Renewable Hydrogen Target

Submission from Siemens Energy

To whom it may concern,

Siemens Energy is an end-to-end technology partner for the energy transition. On the SWIS network, there are E-class gas turbines of Siemens origin located at Kemerton and Neerabup.

The topic of hydrogen co-firing for these E-class gas turbines is rig-tested, and our first pilot will take place end of 2023 in the Asian region for a Taiwanese public operator, followed by other of our customers in Asia having the same model gas turbines. We have discovered through this journey that often the challenge is the volume of hydrogen required, not so much the limitations of the burner technology and control systems which may require only a minor investment. The lead time for such projects are approximately 18 months. Unless the hydrogen supply can be solved for the volume (and pressure) required, the pilots often proceed with trucking hydrogen for a duration of 1 week. (Often the supply is grey hydrogen during these tests). Further, it becomes again a waiting period until renewable hydrogen can be piped to site. Therefore the underlying context for our submission, is that the state weighs the implications of creating an efficient hydrogen supply chain backed by a practical plan for renewable hydrogen production such as a phased approach. In short, the gas turbine investment (and lead times) will be less concerning than the hydrogen supply investment.

Also, Siemens Energy will like to continue to provide sharing as required as the new renewable hydrogen target proceeds to the next stage. We have the experience on this type of journey in Grid Transformation and carry expertise on the Energy System Management perspective, that will involve aspects of modelling, technology pilots and capacity/resource planning.

Prior to submission of this consultation feedback, Siemens Energy was already actively engaging the gas turbine operators in Australia on energy transition topics around grid stability, by conversion of the electrical generators to synchronous condenser for grid

inertia. The generators will be able to function in either mode (electricity generation or grid stability mode) with a clutch, and more inertia can be provided by means of adding flywheels. As more renewables are introduced for the purpose of decarbonization, we believe we are in the position to provide end-to-end consultations so that a formidable plan is in place for the state.

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Renewable Hydrogen Target for electricity generation		
1	What are some examples of an objective or objectives that could be used to assess the benefits, costs and impacts of a Renewable Hydrogen Target for electricity generation?	• Powerplants providing electricity according to the Renewable Hydrogen Target could be rated higher in the Merit Order List and preferred supplier in case of overcapacity. • The Guarantees of Origins (GO) can be used as powerful marketing instruments by the electricity generators within the regional market in order to interest potential off-takers within the industrial sector as well potential private electricity consumers. • Objectives could be measured by Key Performance Indicators such as following: -net change in CO2 emissions (eliminate CO2) -round trip efficiency Will WA become a leader in energy efficiency? • Benefits based on current R&D and future prospects: -increase water vapour as a byproduct (can be transformed, condensed i.e. using hydrogen to create water in targeted locations)
2	How might other uses of renewable hydrogen be accommodated under a Renewable Hydrogen Target certificate scheme? How might Government otherwise support and/or encourage other use cases for hydrogen?	• Beside the Guarantees of Origin (GO) and inherent Book&Claim tracking mechanism there should also be the possibility to issue Proofs of Sustainability (PoS) acc. to mass balancing tracking method. Export products or commodities might need a PoS within to proof the GHG emissions in receiving countries acc. to their specific regulations.

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		• Mandatory quotas for transportation segments (rural, maritime, aviation) can support the decarbonization in this high carbon intensive segments. • Use of gamification or award for participating entities: Best performer with highest amount of decarbonization via Renewable Hydrogen Target can receive a label or price which then supports the marketing and enhances the entities market positioning. • Value of hydrogen compared to using fossil fuels (worth more by x... that delta gives value to the certification scheme) e.g. emissions measure, carbon tax credit, which is essentially levelizing the cost of hydrogen compared to other fuels. Set the certification scheme so that hydrogen becomes more valuable to purchase than other fossil fuels - and to levelize the cost with other fuel types.
Considering hydrogen		
3	What role do you believe renewable hydrogen can play in the decarbonisation of electricity generation? To what extent will a Renewable Hydrogen Target for electricity generation in the SWIS assist in achieving the decarbonisation objectives of the State Government?	• Hydrogen gives the most options for sector coupling - electrification, feedstock, storage, export etc.... It is one of the most flexible energy carriers known at this age with possibility to store energy for the longest periods of time. • What about tracking goods and commodities produced out of the “hydrogen electricity”? The green energy certificates shall be used as pre-condition for trade or to trade. • In the bridging stage, and in the scenario that it will take time to phase out coal. Then the preferred book&claim tracking method (GO’s) can be also used to greenwash

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		the coal electricity generation. It should be permitted for these kind generators to offset they carbon footprint with the certificates.
4	What role can the infrastructure associated with the production of renewable hydrogen (i.e. renewable electricity generation facilities, electrolysers, transport and storage infrastructure) play in the broader SWIS?	• Please consider the relevance of trading platforms. Is it mandatory to exchange or trade the certificates via trading platforms only or can there be also a direct exchange between supplier and off-taker in case of an existing contract? • Interestingly enough, due to the flexibility of hydrogen as an energy carrier for all known use cases for sector coupling today, there are multiple profit paths for producers, offtakers, end users to support the infrastructure and vice versa.
Technical feasibility		
5	To the extent you are able please reflect on some of the technical issues, challenges and considerations in the utilisation of hydrogen in the generation of electricity. To what extent can these technical issues and challenges be overcome? How should this impact on the consideration of a Renewable Hydrogen Target for electricity generation in Western Australia?	• For the consideration of blending hydrogen 1%vol, 5%vol and 10%vol, there is likely low impact to gas turbine operators considering the current burner technologies that exist. This will have to be checked case to case basis and other challenges will surface such as, the fuel throttling technology (which is directly related to the capability of the turbine control systems), safety/fire safety, and other ancillary considerations for additional monitoring. • The main challenge to the projects is the sheer scale of hydrogen volume required to implement a consistent 1%vol to 10%vol blend – and the production capacity that would imply equivalent, if not higher, renewable electricity supply for hydrogen production - not readily available today. The equipment lead time of delivery,

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		labour and land availability (for storage as well) are equally challenging to meet the demand of hydrogen-generated electricity. • Phased implementation as technology develops to mitigate risk is recommended, and it is ideal to start with commercially practical technologies. Set targets based on progressive development of technology. • Start with projects in the range of MWs and scale up progressively to GWs to allow for construction of renewables, and electrolyzer technological advancement. • The Gas Turbine OEMs will also be interested in an observation period to improve burner technologies around hydrogen co-firing as operating data report out the flame temperatures, flame speed and other observable data. This may determine viability of current burner technology to go for the longer term. Instead of test rigs, direct site observations go through similar process - implement, test, operate, analyse and improve the design. Operators also need hands on experience obtained via actual runtime/operation and given enough time, data interpretation may contribute to better design and higher round trip efficiencies. To date, we estimate round trip efficiencies for this use case below 40%. • Please take reference to our online calculator to reference the consumption and benefits: https://www.siemens-energy.com/global/en/offerings/power-generation/gas-turbines/hydrogen-decarb-calculator.html

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Certificate schemes for Renewable Hydrogen Target for electricity generation in the SWIS		
6	Do you believe a renewable hydrogen electricity generation certificate-based scheme represents an efficient and effective means to deliver a Renewable Hydrogen Target for electricity generation in the SWIS? Please explain your answer.	• Quotas to be implemented in specific industrial sectors supports the acceptance of the scheme. I propose to consider excluding specific sectors aiming to produce high carbon density products or commodities out of the hydrogen electricity from the participation of buying certificates to not enable any off setting in here. • Also stronger instrument for specific sectors in need for hydrogen electricity might also be an mass-balanced tracking Proof of Sustainability instead of just an GoO. Off setting or greenwashing in so called “dirty” industrial can be avoided by implementing PoS.
7	What are some other approaches which could be considered alongside a renewable hydrogen electricity generation certificate scheme that would provide a framework to deliver on the objectives or outcomes sought?	• See above. → Decide carefully about GoO vs. PoS with respect to greenwashing • Can blue hydrogen also be used for hydrogen electricity with a different certificate in order to scale faster? The erection of green hydrogen plants in this scaling might overwhelm the worldwide electrolyser producers. • Will ammonia also be considered as an alternative renewable fuel (RFNBO) to co-fired gasturbines in order to generate renewable electricity? • Get multiple (state) governments to agree on a scheme to develop a new trading / marketplace. Uniformity / standardization makes it easy for producers and offtakers to understand and agree on the production certificate of the hydrogen being traded.

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		• Traceability - verified source - prevents greenwashing – it is worth questioning whether these are the objectives or are there more objectives? A platform that can be further customized and scaled up for new requirements, may be the better certification scheme.
Liable entities		
8	Is the proposed approach of certification, deemed liability and certificate transfer an efficient and effective way to deliver on the intent of the Renewable Hydrogen Target for electricity generation? Are there alternative approaches which could better deliver on the objectives?	• Are the requirements of the certification schemes comparable to the most international accepted schemes like ISCC Plus? If not, the acceptance on a global basis might be a challenge for off takers aiming to produce exporting goods or commodities out of the electricity and in need for proofing the green origin. • Will there be different local and global certification bodies being recognized and licensed to audit and certify the electricity producers? What are the requirements for them in order to apply? Consider if the state government has a workstream working directly with consultants on this topic, or it will be part of a federal scheme?
Exemptions		
9	What are the benefits, costs and impacts of an exemptions regime for a Renewable Hydrogen Target for electricity generation?	• At Siemens Energy, we believe risk to human life is a cause for exemption. For e.g. if it is deemed unsafe for hospitals to proceed with replacement of diesel generators, this can be an exemption as compared to a facility like data centers which are not supporting any essential services to protect human life.
Non-renewable hydrogen		
Renewable fuels		

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10	Should the Renewable Hydrogen Target for electricity generation consider alternative renewable fuels as eligible for the creation of Renewable Hydrogen Electricity Generation Certificate? Why or why not?	• RFNBO's like ammonia should not be excluded. Some gas turbine manufactures are researching in blending natural gas with ammonia. At this moment, this creates another environmental issue with NOx generation but ignoring this point, is not the answer. A carbon equivalent of NOx must be / can be included in the certification. • Another argument is that the only alternative renewable fuels to consider must exceed in all ways the benefits of hydrogen. • Otherwise, it dilutes the value of hydrogen which the state is trying to push here.
Setting a target		
11	Please consider the benefits, costs and implications of a 1%, 5% and 10% Renewable Hydrogen Target for electricity generation in the SWIS on your business or industry, and provide commentary on how you would expect to react from a commercial and investment perspective to each target level.	• The current R&D for up to 1%vol, 5%vol and 10%vol is completed for our gas turbines, and R&D investments continue for higher blends of hydrogen depending on market demand. • We have observed that the noble thought process behind the use of hydrogen does very little for the electricity generation industry, simply because there is no hydrogen production to scale that can serve the demand of the gas turbines today. • The lower round trip efficiencies compared to using renewables directly also serve as a blocker. • In Siemens Energy, we deliver this message that the rationale for hydrogen combustion in gas turbines (and Combined Cycle plants) is derived from:

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		-Long term storage of renewable energy in chemical form -CO2 free power production at times of low intermittent Renewable Energy production -More efficient use of excess grey hydrogen -Provision of decarbonized heat through cogeneration (simultaneity of residual load demand for heat and power) -Fuel flexibility between natural gas and H2, can also be thought of as fuel security in which case this only makes sense when there is interest to increase the %vol blend beyond 10% up to at least 50%vol.
12	At a whole-of-economy and / or sectoral level, what do you consider to be some of the benefits, costs and implications of a 1% target, a 5% target, and a 10% target?	• Focus on the economies of scales on the production side • Round trip efficiency... the excess renewables are considered here but this complicates the grid management (SWIS operator) to understand that renewables in excess will be directed to electrolyzers as opposed to the case where renewables are built only for electrolyzers. There is much to consider on the production side even more from the point of view of grid stability and BESS, if we involve a community grid in the system. • Benefits and implications can be results of techno-economic modelling for the given scenarios and this is also part of the Siemens Energy services for the energy transition. Early planning on the manufacturing capacity,

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		skilled labour etc and working in partnerships to deliver all sectors will require substantial coordination. • Phased approach to allow for technological sprints may or may not be attractive to stakeholders.
Target terms		
13	Is the suggested approach of a medium term aggregate target, with annual entity targets, an efficient and effective means to achieve the objectives of the Renewable Hydrogen Target for electricity generation in the SWIS? Why or why not?	• The implementation of increasing quotas for specific industrial segments (cement, fertilizer, transportation | equivalent to the European Carbon Border Adjustment Mechanism CBAM) might be considered to scale the use of “hydrogen electricity” in a fast way. • Capital for hydrogen production and storage - how to offset the costs. Would developers make more money producing hydrogen or from selling electricity? What's more profitable?
14	To what extent should banking and borrowing of liabilities be permitted under the scheme? What are the benefits and costs of a borrowing mechanism as described in the paragraph above?	• Purchasing certificates should only be allowed for e.g. companies supporting one of the Sustainable Development Goals (SDG’s) in a good sense (e.g. not coal mining). Banking and borrowing can attract impact investors.
Scheme commencement and ramp up		
15	How soon do you believe a Renewable Hydrogen Target for electricity generation in the SWIS could be feasibly delivered from a technical perspective (i.e. if cost was not a consideration)? Please reflect on your own organisation and/or sector when providing your answer.	• As mentioned, phased approach to allow for technological sprints may or may not be attractive to stakeholders. • While insurance, brokers, financiers are no longer supportive of coal technologies and to some extent gas turbines, it does not mean that they understand the risks of investments associated with renewable hydrogen projects today.

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		• Again this comes from the massive scale of hydrogen volume required for the gas turbines on the SWIS. If the scale was any smaller, the CAPEX could not support the commercial viability, however, the current scale may not receive a green tick from the financial systems of today. • Therefore with a phased approach, the question of how soon does not automatically mean that we achieve the 1%vol by hitting the ground running and rather causes the question if we would produce, store and distribute the hydrogen at a later stage. Which makes a good rationale behind chemical storage advantage of hydrogen as a carrier.
16	Similar to the above, how soon do you believe a Renewable Hydrogen Target for electricity generation in the SWIS could be feasibly delivered from a commercial or economic perspective (i.e. if cost was a consideration)? Please reflect on your own organisation and/or sector when providing your answer.	• The Renewable Hydrogen Target can be launched and delivered in phases. For older generating assets there should be a longer timeframe (e.g. 3-5 years) to fulfill at least a minimum percentage of 5-10%. • Project phase strategies should also support cashflow for asset owner/operators and hydrogen producers. Phase the projects also so that manufacturers have time to meet demand. • The implementation shall be realized via rising quotas with only very limited exceptions. Most generation asset manufactures are already today able to deliver new gas turbines with an amount of up to 80% ability to co-fire. Upgrades for already existing gas turbines are in development. First prototypes are being installed currently. At the same time it is difficult to answer all customer demands for the variety of generating assets

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		at once. Often, the time to market is not the issue but the risk assessment / readiness of asset owners / mindset shifts could slow down the adoption. Wait and see is a likely reaction.
17	Over what period of time do you believe is an appropriate ramp up period for the Renewable Hydrogen Target for electricity generation in the SWIS? In providing your answer reflect on the actions your organisation and / or sector would need to take to participate in the scheme.	• A feasible ramp-up period can be a 10 – 15 years timeframe. Reasoning please see question 16. • Projects need sure partners, offtakers etc that would stabilize the project. Committed stakeholders, and their shareholders have to be on board... The first financiers and insurers will want to observe the teething problems, possibility of gas turbine derrates in performance (if any) and the reduced intervals between service (if any).
Hydrogen cost outlook		
18	In the short (<5 years), medium (5-15 years) and long (15+ years) term, where do you expect the cost of production of renewable hydrogen to move from the estimated levels of today? What do you expect to be the drivers of this change?	• The current market assumption is not too far deviating from a target of USD 1-2 / kg within 10 years time frame. • The cost of renewable electricity and an efficient supply chain around the projects will be drivers for change.
Hydrogen demand and electrolyser capacity		
19	To what extent to you believe the above scenarios are reasonable and achievable? Please explain your answer with reference to your previous answers regarding the objectives of the scheme.	• Keeping a focus that hydrogen will be the most flexible and clean energy carrier for our mutual future, and the effects of carbon economy on climate change/human survival – these will keep the demand for hydrogen on track. • Continuous development of more use cases in sector coupling and the innovative start-ups that are being

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		funded today, also push the needle nearer to reason and achievement.
20	How would you expect the levels of hydrogen demand for electricity generation in the SWIS to be met at various points in the supply chain? Would you expect a single generator would emerge and provide all certificates?	• From an international or country-to-country perspective, a single generator in a region can be the case for Australia. Where there is high production factors and high demand elsewhere in proximity to Australia. • To further deliberate on this scenario, Australia will need to participate in an internationally attractive market, e.g. USD markets and collaborate with high-sensitive green supporters / sustainable adopters like EU on certification schemes. This will ensure the SWIS remains relevant domestically and internationally. The SWIS operators will need to become more aware and conversant in trade. However, the physical interconnections are as important and utilize emerging technologies for optimal dispatch such as the Virtual Power Plant platforms to connect all producers and offtakers.
21	Would you expect one very large renewable hydrogen producer, a number of very small renewable hydrogen producers, or some other combination, to emerge in the State as a result of the scheme? Alternatively, would a domestic-focused producer have sufficient scale to operate in a domestic market only?	• We expect a combination from very large for export to rather small renewable hydrogen producers that focus on domestic industry feedstock, households and mobility. In conclusion, there is more rationale in those use cases than there is on the gas turbine co-firing / direct combustion in power plants – however if this proceeds favourably, do not discount that **a large renewable hydrogen producer is needed to meet the demand of the gas turbines on the SWIS.** • Specialization or segmentation based on scale, will promote this new industry because financiers, insurers,

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		other stakeholders will have options to participate in areas of focus in alignment to their business agendas. • A producer might segment its own business as it gains experience and new trust in the market. It depends on favourable market conditions and cashflow to move from domestic to export. The market generally does not favour monopoly but there must be enough motivation for a producer to scale up.