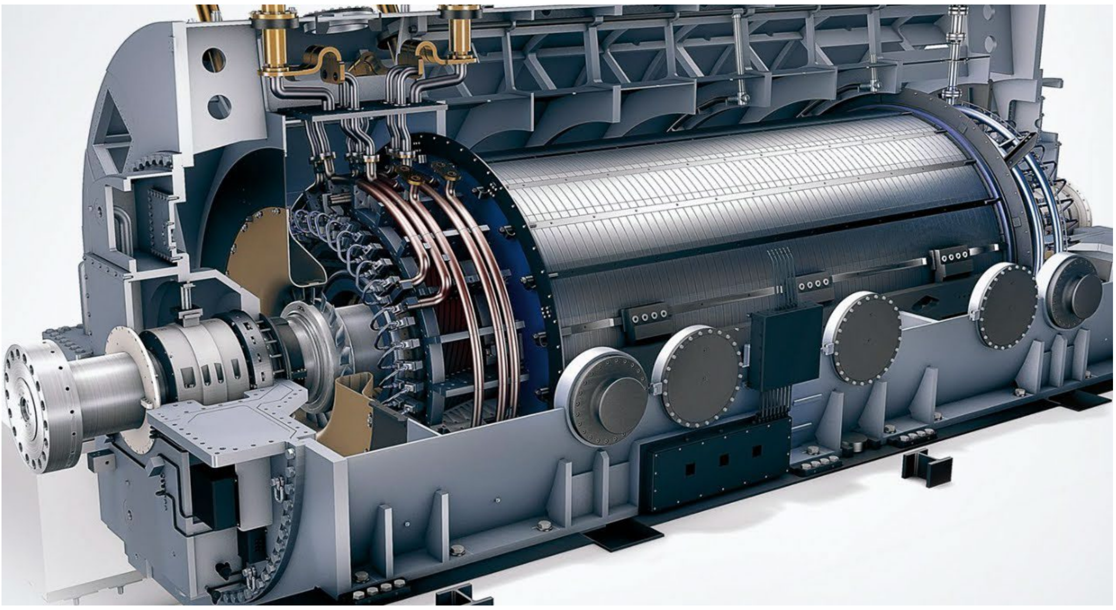


FRICTIONLESS LINEAR EDDY ELETROMAGNETIC BRAKING

RAIDIENT TUBE STEAM BOILER



STEAM TURBINE



ELECTRICAL GENERATOR

Feasibility

This discussion paper refers to the following published documents.

1. The Australian Government COAG Energy Council published a report paper on a National Hydrogen Strategy addressing Hydrogen support for electricity systems which coincides with this discussion papers proposal.
   The concept addresses the lack of an explicit market mechanism in the National Electricity market to value storage.

2. The US *Department of Fossil Energy and Carbon Management* turbine program has identified that using Hydrogen with gas turbines will increase the overall energy cycle efficiency approaching 80%.
   The US Government recognises the importance of Green Hydrogen produced from solar electrolysis and in 2023 announced a tax credit of $3.00 per kilogram plus investors can claim up to 30% investment tax. Other countries have similar schemes.

3 According to a research paper produced by GE dated February 2019 an equivalent stand-alone Gas Turbine the *GE 6F-03* being operated without Turbo fan and without energy recovery was capable of 87Mw.
The peer reviewed report substantiated Hydrogen calculations for the 6F-03 turbine that place the heat output at 857GJ/Hr, Hydrogen (H2) flow rate 78,000M3/Hr requiring water at 68M3/hr and requiring Electrolysis power of 3,600 GWh to supply 100% H2 flow for 8,000hrs.
The published report concluded that hydrogen fuel produced from renewables to power gas turbines and generate electricity was a bankable product.

The similarities of the 6F-03 turbine varies significantly from the "*Trent*" hybrid platform in that it makes no provision for recovered water through the closed loop recycle condenser nor does it consider energy recovery from the Variable Frequency Generator, resultant heat to produce steam nor utilisation of the resultant thrust energy from the turbofan to amplify the power output.

To remove any doubt that the 330 Mw concept is feasible from the "Trent 900" platform, consideration only needs to be given to the availability of the *GE SDF -D250* Steam turbine that has a 100-300Mw Non reheat capability up to 140 bar/565 C including the *STF D650 200-700Mw* with reheat up to 190 bar 585 C. Cost range in 2023 for a turn key generator package is reported between US $670 to $1,149 per base Kw but proportionally reduces as Kw increase. The life span exceeds 50 years. Both steam turbines are operational within the Gas Turbines Maximum heat range of 1,700 degrees Celsius.

The problems that have held back Solar hydrogen Turbine development is that gas turbines are traditionally noisy and historically, hydrogen fuel is volatile, not suitable for long term storage and can affect metal parts that are incompatible for the purpose.
Modern Turbofan construction with its unique "Boomerang" shaped blades and planetary gearbox have not only overcome the noise problem but also the development of materials such as third generation single crystal material and thermal barrier coatings such as *Ceramic Matrix Composites* has overcome metal and heat incompatibility which address Hydrogens unique molecular properties.

The modelling includes bypass storage for converting the gas to liquid for short term storage including battery and in operation storage for electrolysing to compensate for periods when sunlight is not available.
As a back-up, sustained energy is also available when the individual turbines are not in use as energy stored in optional batteries and the solar cells photovoltaic process can still feed into the grid for isolated linked electrolysis purposes to allow loadings to be balanced from strategic conversion points.

(Emerging technology such as Titania Ceramic photoelectrodes and shadow photovoltaic developments are poised to significantly increase the efficiency of solar panels. Current day solar cells have a 40% efficiency but only 8% has been adopted for this modelling.)

(Earlier research going back decades established that Hydrogen can also be produced in vast quantities at room temperature without energy input, using any source of water mixed with a catalyst comprising three parts of gallium to one part aluminium [3:1 composite.] The gallium removes the aluminium oxide coating to produce aluminium nanoparticles that strips the oxygen from water to leave Hydrogen.
Aluminium waste is easily sourced; Gallium is more expensive and less abundant but can be recovered and reused without losing effectiveness.)

(A more recent development is using catalytic electrodes and perovskite solar cells fused together in a single unit. Immersed in water under sunlight creates hydrogen.)

The advantage of selecting a modern Hydrogen Turbofan as compared to an industrial gas turbine for use in a closed loop operation is that operational noise is significantly reduced, the turbofan provides additional by-pass thrust to govern temperature control, aviation fuel can be replaced with hydrogen fuel which was the originating fuel used in the development of the Gas Turbine and Oxygen produced from the electrolysis process can be used as a lower temperature combustion catalyst to increase the engines efficiency.
In addition, a Hydrogen Gas turbine package plant is a natural selection to avoid the "*Renewable Energy Zones*" required delivery systems that include Synchronous Condensers, Compensators and Power Flow Controllers including the newer technology relating to Grid Forming Convertors.
A particularly important oversight is that any *Renewable Energy Zone* by its very expansion will become a strategic target in the advent of Australia becoming involved in any military conflict.
There is also the increasing risk of the Energy Grid becoming a target for criminal or rogue state hackers. This cybersecurity threat is heightened because *Renewable Energy Zones* can only be operated with above ground vulnerable compensated delivery systems. The more Complicated the system the more vulnerable it becomes.

If climate change is to be taken seriously than underground transmission becomes the responsible option to address the long-term problems.

Another safeguard for continuous operation is a turbofans ability to continue to operate even when subjected to adverse environmental conditions such as blizzards, freezing temperature, earthquakes, hurricanes, hail, dust, bushfire, and water inundation. Turbines will also continue to operate even when inundated with Volcanic Ash providing the turbine's operating temperature is maintained below 1100 C to prevent silica fusing onto the turbine blades and nozzle guide vanes.

Stages.

1. **Stage 1**. Rated under Standard Test Conditions (STC) and based on an irradiance of solar fusion at 1000w/h per square meter, a solar array of photovoltaic solar cells measuring 1,400 square metres (37.5 x 37.5m=823 solar panels using direct current 12 volt (generates 24-48 volts) off the shelf electrolysing technology produces during average daylight a target range of 12kg of Hydrogen and 6kgs of oxygen per square metre/hour.
   Electrolysing at just 8% efficiency using natural water without a catalyst is sufficient to produce enough Hydrogen including overnight storage to power an 86 Mw gas turbine for a 24-hour 365-day period.
   During turbine operation the *Variable Frequency Generators* generate *use as produced* Hydrogen to supplement the solar panels electrolysis.
   Overnight storage is achieved with by-pass Hydrogen Fuel during irradiance periods.
   (Comparison-823 electrolysed solar panels used at 8% efficiency produces sufficient fuel to generate 330Mw. Direct grid feed from solar panels is only 301Kw at 40% efficiency.)
   (Solar Panel size 1400/ 1.7x1.0=823 panels 823/18= 45x6.6=301 kw)

2. **Stage Two**. Hydrogen derived from the electrolysing process powers the turbine and direct axial connection generates 86 Mw at 51% of the engine's efficiency.

   (Being a three staged system, the proposal can work as a standalone turbine operation or converted to an energy recovery operation utilising thrust and steam energy.)

3. **Stage Three**. The resultant thrust from the turbine's combustion process and turbofan bypass air spins another two turbines using the same principals as a combustion engine turbocharger. This process can produce up to 86 Mw of power as the resultant thrust is

at the peak of the engines power band to drive the front mounted axial connected generator and because there is no mechanical connection all thrust is converted to electrical generating torque. The gas turbines optimal rate of spin is between 2500-4500 with an exhaust speed approaching 2000Kph. The resultant jet thrust is controlled by "*Frictionless Linear Eddy*" electromagnetic braking technology to govern rotation speed of the Turbo chargers without the need for a variable regulating gearbox.

4. **Stage Four**. Radiant heat from the jet stream produces steam as the turbine exhaust approaches 1700 degrees Celsius. This operating temperature when calculated using the "Rankine cycle," water can be heated to the required constant 275C at 50 bar, and with bypass turbine thrust assistance is sufficient to produce enough energy to work two 55 MW steam turbines between 47% and 60% efficiency. (The same technology used in coal fired and nuclear power stations.) The steam flash area contained within the Radiant Tube steam boiler is not only used to generate steam to drive the steam turbines but also acts as the primary "Hush Chamber" to quieten the jet stream.

   The advantage of using Turbofans for steam generation is that the thermodynamic efficiency increases as the average temperature of the cycle can be kept in a constant isentropic state governed by the amount of fuel used. This process becomes more efficient when using the by-pass thrust from the turbofan to control the thermodynamic efficiency via regulating variable vanes to control temperature and capture bypass thrust as recovered energy.

5. **Stage five**. Turbofan bypass air not only regulates the temperature for steam flash but also merges with the remaining jet exhaust thrust as recovered energy to drive a final rear mounted 48 Mw radiant heat turbine. (There is also capacity to incorporate an additional rear mounted *free turbine power shaft* to drive an additional 20Mw generator) This uses the same principals as the steam turbine the only difference is that steam is replaced with jet exhaust. This has a two-fold purpose. The radiant heat turbine not only slows the direct air velocity from the jet stream but also acts as a secondary dampener by harnessing the turbines noise and converting the noise to harnessed energy to further quieten the jet thrust. The remaining bypass thrust is fed via turbine impellers to assist bypass steam and aids in the depletion of turbine thrust. Operational pressure is equalised and regulated by fail-safe industry pressure relief systems.

(The final drive can be set up in series to run multiple thrust generators based on the same design principals used in Hydro, Coal, and nuclear installations)

6. **Stage six**. By using the "*Pre Cooled Jet Engine*" principal the dissipating radiant heat and steam travels through heat exchangers to condense and distil water vapour not only for reuse but also to pre cool and further quieten the exhaust air before equalising air pressure is redirected back to the engine intake where cooled oxygen obtained as a by product from the electrolysis process is injected into the fuel stream to increase the engines efficiency and significantly extend the engines service life beyond the 80,000 hr service interval.

Costing

For comparison, a new "*Trent*" 86Mw air worthy certified Turbofan including air worthy operational control equipment in 2023 costs up to US 25 million dollars. (adopted for the purpose of costing)
(With the same reliability but without airworthy certification the turbine cost is revised to 8.2 million.)
Auxiliary equipment is costed at $7.8 million. Facility and infrastructure at $3.7 million. ($7.6 for retrofitted Hydro platform)
Total 36.5 million
For a pilot installation, 20% or 7.3 million is added as a contingency and 5.7 million for research and development. Total 49.5 million.
(Equivalent to the cost of thirteen 2 Mw Wind turbines producing 26 mw or 0.13% of a 12 Mw Offshore Wind turbine)

In consideration of the Federal Governments extraordinary funding for renewable energy without a guarantee of meeting the Zero Emission target or claimed energy supply, continuity or end of operational life decommissioning, Solar hydrogen turbine electricity has the attributes to deliver a continual guaranteed supply at a sustainable cost that is well below the current ideology investment for solar, wind and hydro.

There are 5 Major Companies that build Turbo Fan Turbine Engines. They include *GE Aerospace, General Electric*. *Rolls Royce*, *Pratt, and Whitney*, and *Safran*.

There are two major companies that build Gas Turbines specifically for electricity generation and include *Siemens Energy* and *GE Gas Power.*

Ten Major companies build Steam turbines for electricity generation.

They include *Dongfeng Electric corporation Limited*, *Harbin Electric Company Limited, GE Power, Toshiba Energy Systems and Solution Corp, Shanghai Electric Group Co Ltd, Doosan Enerbility Co Ltd, Siemans AG* and *Mitsubishi Hitachi Power Systems Ltd.*

Companies that build Industrial Hydrogen Electrolysers include *Linde Plc, Air Liquide International, Messer Group, Air Products and Chemicals, Reliance Industries Ltd, Cummins Incorporated, Parker Hanifin and Hydrogenics.*

As previously mentioned, to gauge the concepts feasibility, the world's largest Hydro Electric dam, China's Three Gorges Hydro scheme is compared.
The Hydro Scheme cost US $26 billion to construct in 2012. Its thirty-two turbines have a reported generating capacity of 700 Mw each for a combined 22,400Mw. The turbines cost US 50 million dollars each. The water storage area to generate the energy is approximately 1036 square kilometres. The wall is 181 metres high and spans 2.3km.

On 2023 costings a Solar Hydrogen Energy Recovery Gas Turbine equal to China's Three Georges Dam would require sixty-seven installations including 307x307 (94,300) square metres of solar panels operating at 8% efficiency taking up a combined land area less than 40 hectares to produce the same energy for US $2.4-3.3 billion.

The decommissioned Liddell Coal Power Station in NSW generated 2000Mw. The land area occupied is in Square Kilometres.
6 Solar Turbines with 100x100 square metres of solar panels occupying 3 Hectare would produce the equivalent output.

The Snowy mountains Hydro Electric Scheme constructed prior to present day technology is reported to have a generating capacity of 3800Mw. It has an operational area of 5,124 square kilometres, includes sixteen dams, 8 km of aqueducts, 145 km of tunnels and 1600 Km of roads and railway tracks. Its transmission capacity is 4100 Mw.
Comparably 12 Solar Turbines with one hectare of solar panels covering a 6 Hectare footprint would produce the equivalent output.

In September 2023, the Federal Government using the CSIRO Gen Cost modelling claimed that it would cost $387 billion to construct seventy-one small Nuclear Modular Reactors generating 300 Mw each to service Australia needs.

The per capita cost is quoted at $18,167 while Large Scale Solar is quoted at 1,058 per Kw and onshore wind turbine at 1,989Kw.
The required land footprint for Nuclear is 2,840 hectares.

In comparison an 86- 330Mw Hydrogen Gas Turbine installation is costed at $36.5-49.5 million with a guaranteed 5-billion-year supply of Nuclear Fusion.
The 330 Mw solar turbine equivalent for Nuclear is sixty-five installations for $2.4-3.3 billion but only requires an operational footprint of thirty-three hectares.

Based on the projected cost of solar hydrogen to energy proof Australian without gas or coal dependency it is very important to note that the Federal government's decision to cap Gas and Coal in December 2022 is currently costing the Australian Taxpayer between $1.5 to two billion annually to subsidise carbon emissions being the very source claimed to be driving climate change and natural weather disasters.
Using the Gen Cost model, $1.5 billion would fund 62% of the required Solar Turbines to service Australia's energy needs.
If the cap is kept the compensation will increase but if lifted the consumer price for energy will inevitably increase as will inflation by a reported 0.5%.
This is a perfect lose-lose scenario for the environment and taxpayer but a perfect win-win double for the governments consultancy advisors who provided the decision-making feedback to the Federal Government from market providers on behalf of multi nationals.

Another matter for consideration is the possibility of the Government deciding on energy rebates caused by cost of living.
Any sustainable rebate costing more than $2.4 billion would meet the total construction cost of energy proofing Australia with Solar Hydrogen.

According to the report just one 300Mw Nuclear plant is costed at 5.4 billion, construction time 12 years but there is only 80 years supply of known minable Uranium reserves.
Two cost prohibitive and unproven projections predict extraction of Uranium from sea water to supplement minable reserves and *Fuel Recycling Fast Breeder Reactors* which theoretically will generate more fuel than is consumed is possible in theory but must be relegated to future advances.

At present Uranium, just like oil, has a finite supply and if history repeats itself without achieving the theoretical projections, then Uranium depletion with certainty will lead to global conflict as supplies are used up and demand increases.
In 2021 the reported cost to maintain a nuclear reactor is $200 Million per year for each 100-megawatt output producing one gigawatt per annum.

A Nuclear fission reactor because of its finite minable supply and long-term waste problems is only an intermediate solution to a protracting problem. There is nothing planned to replace Nuclear fission because unlike Solar hydrogen with a five billion year supply of solar energy it is incapable of addressing cumulative climate change caused by population growth that has grown from 1 billion in 1800 to 7.9 billion in 2020 and projected to reach 11.2 billion by 2100.

Green Energy Accumulative Costings

The examples of green energy under development strongly shows a vast cost disparity with little to no certainty of costings or guaranteed continuity of *Firming* for power output.

Systemic blow out costs for green projects such as *Snowy 2.0.* was proposed at $2 Billion to produce an added 2000Mw when construction commenced in 2019.
Snowy 2.0 is using Carbon Offsets based on Snowy Hydro confirming that its renewable energy procurement program contracted 888Mw of wind and solar facilities in 2019.
The offset does not include the upstream construction carbon footprint of a 2 Mw Wind Turbine installation quoted at 1,688 tonnes.
The projects operational land disturbance footprint is quoted at 620 hectares, requires two Double Circuit 330Kva overhead transmission lines cutting 10 Km through the Kosciuszko National Park, requiring a 120-metre-wide easement. The project is predicted to generate an estimated fifty million tonnes of CO_2 during construction.
The environmental impact includes the production of fourteen million cubic metres of excavated material with an unacceptable proposal to dispose of seven million cubic meters of contaminated tailings including rock containing asbestos into either Talbingo or Tantangera Reservoirs.
The projected cost has now exceeded $12 billion for a projected seven-year build and latest estimates expected to exceed twenty-nine billion over 10 years which will make the project cost prohibitive.
The claimed technological advances for Snowy 2.0 is based on a closed system that relies on cheaper green energy to pump water uphill to a

reservoir battery then releasing the water to drive the water turbines when peak energy is required.
Despite these claimed technological and engineering advances, gravity will always dictate that it takes more energy to pump water uphill than generated from downhill flow.
There is still no certainty that a renewable generating capacity will be available when required and based on past natural disasters there is no guarantee to future proof Hydro against climate change including the 11year sun cycle which ends in drought and bushfire and commences with flood.
History shows that Hydro dams are a prime military target.
The expenditure and environmental impact compared to an equivalent Solar Hydrogen package of six installations without the need to acquire carbon offsets, covering a total operational land footprint of 3 Hectares using existing transmission lines with natural disaster protection for a cost of $219 million dollars raises fundamental questions.

According to the 2020 *Levelized Cost of Energy* estimates per MWh the following costs were quoted.

- Solar $35 to $110.
- Wind $40 to $60
- Geothermal $50 to $80
- Nuclear $55 to $164
- Natural Gas $59 to $100
- Coal $60 to $112
- Natural Gas Peak $175
- Storage $132 to $189

Solar Hydrogen has a target production cost of $2 kg which places fuel costs (excluding oxygen for "*Pre-Cooled Jet Engine*") operating at 100% and producing a 51% efficiency for the purpose of the exercise at $12,960 hr for 6,480 Kg per hour of Hydrogen to produce 330 Mw ($39 per Mwh).

Carbon Market

Carbon Offset was designed to help consumers counteract the impact of expected or future emissions by investing in projects that counteracts the carbon burden by funnelling proceeds into renewable energy sources such as Wind Solar and Hydro. Carbon Credits in 2023 are trading between $40 to $80 per metric tonne. Carbon offsets are trading at around $ 3 to $5 per metric Tonne.

Solar Hydrogen qualifies for genuine Carbon Credits and Carbon Offset income with a net zero operational carbon footprint which is an added safeguard against Australia becoming a dumping ground for wind and solar farms including Hydroelectric projects to enable polluting industries to "*Greenwash"* their activity by securing Carbon Offsets to increase their pollution levels.
A good example is a foreign owned coal producer investing in Australian renewables such as wind and solar farms including Hydro to offset its extraction intensification and increase its carbon footprint.
This is relevant to a term known as *Stranded Assets* and covers a failure for carbon markets to adjust investment in line with the emissions target required to limit global warming.
There is a growing concern that points to systemic failures of the voluntary market as the carbon market is being flooded with millions of tonnes of poor-quality credits where polluting companies can set an *ambition* and because this is not binding to reduce carbon emissions, they are in fact being used to increase their emissions with the aid of offsets which is responsible for accelerating global climate change.
The sole purpose for Carbon Credits was to make it more expensive for regulated industries to pay for the carbon units they emit and disincentivise future emissions.

Estimates by BP put electricity generating costs per Kwh installed at Au700 for gas /coal fired plants and $4,700 for wind generated electricity.

To show the income cost variation including pointing out the current overuse and underutilisation of Solar Panels the following cost comparison used in this paper can be interpolated based on 1m2 of solar panels and electricity consumer cost of $0.30Kw/h.

Source	Expenditure	Return
Solar panel	1.0m2 X 0.35w/hr x 30cents Kw/h	= $ 0.105c hr
Hydrogen	1.0m2 X 12kg/hr X $2.00 Kw/h	= $ 24.00 hr
Turbine	1.0m2 X 86Mw/hr X 30cents Kw/h	=$ 172.00hr
Turbine /Steam	1.0m2 x 330Mw/hr X$0.30cents	=$ 660.00hr

As of July 2021, there were 4,800 Wind turbines in Australia producing 9,690 Mw. Excluding environmentally damaging installation and unsealed service roads generating dust levels, each installation with bushfire clearance protection and extensive chemical use to control vegetation regrowth requires 17Ha per installation.

Each Turbine/Generator costs Au $4 Million and with regular maintenance costing an average of $48,000 pa has a life span of 120,000 hrs or 13.6 years.

Studies undertaken into the US West Texan windfarms using satellite data between 2003 and 2011 investigated the impacts of wind farms on land surface temperature.
These studies concluded that wind farms are adversely affecting climate change and causing atmospheric temperature to rise as wind turbines convert kinetic energy into electricity.
In doing so the rotating turbine blades being higher than the surrounding natural features draws the warmer ground surface into a cooler atmosphere and because of heat convection the process is not reversed by drawing cooler air to the ground which causes warming of the atmosphere.
A compounding problem is related to the geographic locations for wind farms requiring the turbines to be placed in special patterns to suit the geography so that the turbine blades can collect distributed wind energy more effectively.
According to the studies the uplift caused by the rotating turbine blades is causing atmospheric warming which is a conundrum the wind turbines credentials were designed to prevent.
An observation as to how the height of wind turbines above the natural features affect the isotropic proficiency of natural temperature variations between ground and atmosphere can be observed in established tree lines that are naturally cropped to an equalling height.

The proposed offshore wind farm projects will allow wind turbines with capacity ranging from 12 to 18 Mw with projected operational and installation costs approaching $400 million each. The offshore projects are costed at $3,720 per installed Kw. The turbine power factor is represented by the following formula P=0.5pv3. (*Power being equal to ½ the air density X wind velocity cubed and the radius squared.*)
The size of the largest wind turbine the H260 18Mw turbine has been compared to the size of an A380 Airbus however, an overlooked factor is that the A380's four engines produce 344Mw, has an operational life of 14 years a new plane costs $446 million and weighs six hundred tonnes.
Another comparison is the proposed Illawarra offshore Wind farm that is projected to cost $10 billion to produce 2,000Mw.
The propensity for offshore turbines to also increase air temperature is connected to the extended height of the offshore turbines and global warming of sea water temperature.

The largest Gas Turbine is the 500,000 bhp *GE Harriet* that can run a 600Mw steam power plant. Its maximum noise level is 92.5 dB at the inlet plenum. Its fuel capacity caters for 681,000 litres of liquefied natural gas. Development cost was estimated by GE at one billion dollars. Its maximum power output can cause severe grid instability.

An 86-330Mw Solar Hydrogen installation is costed at Au $36.5 million dollars requires 0.50 ha of land and the turbine has a minimum maintenance free period of 80,000 hours and 14-year continuous life cycle operating at 51% efficiency. Unlike the GE Harriet the 86-330Mw turbofan design with aircraft efficiency effectively balances energy loads to protect against grid instability.

Comparably, 86Mw of wind turbines requires forty-three installations costing $172 Million, a land area of 731 hectares without a guarantee of a constant wind supply with an efficiency rating quoted between 20 to 40%.
The offshore 12 Mw equivalent is twenty-eight installations costing $11.2 billion which is more expensive than Nuclear.
The carbon manufacture and commissioning comparison weight for a 2 Mw land-based Wind Turbine installation is quoted at 1,688 Tonne. The comparable *Trent* 900 86 Mw turbine weighs just 6.5 Tonne.

In addition, wind turbines and solar farms require *Renewable Energy Zones* comprising a reported 28,000 Km of overhead poles and wires costed at $10 billion to prevent congested areas from becoming financially unviable because of differential pricing including the balancing of loads to allow for a congested relief market caused by curtailing to trade with unaffected generators. This aspect and decommissioning have not been factored into the total operational costs for Wind and solar.
(Allowing for a hypothetical error factor of 400% and excluding energy recovery capability would still make the Solar Hydrogen package a more viable and economic proposition to wind turbines.)

Environmentally wind turbine fiberglass blades are toxic, cannot be recycled, can only be disposed to land fill, visually polluting, amenity destroying, subjects prime Agricultural land to resumption. high mortality for birdlife, governed by favourable wind conditions and prone to damage from cyclonic conditions, land footprint and isolated dependant, bushfire prone requiring clearing and highly dependent on chemical use to control regrowth, A major bushfire fault requires turbines to be placed on top of escarpments which is the Achilles heel for bushfire attack. Turbines can also present a hazard to aerial bushfire fighting aircraft due to bushfire

smoke reducing visibility to the turbine structures. Requires all weather dust producing unsealed service access roads and have a noise level up to 105db A.
A more recent concern involves the turbine blades made from resin and fibre laminate shedding plastic Micro and Nanofibers contaminating air and farmland and with ocean turbines that risk is extended to the oceans. According to landmark research conducted by the *New England Journal of Medicine,* scientists have discovered nano plastics in human arterial plaque and studies are now being conducted to determine if the fibres are linked to adverse cardiovascular outcomes including heart attack and stroke.

Solar panels have the potential to be recycled as the panels are reportedly 75% Glass 10% Polymer, 8% aluminium 5% silicon and 1% copper. There is also 1% of heavy metals such as Lead and tin which prevents the panels from landfill disposal.
The biggest disadvantage for solar panels is the damage risk caused from large hail which potentially can cause leaching of manufacturing chemicals resulting in long term chemical pollution of soil.

It is planned in 2022 to install another 21,845 wind turbines. This coupled with the increasing uptake of agricultural land for solar panels and the controversial proposal for ocean-based wind turbines has collectively made Solar and Wind renewable farms environmentally damaging and unsustainable.
There is also an emerging question concerning a reported Deed Rate Return agreement with Multi Nationals that allows an undisclosed financial benefit paid by the taxpayer even if power is not generated from the installed renewables.

Reportedly the Australia Federal Government has committed $25 Billion Dollars for clean energy and renewable projects for 2022-2023 to meet the 2050 net Zero commitment. The unilateral takeover of targeted land required for *Renewable Energy Zones* is meeting increased resistance.

In 2023 The Institute for Public Affairs released a study report entitled ANALYSIS OF LAND USE BY VARIABLE RENEWABLE ENERGY PRODUCTION BY 2050. The study examined four possible scenarios and quoted sixty-eight million hectares, equivalent to 9% or the size of ten Tasmania’s would be required to transition to renewables.

According to Siemens Energy in Dec 2023 the demand for renewable energy sources for grid stabilisation technology will require an investment of at least US $21.4 trillion by 2050 to support a **Global** net zero trajectory.

In November 2021, the Australian Government released a joint media report claiming three million homes have Solar Panels that provide 7% of Australia's total energy needs. As of December 2022, there are reportedly 3.36 million PV installations in Australia generating 29.7 Gigawatts.

In comparison. Sixty-Five Solar Hydrogen installations to service Australia's electricity needs for hydrogen fuel only requires a generating capacity of 26 Mw equivalent to 3,000 PV installations.

Solar panels are available in 12-24- and 48-volt configurations.
In operation a 400-Watt solar panel has a voltage range of 44 to 48 volts for a 12 Volt panel, 88 to 96 volts for a 24-volt panel and 176 to 192 volts for a 48-volt panel.

Ohms law formula V=IR where V is the voltage, I is the Current and R is the Resistance.

Excluding commercial installations, the 2016 Census estimated there are 8.3 million dwellings in Australia with an average of 100,000 constructed per year.

Using daily average energy consumption for dwellings at 18 Kw/hr, just one 86Mw turbine plant utilising energy recovery can power 18,000 households.

(It is acknowledged that the costings are subject to change based on emerging technology, inflation, and currency rates. The following simplistic equation does not take into consideration that hydrogen has twice the BTU of standard fuel nor has there been a saving factor included for the added *Pre-Cooled Jet Engine* **efficiency principal, increasing solar efficiency from 8% to the present-day efficiency exceeding 40% or carbon credit and offset eligibility)**

COSTINGS ESTIMATE 330 Mw plant.

Facilities and infrastructure (one off) (9-year life span with optional 5-year contingency Av 4.05 million per year)	**Au $36.5 million**
Hydrogen production per annum	$**4.73 million**
Overheads and operating costs per annum	$**1.7 million**
Preventative Maintenance	**$0.2 Million**

Running costs per annum **$2.1 million.**

Expenditure total 45.23 million

9-year Annualised Total 12.78 million PA

Income (18,844 homes averaging $1,212 per quarter) **$91.35 million PA.**

Based on these figures and excluding Carbon Credits the EROI (*Energy Return on Investment*) component is Satisfied.

(Note: *Variable Frequency Generators* operating DC current can also be used to charge Optional Battery storage. This is costed at $0.8 Million per Mw. Construction costs break-even excluding battery storage is based on a 7-month return. 70 Mw battery storage is 3 years.) Fluoride-ion batteries because of their solid state are preferred over Lithium-ion batteries.

OVERVIEW

Environmental Issues.

Noise.

In comparison modern aircraft turbine noise at take-off and full power approaches 140dba at 50m. Jet exhaust noise is caused by the violent turbulent mixing of the exhaust gasses, influenced by the shearing action caused by the relevant speeds between the exhaust gas and atmosphere. Shock waves will occur unless governed to prevent the exhaust velocity from exceeding the speed of sound.

Advanced technologies are shovel ready to control noise. For example, the same technology that makes the inside of an aircraft cabin silent to its passengers such as the A380 Airbus, four Trent 900 turbofans at take-off power is measured at a maximum of 69.5 decibel. The same technology to quieten the turbines operation to the environment is simply reverse engineered. In addition, the high quality of balancing rotational forces, land based "*hush channel*" with damping and added energy recovery, noise cancelling equipment and vibration suppressant mountings like that used in jet engine testing facilities can also reduce operational noise levels to a modern factory environment equivalent to sixty decibels at sixty metres. Additional noise reduction measures include turbofan with planetary gearbox and changing the pattern of the exhaust jet to include diffusing outlets surrounding the main jet stream without efficiency loss. The achievable turbine noise reduction level is significantly less than a modern coal fired electricity generating plant, or nuclear reactor workplace level of 85-90 dB or a 2Kw wind turbine which generates an operational noise level of 105dB at 50m.

Water.

There is no operational water pollution caused by either hydrogen combustion, steam generation or the electrolysis process. The benefit of recovering water vapour for recycling from the hydrogen combustion process and steam condensing system is the same as that used in Coal and Nuclear plants and treats water to a pure condition by distillation for reuse.

Air.

An added benefit of the gas turbines filtered air operation is its natural selection for emerging technology such as Direct Air Capture (DAC) of CO_2.
Instead of using multi fans to draw in atmospheric carbon rich air for collection on potassium Hydroxide filters the plenum air from the turbine's intake maximum of 1,245 Kg of air is filtered at a volume of 100 kilograms (814 cu m of air) for each kilogram of hydrogen fuel consumed which provides both filtered air for the turbines operation but also captures atmospheric carbon content which exists in atmospheric volume at 0.04%.
This process not only assists in the decarbonisation of economies but also provides carbon free electricity as a negative emission because the energy being generated from the Turbines Hydrogen fuel is carbon free.

Because hydrogen and oxygen are the primary source of fuel there is no carbon production as hydrogen reverts to water after combustion and sustains a zero-carbon footprint. However, Hydrogen combustion will create NOx.
NOx also occurs naturally during lighting events and during extreme bushfire events due to the extreme heating and cooling process.
In copious quantities NOx is dangerous to the environment including human health which is attributed to lung damage, breathing and respiratory problems. NOx is formed by endothermic reaction such as hydrogen being burnt at a gradient temperature of 1,350 degrees Celsius. Above this temperature gradient, NOx disassociates into its atomic state.

The primary source of NOx caused by combustion comes from the ambient air itself as Nitrogen and Oxygen react together under elevated temperature.
To eliminate NOx formation from hydrogen fuel, research has determined it is as simple as slowing down the rate at which the fuel and air mixes. This is a design known as lean burn technology which is incorporated into modern Turbofan gas turbines.
Diffusion flame will also avoid the formation of NOx.
In the advent that NOx is formed to a natural detection level accepted as 25 PPM it would be either neutralized by the operational exhaust heat above 1,350 degrees Celsius and arrested in the closed loop scrubber process. Other available control methods include selective catalytic reduction, lean NOx traps and exhaust gas double burn recirculation.

Safety

Hydrogen fuel just like any other fuel is by its nature explosive. Current technology has addressed storage problems and developed storage methods that enable it to be stored and contained in the same manner as fuel is stored for automotive use which makes it no more dangerous than standard fuels.
An added safety supply and associated storage hurdle is to use the fuel at the point of production to enable a use and replenish operation to compensate for periods when electrolysis is less effective.
Theoretical pressure explosions from sources such as hydrogen leakage, sabotage, natural disaster, military threats including internal and external environment sources such as fire, gas and rotational failures have been considered.
In the unlikely but possible advent that fundamental Construction shielding, automated fire suppression and industry pressure fail safe shut down relief mechanisms were to fail causing an explosion then the insulating encasement of the turbine, steam generating facilities and gas storage becomes the last line of defence which incorporate a construction design to allow any explosion to vertically vent to prevent horizontal pressure damage.

Positioning

All major projects that have the potential to environmentally impact on communities are required to undergo environmental assessment as to specific project positioning to have the best outcome for its operation and avoid potential impact on the wellbeing of a community.

In the case of solar hydrogen the prime location is Australia's 24 coal fired plants and particularly the existing 120 Hydro electric schemes. Retrofitted Hydro schemes is the most preferred sites as there is a reliable water source, isolated from communities and have existing infrastructure for both electricity generation and transmission.
The unassuming benefits is that solar hydrogen electricity can be used to pump water for hydro battery purposes without having to rely on grid feed and supply carbon free energy without having to rely on auxiliary back up operations such as Snowy Hydro's carbon offset projects that rely on natural gas and diesel peaking power plants that have a high carbon footprint.
There is also the symbiotic relationship of having backup hydroelectricity for hydrolysis in the advent of unscheduled solar or variable frequency generators being compromised but, predominately Solar hydrogen is of greater benefit to Hydro then Hydro is to solar hydrogen.

Benefits

Gas Turbines were invented in the 1930's and originally designed to run on Hydrogen Gas. Hydrogen is still the most efficient fuel for gas turbines and are simpler to build and operate than conventional aviation fuelled jet engines.

A significant advantage of hydrogen turbine use is its package convenience that allows the units to be constructed using today's technology. There is also the minimisation of complexity associated with distributed energy resources connected to the Grid such as the small-scale generators.
In addition, it addresses the Architecture and stability for distributed energy resources including the *Global Power System Transformation Consortiums* primary interest, being for the rapid decarbonisation of the power sectors. Unlike Hydro, Nuclear, Grid feed Solar farms or Wind turbines a package plant can be strategically located where base loads occur such as existing pole and wire grid conversion points to balance demand when grid supply cannot service energy demands.

One of the biggest benefits of using minimal concentrations of solar panels in geographically linked series throughout the Australian mainland for hydrogen production instead of direct grid feed is to take advantage of Australia's usable sunlight irradiance. This concept is intended to manage irradiance periods to prevent demand exceeding supply and avoid blackouts or energy rationing.

One of the contested problems with renewables is that they are ineffective when the wind does not blow, and sun does not shine.
According to some energy experts this is incorrect and would be overcome by linking geographically isolated wind and solar to the grid but that can only be done by constructing expensive *Renewable Energy Zones.*
According to the AEMO there will in addition to renewables be a large demand on storage such as batteries, Hydroelectric and gas fired plants.
There is also a claim that renewables for the whole of Australia will come with a $121 billion cost to decarbonise the electricity system.
According to the Grattan institute that is an economic activity cost made up of jobs and materials however, that claim is questioned on the basis that the expenditure would be better spent on more economic and productive energy projects.

According to the Australian Energy regulator approximately 8% of retail electricity is transmission and 35% related to distribution expenses.
The CSIRO Gen Cost report claimed that the integration of renewables will provide the cheapest form of energy based on $94 to $134 per MW /hr in 2023. Coal was assessed at $110 to $217 per Mw/hr.

The revised costing shows a significant increase from the 2020 *Levelized Cost of Energy* that was quoted as Solar $35 to $110, and Wind $40 to $60 and this cost can only keep on increasing.

According to the NSW Agricultural Minister of the Minn's Government stated that renewables would only take up approximately 55.000 hectares.

Solar Hydrogen has not been considered in the CSIRO Gen Cost report but is costed at $39Mw/hr using existing transmission corridors and retrofitting the remaining 24 coal fired and 120 Hydroelectric platforms with sixty five Solar Hydrogen plants to service Australia's total energy needs with zero carbon emissions from an operating footprint of 33 hectares and a 2023 costing of $2.4 -3.3 billion.

Overhead Transmission

The modernisation of any poles and wires to service renewables should be underground not only to protect supply systems from intensifying storm events caused by climate change and raising sea temperatures but also to prompt a rethink on the distribution of energy supply as should the methods that govern the consumer price paid at the meter.

The proposal to spend over ten billion dollars to unilaterally link isolated "*Renewable Energy Zones*" will reportedly require 28,000 km of environmentally damaging lines and wire which not only socially impacts on land ownership and farmland resumed for the purpose but also destroys the amenity of the community.
The savings made by Solar Hydrogen would make it more cost effective for underground transmission which has not been a serious consideration in the costings prepared by consultants on behalf of overseas investors as the cheaper poles and wires is intended to give the investors a greater return at the cost of Australia's environmental destruction.

Overhead high voltage power line steel structures face an increased risk of collapse as climate temperatures rise. They are also prone to increasing the induction risk of fatally electrifying metal structures such as farm fences and metal sheds and other steel structures as these structures are classified as exempt development under planning legislation and are not effectively regulated against construction under power lines with the same safeguards afforded by the planning assessment process.
There is also the health risk of increasing electromagnetic radiation from overhead poles and wires compared to underground.
Experts from the International Agency for research on Cancer (IARC) working group classified ELF-EMFs from overhead high voltage power lines as "possibly Carcinogenic to humans." by constructing an additional 28,000km that risk increases as does the risk to electricity disruption caused from solar storms such as the *1859 Carrington Event* which if occurred to the modern overhead electricity grid would be catastrophic and one of the primary reasons why power grid failures are termed as S*ignificant Risk Events.*
There is also the consideration of the increasing risk for a hostile military electromagnetic pulse which can be significantly reduced by a *Faraday Cage* protected underground transmission system.
The Solar Hydrogen proposal questions if the expenditure and environmentally damaging development of renewables is sustainable given the intensifying pushback that the high impact pole and wires, intensive solar farms and wind turbines including Snowy 2.0 are having on the natural and built environment.

Reportedly, overhead power transmission lasts for up to 70 years and underground 35 years. Cost for overhead is ten times less than underground but have a substantially higher maintenance cost. Overhead power lines use the surrounding air for insulation while underground requires thickened insulation. Overhead lines are prone to lighting strikes,

mechanical impacts, falling trees, wind damage and causing bushfires. Maintenance includes extensive chemical use including the use of organophosphates and continual vegetation clearing. Power lines as do wind turbines and solar farms require environmentally destroying bush fire buffer zones while underground is protected. Power outage for underground is halved but more difficult to repair. Low voltage is suitable for underground and above ground is suitable for both low and high voltage.
According to *Ausgrid* in 2023 it will cost consumers between $1,200 to $2,200 for 40 years to place transmission underground and cost consumers approximately sixty billion for renewables. Inevitably these costs will be passed on to the consumer.
Those projected costs in support of renewables have already been incurred by the consumer through increased electricity prices.
The asset value for the electricity network in 2023 is quoted at just over $100 billion dollars. There is no available figure for overhead poles and wire maintenance which would offset the cost of underground transmission.

According to the *World Economic Forum,* Climate Change attributed costs caused from extreme weather events between 2000-2019 at $16 million per hour. If Climate Change is to be taken seriously then it is economically feasible to locate all power transmission underground to future proof energy delivery.
The latest state of the art research involves high power gas insulated underground transmission that involves very high-power capability, low capacitance, lower resistance losses, negligible magnetic fields, no aging phenomenon of the insulating system and maintenance free design which is already under development by the IEEE SA Standards Association.

The Clean Energy Council reported in 2018 there were 120 Hydro Electrical Generation stations providing 33% of Australia's Clean energy Generation. A hydro station is a perfect operating platform to construct solar hydrogen installations.

In summary the 2023 CSIRO Gen Cost report calculated a total of seventy-one 300Mw Nuclear plants would service Australia's energy needs for an estimated cost of $387 billion. Snowy 2.0 has now exceeded $12 billion for 2,000Mw.
The Nuclear equivalent of Sixty-Five 86-330 Mw Solar Hydrogen installations for a cost of $2.4 billion (even allowing for each installation to be costed as a pilot plant for $49.5 million per platform would place the total cost at $3.25 billion.)

By strategically placing linked Solar Turbine plants throughout the mainland on existing energy grid lines conversion points there is a reduced need for poles and wires. Unlike that experienced by wind turbines the units can be linked in series to sustain constant electrolysing production from existing grids because a gas turbine is capable of instantaneously bridging sudden frequency drops and operated from a central control point by remote control with aircraft efficiency anywhere within the linked series.

Hydrogen Gas existing as a natural reserve is small because of its tendency to weakly bond with other natural elements. Being the most abundant of elements Hydrogen can be produced on an environmentally responsible commercial scale to separate it from other bonded elements.

The use of solar cells to create electrolysis from sunlight is self-perpetuating. Solar panels capture protons from the suns nuclear fusion known as proton-to-proton chain reaction which creates enormous amounts of energy as the Sun's Hydrogen is fused into Helium to create sunlight. Solar panels capture protons from the suns fusion process and creates electricity for electrolysis and releases hydrogen from its bonded elements.
This process is a far superior preference over present technologies that are reliant on the suns resultant energy to create wind and direct energy feed from solar constants that become unreliable energy sources due to intermittent disruption as the technologies without battery storage causes energy curtailment, because the energy supply cannot store its energy, nor be used outside their resultant natural energy sources which is the sole contributor to energy congestion and firming.

Using Solar Panels to feed electricity directly into the grid instead of producing electrolysis is not only self-defeating but also counterproductive as substantially more expatiating energy can be extracted from less solar panels by the electrolysing process.

Another significant benefit is battery storage viability generated from both the turbines *Variable Frequency Generators* combined with solar panels which can use bypass electrical energy available to charge lithium-ion batteries constantly and continually for direct electrolysing or grid feed purposes.
This is an option but not recommended because of lithium's consumable, mining, and recycling inefficiencies.

The closest comparison to a solar hydrogen turbine is a Nuclear Reactor. However, Uranium comes with historical problems as it requires mining of a limited resource and a purification process which produces a long lasting and dangerous by product.
While Nuclear Fission from Uranium splits atoms to create energy, Solar Hydrogen is produced from Nuclear Fusion that creates sunlight.

Sunlight fusion unlike Uranium is a purer and safer form that is available and essential for life. Natural sunlight created by the sun's Solar Fusion produces a constant 1kw of energy per square metre with an estimated 5-billion-year supply.
Uranium supplies based on current extraction rates but excluding reserves for new online reactors are reportedly estimated to have an eighty-year reserve but carries with it, thousands of years of unsafe legacy.
According to the OECD and IAEA excluding all other uses of uranium the worlds known minable Uranium supplies is quoted at 8.74 million Tonnes. The world's total operational nuclear reactors in 2023 require 67,500 tonnes per year.

Environmental impacts from Ground fracking have also been considered as Solar Hydrogen gas produced from solar panel electrolysis will negate the need to continue extraction of Natural Gas to fire planned Natural Gas power stations or hydrogen production.
According to IRENA approximately 47% of global hydrogen production comes from natural gas and 76% of hydrogen comes from steam methane reforming of Natural gas. The Federal Government has committed $53 million in 2023 to fund gas fracking projects which is a high emitter of methane and Carbon dioxide and predicted to raise Australia Greenhouse gas emissions between 7 and 22%.
This figure does not take into consideration the dangerous fugitive gas escapes that include *Benzene, Toluene, ethylbenzene xylene. hydrogen sulphide* and *nitrogen oxides* including *volatile organic compounds,* Fine particulate matter, and silica dust. Ground fracking has a disastrous historical environmental record because of its significant impact on water contamination, heavy chemical use to control vegetation, waste disposal and impacted land use including an inability to remediate because of the operational depth varying from 1,600 to 3,000m.
The land area and number of wells currently used for gas fracking in Australia is undisclosed but as an indicator Australia's largest gas producer Australia Pacific LNG is currently seeking approval in 2023 to frack an additional one thousand wells in Queensland.
The required operational land varies from 1 to 2 hectares but does not include additional land for infrastructure such as pipelines, dust

producing unsealed access roads and storage tanks. The industry is ventured by overseas conglomerates that are driven by the largest return for the least cost which makes the Australian environment again the end loser and that will not only impact on Australia's future generations but contribute to the very greenhouse emissions that are causing climate change.

With the increasing scientific predictions of escalating climate change and global warming causing sea temperatures to rise with resulting severe storm events perpetuated by massive land clearing and land forming for power line construction and greenhouse gas production to address the growing human population which is the driving force for climate change, it makes no logical sense to deny the benefits of technology that exists today to sustainably produce clean economical and continual renewable energy until more proven efficient outcomes can be developed.

The reader can be left with no doubt that the technology and intellectual ability to construct the projects to achieve 100% of constant renewable electricity target is achievable with solar hydrogen. It will not only future proof Australia's electricity supply but also be carbon free.
Based on the CSIRO's Gen Cost report identifying seventy-one mainland nuclear installations generating 300 Mw each would service Australia needs. That can be done with solar hydrogen without reliance on Nuclear, Hydro, Wind or Solar farms for less than 10% of the 2023 projected final cost for Snowy 2.0 and with its modular turn-key construction platform the projects can be done in half the time.

History has never been kind to mankind's ideological developments that produce short term gain for long-term legacies.
Unsustainable renewables resulting in environmental destruction and loss of amenity without achieving targeted outcomes or contingency for end-of-life plan falls into this category and the primary reason as to why there urgently needs to be a rethink on more efficient use of existing and proven technology.

This discussion proposal demonstrates a practical alternative solution to an economic and social world problem because the present solutions currently being employed to meet unachievable targets are based on the same ideas that created the problems.

This concept has only one hurdle and that is commonly known as the *First Responders Disadvantage.*

In conclusion, the reader will readily understand the identified benefits and for the others, with the greatest respect for their reasoning, it may not be their time.

END

John Kite
December 2023

4 July 2024

Office of the Independent Planning Commission NSW

[redacted] [redacted]

135 King Street Sydney NSW 2001

Re: Proposed Hills of Gold Wind Farm, Nundle NSW SSD-9679

I refer to my reply to the reopened submission and the issue as it relates to the Discussion Paper marked “Not for Publication”.

Following discussion with IEAPTET and reviewing the panels public submission guidelines I have taken into consideration the following statements.

The Department’s response concludes, in part, that: …. based on IEAPET’s advice that constructing 62 turbines is the only viable option for a wind farm to proceed at this location and given the lack of other mitigation provided by the Applicant, the Department recommends that it would be in the public interest to approve turbines 53-62 to provide 384 MW of renewable energy to the State of NSW, with strict conditions for the acquisition of Lot 47 DP753722 (the land which contains DAD01

The Panel will only consider submissions received directly from the person making the submission……… Submissions must specifically relate to the new material only.

A conflicting point is raised with the departments statement that “*it would be in the public’s interest to approve turbines 53-62 to provide 384Mw of renewable energy to the state of NSW*”.
Given that each proposed 6mw turbine under favourable conditions is only capable of 20-40% efficiency, the approval of 62 turbines would provide an intermittent peak maximum of 372Mw.

I request the panel disregard my earlier submission submitted on 30/6/24 and accept my revised submission objecting to the 62-turbine proposal. Please note the “Not for Publication discussion paper is lifted to allow my reasoning for the alternative to be considered.

Yours Sincerely

John Kite