10 November 2022

Energy Policy Western Australia
Sent to: EPWA-info@dmirs.wa.gov.au

Good afternoon

Renewable Hydrogen Target for electricity generation in the SWIS

Perth Energy welcomes the opportunity to provide feedback to Government on the proposed Renewable Hydrogen Target (the Target) for electricity generation in the South-West Interconnected System (SWIS). We also appreciated the recent briefing and discussion that was held with representatives of Government and their consultants on this matter.

Perth Energy is a major retailer within the SWIS supplying a broad range of large and small commercial and industrial customers. We also own and operate a peaking gas fired power station at Kwinana and regularly review the opportunity to develop or acquire other generation facilities. This gives the company a broad understanding of many aspects of both the gas and electricity market. Perth Energy has also supported the current transformation program through staff participation in workshops, working groups and submissions.

Perth Energy is part of AGL Energy and draws upon the work being undertaken on the introduction of hydrogen into the energy industry within the eastern states. We have been monitoring developments with respect to using hydrogen within the electricity generating system and consider that it has the potential to fulfil a role for firming plant. Batteries would appear to be more suitable for short-term storage, but hydrogen-based plant may well have a role to play in longer term firming. Turning theory into practice will, however, be very challenging.

Should the Target go ahead, it was not clear from the paper exactly how directly the hydrogen must be used for electricity generation and some clarification would be useful to understand the full impacts of what is proposed. For example, does the hydrogen need to be created by/ shipped to and used on the generator site? Or are more complicated arrangements envisaged where a generator can be certified and then buy hydrogen that is injected into a gas pipeline, so they generate certificates even though the hydrogen molecules will not pass through the generator?

This submission provides some general discussion points and then addresses the specific questions raised in the Consultation Paper using the format of the stakeholder feedback template.

Perth Energy Pty Ltd | (08) 9420 0300 | info@perthenergy.com.au
ABN 39 087 386 445 | 24th Floor, The Forrest Centre, 221 St Georges Tce, Perth WA 6000

Four key issues associated with the use of hydrogen

Technical issues

Hydrogen is very different from natural gas. It is a much smaller molecule, so small that it dissolves into steel and other materials making handling and storage especially challenging. Its combustion characteristics are also different. It can be blended into natural gas, but these physical characteristics mean that the blend must be quite lean, probably no more than around 10%, if it is to be transported through existing gas supply pipelines and used in existing gas fired plant.

In recent discussions with a major gas turbine manufacturer, Perth Energy was advised that a blend of about 50% hydrogen can currently be achieved with new-build plant and, within a few years a blend of about 70% should be achievable with new gas turbines that would be suitable in type and size for use in the SWIS. While this is promising for future developments, the current assets were not designed to be hydrogen friendly.

We do note, however, the report in the Australian Financial Review dated 9 November 2022, concerning the Kurri Kurri power station being built in NSW which is designed to run on a mix of hydrogen and natural gas. Snowy Hydro chairman David Knox is quoted as saying:

> *"the delayed Kurri Kurri power plant in the Hunter Valley will completely rely on natural gas when it first starts up and will not be able to use green hydrogen because it is not available".*
>
> *"Subsequent to that as the hydrogen supply becomes available we can go to 15 per cent hydrogen," he said.*
>
> *"Subsequent to that as significant demand for hydrogen becomes available then you could consider going to a higher hydrogen uptake. These are stages of this project. "*

This raises questions as to how much hydrogen a purpose-built unit can actually consume and the time scale that may be required to ramp-up the proportion of hydrogen in the fuel blend. It would be wise to assume that developers of any new build plant would follow a similar staged ramp-up to ensure that the risk of any safety and operational issues are minimised.

The existing gas turbines on the SWIS may be able to accept a low blend of hydrogen but the fuel supply, control, safety, and other systems, as well as the machines themselves would need to be individually audited to assess their compliance with safety and insurance requirements. This would be a lengthy process and there is no guarantee that all plant could be adapted.

If higher blend concentrations of hydrogen are to be used new purpose-built plant and supply systems would be required.

Safety

Hydrogen has several well-known safety issues. It is highly explosive when mixed with air over a broad range of mixture ratios. As noted above, it is a tiny molecule and special tanks, fittings and seals are required for storage and transportation. It also burns with an invisible flame which means that hydrogen fires may not be seen by staff working around a site.

These issues can be addressed through careful design, operation and staff training. Any scheme that encourages the development of hydrogen production and usage would need to ensure that all necessary safety systems and procedures were fully implemented and regularly audited. It would be potentially disastrous if the scheme encouraged hasty development of plant or corner-cutting to save costs.

The appropriate Government agency, presumably DMIRS, would need sufficient well-trained staff to oversee this work. It is also likely that insurance providers will want to be closely involved in any new developments or plant conversions.

Costs

The paper states that modelling projects the cost of hydrogen in 2024 to be a median of $50 per GJ which is around nine times the present cost of natural gas ($5.60 stated in the paper). Using these figures, the cost of adding 1% of hydrogen-based electricity into the power system would be around $84 million per year. If spread evenly across all energy sold to customers this would raise costs by around 0.38 cents per kWh (see appendix). This is just the energy cost and the additional costs for storage and delivery would increase this figure.

Increasing the required blend percentage would proportionately increase costs. A 5% obligation would increase costs by around $420 million per year (an average of 1.9 cents per kWh) while a 10% obligation would raise costs by around $840 million per year (3.8 cents added to the cost every kWh on electricity used in the SWIS).

Electricity customers are already facing significant cost increases. Western Power network costs are projected to rise at around 7-8% per year through the five years of the next access arrangement (AA5), even without any allowance for new transmission lines. AEMO has been granted a fee increase of around 40%. While residential tariffs have been capped for the coming few years this is not the case for commercial and industrial customers. These impacts also raise the prospect of Synergy posting significantly reduced returns, or losses, to Government with the “lost” money needing to be found elsewhere in the Government’s budget. A further uplift to support hydrogen development would accentuate these rises.

Perth Energy does not consider that a further significant price increase can be justified unless the primary reason is to provide benefits to SWIS electricity customers. Using SWIS customers to underwrite industrial development through substantial price increases is highly questionable.

We question how contract prices and quantities would be appropriately established. We are concerned that any mismatch between supply and demand would cause the potential for market power to swing between suppliers and purchasers. For this reason, perhaps Government should regulate a tight price band, based on suppliers’ audited costs, within which hydrogen can be bought and sold. If this is coupled to a quantity target this would effectively set a cap and floor on the total level of support transferred to hydrogen developers. This could assist in capping potential price rises.

Equally of concern is how market participants would manage in an environment where the available supply of hydrogen was substantially less that the target Government sets on participants, and how participants are able to manage this mismatch, which may be entirely outside their control.

Hydrogen developers appear very confident that prices can be substantially reduced over the next few years. Any support scheme should acknowledge this with a steady ramp down of prices and a nominated end date for support. The scheme should not encourage subsidised hydrogen as an end in itself. It should lead to a viable export industry or to commercially sound firming electricity generation. If the hydrogen industry cannot achieve these aims, then it should no longer receive support from electricity consumers.

Efficiently absorbing hydrogen into the SWIS

The SWIS is a small, isolated grid that is undergoing significant change through the energy transition process. For this reason, one primary policy design objective must be that it does not adversely affect system reliability or security. This fundamental objective is an absolute and will need to be addressed in a number of specific elements.

The daily load shape is now dominated by the duck-curve with very low loads being experienced during the daytime on mild, sunny days. AEMO projects that the minimum load will go negative within a few years. Any scheme to encourage hydrogen-based generation must ensure that this situation is not made worse. Hydrogen-based plant must be capable of, and may be required to, turn off during periods of low system load.

Hydrogen electrolysers may be able to provide a controllable load for these periods, but that is only feasible if the hydrogen they produce can be stored for use at another part of the day when generation may be required.

In parallel with this, expensive hydrogen-based electricity must not be allowed to displace renewable generation which has essentially zero marginal cost. Hydrogen based plant needs to be dispatched in merit with renewables always having priority even if this means that an annual hydrogen target is not achieved. This may mean that the amount of hydrogen-based electricity varies significantly from year to year as a result of annual wind variation. The scheme must accommodate such variations, or it may create unusual outcomes that do not support the efficient and effective operation of the SWIS and the WA energy markets.

Batteries, charged using renewable energy, would appear to be a better technology for load following and short-term firming. Any support scheme for hydrogen needs to be designed such that it does not displace batteries unless it can be shown that any displacement reduces electricity costs, reduces emissions and does not adversely affect the operation of the power system.

The strategy must also take into account the proportion of hydrogen used in power plants. If the target for hydrogen-based electricity is set at, say, 5% but the plants providing this electricity run on a 50/50 mix of hydrogen and natural gas then the policy is forcing these plants to provide a minimum of 10% of system energy. All this energy needs to be absorbed into the SWIS without jeopardising reliability or displacing renewables.

The major benefit of introducing hydrogen as a fuel in the SWIS is that it can be stored for use in firming plant. This plant needs to be able to run intermittently and potentially for lengthy periods to back-up the increasing quantities of renewable intermittent generation. This means that the plant must be able to turn on and off and change its output quickly and reliably. Adequate fuel storage must be provided along with appropriate re-supply arrangements if the generating facility is away from the hydrogen production facility.

The output from firming plants varies over a range of timeframes including seasonal and annual because they need to fit around the weather patterns that affect sunshine and wind. Much of the benefit of these plants comes from being available but operating at zero or low load. In the reserve capacity mechanism (RCM) this is recognised by ensuring that firming plants receive an appropriate mix of fixed and variable income streams. A similar approach, potentially an extension of the RCM, would be the best way to support hydrogen-based firming generation.

Hydrogen-fuelled plants should also demonstrate that they can achieve high availability like all other SWIS generation facilities. This includes the hydrogen production, delivery, and storage systems. These requirements are essential, not nice-to-haves. These plants should be included in a thorough certification process that builds on the reserve capacity certification process.

It is only the ability to provide reliable, low emissions firming capacity that can justify installing hydrogen-based generating plant in the SWIS and the requisite additional cost to support them. Perth Energy suggests that the maximum output of any plant that cannot meet these firming requirements should be strictly limited.

A key mechanism for ensuring system reliability is that electricity is provided by numerous independent generators. This allows for scheduled outages, breakdowns, and unit trips by ensuring that adequate reserve plant is always available. Further, these generators must be connected to the SWIS in arrangements that do not allow a single contingency to remove too much capacity from the grid. As the level of hydrogen-based generation increases this pattern must be replicated to avoid placing the SWIS at risk of failure.

These factors mean that a system requiring electricity users to purchase a certain percentage of hydrogen-based energy is too crude to incentivise development in a manner that supports the power system. It would be suitable for only very small quantities. However, if we want to encourage and accommodate significant quantities of hydrogen-based generation into the SWIS the mechanism must:

- Accommodate large swings in generation including seasonal and annual swings;
- Not displace generation from renewables;
- Require high plant reliability and flexibility to respond to short term load swings;
- Require appropriate storage and supply systems to ensure that the plant provides reliable medium to long term firming capacity;
- Provide revenue streams that support both providers' fixed and variable costs; and
- Encourage multiple generators and ensure appropriate network connection arrangements.

If these factors are not addressed, Perth Energy considers that a certificate-based mechanism would send inappropriate signals that would drive unacceptable impacts on SWIS reliability and security.

Response to specific questions raised in Consultation Paper

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?***

A. The key objective from the power system perspective is the extent to which hydrogen-based generation can provide firming capacity. This can be measured by considering the amount of natural gas that can be displaced from this role and by the amount of renewable generation that can be supported.

The reduction in carbon dioxide emissions would be another objective but this should not be achieved at the expense of displacing other, better approaches such as direct generation from renewables or renewable/storage systems.

One critical disbenefit would be any adverse impact on SWIS reliability and security. This must not be allowed to occur and, if it does, then changes need to be made to the scheme.

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?***

A. As is done in NSW, expanding the scheme to other uses of hydrogen, such as manufacturing, could help to lower the costs of meeting targets, while supporting all of the uses in the WA Renewable Hydrogen strategy.

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?***

A. The major role for green hydrogen is likely to be as a fuel for medium- and long-term firming plant. It would potentially have a role for short term firming, but storage batteries are more likely to fulfill the bulk of this role because:

- they have instantaneous response unlike a hydrogen-fuelled engine;
- their energy input is from renewables giving much lower operating costs; and
- they are a simple technology that can be located almost anywhere.

Putting the firming role in place will be complex due to the disaggregated generation, age of generation fleet and need to deliver the hydrogen to various locations.

It is considered very unlikely that hydrogen can provide mid-merit or base load electricity because of its costs compared to renewables and renewable/storage systems. This may change if hydrogen prices can be substantially reduced.

Use of green hydrogen will also decrease the carbon dioxide emissions from end-user businesses and industries. This will complement any actions that they are taking.

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?***

A. Electrolysers can contribute towards solar soak load and reduction of peak load particularly if associated with liquified storage.

If hydrogen is distributed by pipeline, then any linepack could potentially be used for storage to accommodate relatively short-term demand swings.

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?***

A. As noted above, there are very significant technical and safety issues with the use of hydrogen. Detailed assessment would be required to use hydrogen in existing facilities if more than a very small percentage blend is proposed. This includes generators and associated infrastructure as well as gas transmission and distribution pipework.

A further challenge is determining the best locations to place electrolysers and generating plant. This ties into Question 19 below. Economics may suggest that a single large producer, linked to a single large power station would be the most economic provider. However, smaller systems spread around the SWIS would be much better from an availability perspective. This will require assessment of the optimum location for the extensive storage that will be required as well as the generation plant with significant work to be undertaken by Western Power, AEMO and others to ensure that all installations support rather than compromise system security and reliability.

If hydrogen is to be provided by blending into natural gas, the location and connection to existing natural gas assets become very important. It is essential that hydrogen is correctly and consistently blended with natural gas before being supplied to end users.

While some very bold claims have been made about the potential rate of development, Perth Energy would be surprised to see substantial hydrogen installations within the next five years.

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.***

A. No – not if it mirrors the simplicity of renewable energy certification schemes. Hydrogen needs to fulfill a specific role supporting medium- and longer-term firming plant with, potentially, some shorter-term firming role. Critically this means encouraging the development of hydrogen storage and supporting plant that may be on stand-by or running at low load for considerable periods. A certificate scheme that is solely targeted at requiring a certain quantity of electricity purchases would not be acceptable for encouraging more than very small quantities of hydrogen. It would place significant risks on the power system if used to encourage larger quantities.

A corollary is the use of blanket encouragement of electricity generation from domestic solar PV systems. This worked effectively for small quantities, but we are now seeing the downsides of maintaining this approach with much larger quantities and the difficulty of taking remedial actions.

Within a few years the two largest generator systems on the grid are likely to be solar PV and wind farms. Both are weather driven with highly variable output over both short- and longer-term timeframes. All other generating systems will have to be flexible enough to work around this variability so establishing certificate targets, unless this is for very small quantities, will be difficult.

Perth Energy is also concerned at the overhead cost of operating a certificate scheme. Some entity will have to manage the scheme and each retailer will be required to monitor their own compliance and manage their purchasing and surrender.

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?

A. A sound approach would be a mechanism that recognises both the capital and operating costs of hydrogen developers and separately addresses these. The reserve capacity mechanism does this for conventional generators, and this could be adapted to support green hydrogen with hydrogen-based generators receiving a reserve capacity price that covers the capital cost of the hydrogen production facilities.

Hydrogen-based electricity generators should be required be bid appropriately into the market. Forcing this plant to bid would place competitive pressure on hydrogen producers and stimulate the technical improvements that will lead to commercialisation. It must also avoid the perverse incentive to maximise the use of hydrogen even where this causes instability issues on the grid and displaces renewables.

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?

A. Perth Energy is concerned at the overheads associated with this scheme both for the scheme's operators and users. We consider that an approach that is leveraged off the reserve capacity mechanism would be both more efficient and have lower costs for users.

Exemptions

9. What are the benefits, costs and impacts of an exemptions regime for a Renewable Hydrogen Target for electricity generation?

A. At present the cost of hydrogen is very high and this will significantly impact on electricity prices. While residential customers are protected by Government nominated tariff increases, this is not the case for business and industry. With all of the other cost increases due to the transition process there may be some benefit in providing protection for various businesses. The cost of these protections would, however, to be picked up by all other consumers thereby accentuating their cost increases.

Also, until certificates at least meet the target demand, there is an inequitable outcome if participants are penalised for not having certificates they cannot purchase. The discussion paper assumes that each entity will be able to purchase certificates to meet its annual obligation, or penalties will be imposed.

As such, if a generator cannot buy certificates, but is penalised for such a failure, then this may lead to deferred investment by potential investors, who are concerned about being liable for non-compliance in an evolving market where they cannot reasonably meet those obligations. These additional costs will most likely end up in the wholesale price of electricity and be passed on to customers.

Perth Energy notes that Western Power is seeking to roll out a substantial number of Stand-Alone Power Systems (SAPS) which will remove customers from extended/remote parts of the distribution network. These SAPS supplies will be predominantly solar/battery supply with some generation. Perth Energy considers that this load should be always excluded from any hydrogen proposals.

Non-renewable hydrogen

Renewable fuels

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?

A. This would allow time and encourage other services to be developed and reduce the likely scarcity outcomes for just a hydrogen target. However, the reason to support hydrogen is because of its current very high cost. Subsidising other, potentially lower cost, renewable fuels seems to destroy the whole purpose of the proposal.

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.

A. These targets would increase the cost of electricity that retailers purchase for on-sale to customers and this will flow directly to customers. The appendix estimates the energy component of this increase. However, there would also be the further costs of substantial storage and transport systems.

We note that there is already a public groundswell against the higher energy prices that are now seen in the Eastern States with concerns about energy poverty and business closures. We would expect similar public resistance to a hydrogen support scheme that further raises electricity prices but fails to yield any equivalent benefit to users.

On the positive side, it does provide an opportunity for generators to consider hydrogen fuelled plant within their portfolios.

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?

A. As noted in our general comments, targets would need to be set such that hydrogen-based energy does not accentuate the low-load issue within the SWIS and does not displace low-cost renewables. Initially a high target could be accommodated from a technical perspective but neither the hydrogen nor the generating plant is likely to be available for several years. In the longer term, the expected increase in renewables will limit the opportunity for hydrogen.

Another potential limit is the increase in batteries for short term storage possibly augmented by batteries on electric vehicles.

The other major issue is the very high cost of hydrogen. Even relatively small targets will have a noticeable impact on electricity prices. These increases would be on top of expected Western Power and AEMO cost increases plus the cost of new transmission works and new renewable generators required for the energy transition. There is potentially a point at which price increases will undermine the social licence driving the energy transformation.

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?

A. A medium-term aggregate target is potentially a sound way to accommodate the uncertainty of required hydrogen-based electricity. Rolling this forward annually to take account of actual historic weather conditions would ensure an on-going balance between supply and demand. Noting our comments above, any target should be adjusted accordingly so that it supports, rather than displaces, renewable energy generation.

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?

A. If you consider the certificates to be much like cash, then banking/borrowing/selling are all rational operations in a market to ensure that the product continues to grow and to be available to participant. Without such facilities, participants may purchase and hoard, forcing others to unnecessarily invest to meet their obligations and such inefficient investment would lead to additional costs being borne eventually by end users.
Banking and borrowing of certificates provide the liable entities with some flexibility to meeting their obligations, which could help to minimise the costs of the scheme. However, there needs to be some limit on timeframes to ensure that they do not adversely impact the supply/demand balance for certificates.

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.

A. Perth Energy considers that hydrogen-based generation would have a lead time of around five years, assuming that the economics of plant development supports new generation. At present the minimum lead time for new generating capacity in the SWIS to secure network access and capacity certification is around 4-5 years. Anyone developing a new hydrogen plant would need to be assured that the requisite fuel would be available when the plant is ready for service. These arrangements could probably be undertaken concurrently.

The paper notes that presently ‘there are no commercial-scale renewable hydrogen production projects operating in Western Australia’, although ATCO is commencing work on hydrogen testing and APA is commencing work on hydrogen supply. That consideration is only the first of the three key criteria for the proposed scheme to operate, namely:

- Production
- Delivery to the facility
- Facility capability to use the Hydrogen

The scheme proposes a growing target. To meet an initial target of 1%, there must be hydrogen production capability of around 18,700 TJ per year along with appropriate storage. Sufficient generation capacity would be required to run continuously at 20 MW if fuelled by 100% hydrogen. In practice, to avoid exacerbating system stability and to allow for maintenance, this plant would not run continuously. Also, this plant may run on a blend of hydrogen and natural gas. So, if a new, purpose designed plant were built it would need an installed capacity approaching 80 MW (assuming a 50/50 blend). If hydrogen were to be used in existing plants, which would only accommodate a much leaner blend, then substantially more generation capacity would be required.

Assuming that there is adequate production of hydrogen, the next issue is whether or not that hydrogen can be delivered to the generation site. At present, neither the gas transmission nor the gas distribution businesses have undertaken the appropriate studies to determine what blending can be safely undertaken to deliver the hydrogen. Existing pipelines are probably limited to 10% hydrogen blend so if a richer hydrogen blend is to be burned at a power station a completely new delivery system is required.

Assuming that there is both production and then delivery, there is still the matter of whether or not the facility can safely consume the hydrogen. WA gas generation facilities were not built with the consideration of consuming hydrogen.

Conversion of existing plant to hydrogen could potentially also be accomplished in a five-year time frame but we should not underestimate the requirement for infrastructure assessments, asset changeovers and securing of safety and insurance sign-off. There would also be the impact of plant outages during these refit periods which would likely require extended periods for the work to be completed. This would potentially restrict gas plant availability just when this is needed for firming renewables.

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.***

A. Given the fact that hydrogen costs need to reduce by an order of magnitude to compete against natural gas it is hard to see hydrogen plant becoming feasible from an economic perspective for many years. Our understanding is that some developers are predicting much lower prices but these still do not appear to be competitive. Natural gas remains abundant and relatively cheap in WA so without some form of external driver, from government or customers, there is little incentive to change.

Having said that, AGL and many of our customers are committed to decarbonisation and there is real potential for hydrogen if prices can be brought down to a competitive level. If hydrogen prices can be reduced, there may be an increasing acceptance amongst customers to pay the decarbonisation uplift.

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. Electrolysers cannot commence real operation until infrastructure is ready to accept delivery. As such, AEMO and Western Power are better placed to comment on the likely locations and necessary infrastructure required.

Given that the prime objective of the target is to stimulate technology change and cost reductions, ramp up should be in relatively small increments and spread out over time. This would allow new technologies to be brought into the market rather than letting older, less economic technologies dominate production. Further, the maximum permitted price for hydrogen from new production facilities should be decreased each year to drive innovation.

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?

A. This is very hard for us to gauge as we can only draw on the same publicly available information as others. However, as noted above, as the level of renewables and storage in the SWIS increases the opportunity for hydrogen to provide firming capacity will be restricted. Hydrogen usage may well peak and then fall away as it is displaced by new, more economic technologies.

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.

A. It is our understanding that the largest electrolyser in Australia is less than 10 MW, so the projected capacities appear to be very optimistic. However, because electrolysers are likely to be modular there is no intrinsic reason why the projected levels could not be achieved. This will depend on the overall capital and operating costs of any plant.

Also, in our opening remarks, we noted recent commentary on development of the Kurri Kurri plant in NSW. We would expect any developer in WA to follow a similar measured, low risk approach to the development of hydrogen fuelled generation plant.

It is planned that the SWIS undergo a major transformation over the next 5-10 years with new renewables, plus storage, replacing much of the current thermal generation. Bringing this amount of renewable capacity onto the system will be a major challenge on its own. Requiring even more renewables to be built to supply hydrogen production will accentuate that challenge. We would not want to see the desire to develop hydrogen push back the replacement of thermal plant.

It is also essential that hydrogen plant efficiently meet the requirements of the SWIS otherwise alternative firming solutions, probably based around storage, will be used instead.

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?***

A. If the number of certificates is low then it would be reasonable to have a single, or very few, hydrogen generators emerge. This could actually be an advantage as it would allow development work and safety assessment to be focused rather than spread over a number of sites.

However, if hydrogen is to provide a significant proportion of firming capacity, then it is essential that enough generators are built to provide the diversity required to cover scheduled and unscheduled outages as well as plant trips. AEMO and Western Power modelling would be able to provide a guide for this requirement.

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?***

A. In theory there is no reason why a single large producer could not provide the bulk of green hydrogen. This would be akin to the North West Shelf providing virtually all gas to the SWIS for many years. A single producer should be able to install sufficient redundancy at the facility, and storage, to ensure very high delivery reliability.

If the prime aim of the Target is to stimulate technology innovation, then multiple competing production facilities may be a better approach. However, a single developer, building a modest level of hydrogen production capacity each year, may well achieve the required cost break-throughs.

A potential issue with the single producer model is that the power generation needs to be located so as to ensure the security and reliability of the power system. It could be located at one site as long as there is no point of common failure, there are numerous generating units and sufficient diversity in the network connections. It would probably be better to have several generation sites and the issue then becomes transport of hydrogen to these. A central hydrogen provider supplying to various sites by dedicated hydrogen pipelines or road tankers would potentially be the most economical model.

Again, Western Power and AEMO system modelling could provide greater insight into these options.

Summary

On the surface, putting a hydrogen obligation onto the SWIS appears to be a good way to encourage industrial development. The reality is, however, far more complex. There is also the equity issue of forcing electricity users to subsidise development of an industry through a mechanism that brings them very little benefit. Hydrogen is very expensive compared to natural gas and there must surely be alternative areas in the economy where hydrogen can be used to more efficiently offset expensive fuels such as diesel.

To be blunt, there is no role for green hydrogen in the WA electricity system unless it can be used to provide firming capacity. The energy losses in the process of generating, storing, transporting, and using green hydrogen make it totally uncompetitive compared to using renewable generation directly. Even in the firming role, it needs to compete with other developing technologies.

A better outcome for WA electricity consumers would be a more technology neutral approach to addressing the future system need. Instead of a Renewable Hydrogen Target, WA could consider a more general policy to encourage any form of long duration renewable firming technology – which would include hydrogen as well as battery technologies, concentrated solar thermal, etc. Such a policy could be leveraged through the existing capacity mechanism or some similar approach.

Aside from high cost, the real strong objection to this proposed scheme is the risk that it places on the security and reliability of the power system. The combination of solar PV driving down the minimum load and wind farms increasing supply volatility is already causing significant issues. Strong measures, such as involuntary curtailment of residential PV, are having to be taken to keep the system whole.

Injecting substantial quantities of hydrogen-based electricity into the grid without very careful and detailed consideration is likely to accentuate these major system issues. The public will be totally unforgiving if this scheme results in brown outs or, at worst, system collapse especially given the cost increases being incurred. This may sound over dramatic, but the SWIS is already facing its largest ever shake-up with closure of all Synergy's base load coal fired plant and the mass installation of wind farms and storage. This alone carries significant risk and the additional complexity of including hydrogen obligations into this mix should not be underestimated.

If Government decides that this scheme will go ahead anyway, we consider that the proposed certificate arrangement is far too crude as proposed. A much more sophisticated approach is required which adequately addresses the realities of the power system and the role that hydrogen could realistically play. Perth Energy would be happy to discuss this in more detail.

Should you have any questions in relation to this submission please contact me on 0437 209 972 or at p.peake@perthenergy.com.au.

Kind regards,

Patrick Peake

Patrick Peake
Senior Manager, WA EMR

Appendix – Calculation of price impact of using hydrogen fuel.

Assumptions taken from Consultation Paper:

1. Total electricity consumption in 2030 = 22,000GWh
2. Current hydrogen price = $50.72/GJ
3. Current natural gas price = $5.60/GJ
4. Excess cost of Hydrogen = $45.12/GJ

Further assumptions:

1. No coal in system by 2030
2. Hydrogen displaces natural gas but not renewables
3. Gas plant efficiency = 8.5 GJ/MWh of output

Additional energy cost using 1% hydrogen

- Generation produced from hydrogen = 220 GWh = 220,000 MWh
- Quantity of natural gas displaced = 220,000 MWh x 8.5 GJ/MWh = 18,700,000 GJ
- Additional cost = 220,000 MWh x 8.5 GJ/MWh x $45.12/GJ = $84.4 million
- Spread evenly over all electricity consumption the extra cost is $3.84/MWh or 0.384 cents per kWh

Additional energy cost using 5% hydrogen is $19.2/MWh or $1.92 cents per kWh

Additional energy cost using 10% hydrogen is $38.4/MWh or 3.84 cents per kWh