Mallee Regional Innovation Centre

SUBMISSION

to

Victoria State Government Department of Environment, Land, Water and Planning

in response to the

Green hydrogen discussion paper Victorian hydrogen investment program, November 2019

February 2020

Contents

Executive Summary

The Mallee Regional Innovation Centre (MRIC) is an unincorporated joint venture between the parties of the University of Melbourne, La Trobe University and the Sunraysia Institute of TAFE (SuniTAFE).

Led by Centre Director, Professor Michael Stewardson (The University of Melbourne) and Co-Directors, Professor Ashley Franks (La Trobe University) and David Harris (SuniTAFE), the MRIC pairs in-depth knowledge from the Mallee region with the world-leading research capabilities of the University of Melbourne and La Trobe University and through the Australia's Large Training Provider of the Year 2019, SuniTAFE, the capabilities of applied research and delivery of training to address emerging skill requirements.

The MRIC has staffed offices in Mildura, in the North West of Victoria. The Centre opened on the 6 May 2019 and concentrates on the focal areas of horticulture, water, energy and the environment in irrigated production and natural resource management along the Murray River in the Swan Hill Rural City Council local government area, through the Mildura Rural City Council local government area. The Centre coordinates research and development projects and delivers contracts on a user pays basis.

The purpose of the Centre is to:

> Drive collaboration to promote innovation in practical research, development and adoption to address the key challenges in the Mildura and Swan Hill regions in horticulture and natural resource management.

To ensure a successful and sustainable Mallee region through innovation and collaboration, we are focused on:

- Prioritising and fast-tracking R&D projects which will strategically address the key challenges of the region in the four focal areas of horticulture, environment, energy and water;
- Seeking opportunities to foster new areas ofdevelopment;
- Facilitating the commercialisation of research and development outcomes;and
- Seeking outcomes that are practical, implementable and value add to the

region.

To do this we need to:

- Have strong collaborate partnerships;
- Source funding to support projects;
- Compliment established activities;
- Bring in new capabilities where required;and
- Build capability and encourage the adoption of Research &Development (R&D).

This submission seeks to address some of the questions raised in the Victorian State Governments Department of Environment, Land, Water and Planning's *Green hydrogen discussion paper Victorian Investment program*.

Responses to the questions will highlight as an example the opportunities in the Mallee (North West Victoria) in regard to the production and use of hydrogen. Initial investigations into the use of hydrogen in the region have been driven by the Mallee Regional Innovation Centre, with the assistance of Professor Paul Webley from the Melbourne Energy Institute and Regional Development Victoria.

Professor Webley has concluded the following:

Evidence
The Mallee region has all of the essential components for a hydrogen hub:

- a rich solar resource for renewable energy and hydrogen production and seasonal storage
- a concentrated agricultural and industrial infrastructure which could benefit from heavy duty hydrogen powered transport as well as back-up generation
- a large biomass resource which can complement hydrogen use for power generation
- access to transport infrastructure for a hydrogen export market.

Considering the interests and potential in the region for hydrogen economy we recommend a feasibility study for a Mallee Hydrogen Hub. This study will set out to evaluate how a hydrogen facility can complement the regional economy, specifically the resources, infrastructure and local industry

Further to this the Mallee Regional Innovation Centre has collaborated with Lower Murray Water and Mildura Regional Development in putting this submission together. Lower Murray Water have provided a case study and Mildura Regional Development have provided some data.

Terms of Reference

The Victorian Government wants to ensure that the potential for growth in green hydrogen technologies is developed through the Victorian Hydrogen Investment Program (VHIP).

The VHIP is informed by the growing expertise of industry, academics and communities, as well as drawing on previous experience and best practice both locally and internationally. The discussion *Green hydrogen discussion paper Victorian Investment program* paper is designed to inform the VHIP by building on the information received through the market testing Request for Industry Submissions (RFIS) process undertaken in early 2019. It sets out issues and poses questions designed to help guide submissions that will contribute to the development of a Victorian Green Hydrogen Industry Development Plan (IDP). Submissions containing additional information and issues beyond the scope of questions posed in this discussion paper will be considered in the development of the IDP.

Information gathered through the process will also inform the development of Victorian Government policy.

Scope

This discussion paper is for stakeholders who would like to shape the development of Victoria's emerging green hydrogen sector, identifying competitive advantages and priority focus areas for industry and the Victorian Government.

The Victorian Government is using this paper to focus on the economic growth and sector development opportunities emerging for a Victorian hydrogen industry powered by renewable energy, also known as 'green' hydrogen. In addition, this paper seeks input from all stakeholders on how, where and when the Victorian Government can act to establish a thriving green hydrogen economy.

Although green hydrogen is the only type of hydrogen production within the scope of this discussion paper, the development of the VHIP aligns with the policies, projects and initiatives which support these other forms of hydrogen production. The VHIP is considering the broad policy landscape and actively coordinating with related hydrogen programs, policies and strategies under development, including the Council of Australian Governments (COAG) Energy Council's National Hydrogen Strategy, to ensure a complementary approach. In Victoria, there are several programs and strategies in development and underway that have linkages with hydrogen and the VHIP.

Key Questions

- What are the greatest opportunities for investment and employment in hydrogen?
- What is Victoria's competitive advantage in relation to capitalising on an emerging hydrogen economy?
- What lessons can Victoria learn from the global hydrogen agenda and international experience to date?
- Geographically, where are the most significant clusters for this investment, employment and production?
- What are the skills and training requirements needed to grow Victoria's hydrogen industry?
- What are the challenges to developing a hydrogen economy in Victoria?
- Who are the critical stakeholders needed to support a Victorian hydrogen economy?
- What does a supportive regulatory environment for a sustainable hydrogen industry look like?
- Are there barriers to achieving a social license for hydrogen to operate? What does the Victorian Government need to consider in addressing these?
- What role can hydrogen play in Victoria's energy system into the future? Are there limits to the role hydrogen can play in Victoria's energy mix?
- What does the Victorian Government need to consider attracting investment in the hydrogen supply chain in Victoria?

- What is the best way for the Victorian Government to support hydrogen R&D, pilot projects and demonstrations? Are there any we should prioritise?
- What possible uses for hydrogen offer greatest benefit to Victoria?
- What is the level of hydrogen transport infrastructure needed in Victoria and where are the priority areas for infrastructure and Victorian Government policy (e.g. procurement)?
- What are the considerations for business and consumers in purchasing a new type of vehicle, such as hydrogen or battery electric vehicle?
- Other than cost and technology barriers, what factors help current and potential users of hydrogen in commercial and industrial settings decide how to procure hydrogen? How could the Victorian Government assist commercial and industrial businesses switch to green hydrogen for chemical feedstock and/or heating?
- What other issues does the Victorian Government need to consider in developing an Industry Development Plan

Introduction

The Mallee Regional Innovation Centre's research and development projects are focusing on tangible, value add outcomes for the region that encompasses Mildura and Swan Hill government areas.

What we do

Our role is to:

- collaborate to address the priorities and challenges of the region;
- coordinate research and development (R&D), and facilitate the dissemination, adoption and commercialisation of the results;
- investigates data insights to allow them to capture commercial opportunities;
- engage in R&D that builds excellence, improves resource management and sustainability; and
- builds capability and encourages the adoption of R&D.

We are actively encouraging and supporting innovation, extension and adoption of R&D and engage with industry, business, government and other stakeholders in the region on the issues that matter to them.

Our Vision

Our ambition for the Mallee Regional Innovation Centre is to contribute to a successful and sustainable Mallee region through innovation and collaboration. Our MRIC *Strategic Plan 2019–2024* outlines our priorities and activities to achieve this.

Our Funders

Funding Agreement

Core funding of $1.7 million for the Centre was announced by the Victorian State Government in the 2018/19 budget. The University of Melbourne has entered into a funding agreement for a grant that is administered through the Department of Jobs, Precincts and Regions.

Centre Agreement

The Centre partners, namely the University of Melbourne, La Trobe University and SuniTAFE provide cash and in-kind contributions as per the Centre Agreement.

Scholarships

The Centre is also supported through the Invergowrie Foundation. They have committed to five Invergowrie and McPherson Family Women in STEM PhD scholarships over 5 years.

User-Pay

The Centre is also engaged in User-pays activities. User-pay activities are defined with contractual agreements between one of the partner university's and the proponent wanting research undertaken.

As an enabler, the governance structure of the Centre was designed with a view of how best to support such outcomes.

Steering Board

On the Centre's Steering Board comprises the representatives of all parties of the Centre.

Mallee Regional Innovation Centre Steering Board members	
Professor Mark Hargraves - Pro Vice Chancellor (Research Partnerships and External Relations)	Professor Susan Dobbs Deputy Vice-Chancellor (Research and Industry Engagement)
Peter Forbes (Manager Regional Planning and Coordinated, Regional Development Victoria)	Geoff Dea (Chief Executive Officer, SuniTAFE)
Professor Mike Stewardson (MRIC Director, University of Melbourne)	Professor Ashley Franks (Co-Director La Trobe University)
David Harris (Co-Director SuniTAFE)	

Strategic Advisory Panel

Underneath the Steering Board, the Centre is supported by the Strategic Advisory Panel (SAP) who assist in setting the direction for research and development projects that address the challenges and priorities of the region.

The panel is comprised of key regional leaders from a cross section of industry, who individually and as a group bring a depth of expertise and knowledge to the Centre for the betterment of the region.

Mallee Regional Innovation Centre Strategic Advisory Panel Members	
Leonie Burrows (Chair)	Ross Lake (Chair Integrated Water Management)
Ferdi Bergamin (Development Manager, Mildura Fruit Company)	Anne Mansell (CEO Dried Fruits Australia)
Anthony Couroupis (Managing Director, Lower Murray Water)	Peter O'Donnell (Executive Director, Southern Cross Farms)
Jenny Collins (CEO, Mallee Catchment Management Authority)	Stefano de Pieri (Board Member of Mildura Regional Development)
Paul Dillon (CEO, Mallee Rising)	Patrick Timmons (Executive Officer, Rural Financial Counselling Service, Victoria North West)

Academic Panel

A key feature of the Centre is the prominence of the two universities. The Centre has an Academic Panel which comprised of academics from both the University of Melbourne and La Trobe University and is coordinated and facilitated by the Centre's Innovation Fellow Matthew Toulmin. MRIC is a relationship broker between those requiring research and the universities. In an innovation system context, this is described as a capacity to co-innovate and requires:

- Skills and competencies that cover science, technology and innovation management practice
- Linkages between producers and users ofknowledge
- Relationships and the institutional setting conducive to knowledge sharing and interactive
- Learning

- Flexibility in working habits and institutions that allows dynamic and rapid responses to changing circumstances
  negotiation of place-based rural innovation
- Governance arrangements that support emergent practice and collaboration
- Presence of brokerage/intermediation roles and stimulating networks of factors
- Supporting new ways of working

The Academic Panel has enabled pathway for the MRIC to engage with Professor Paul Webley from the Melbourne Energy Institute to investigate the use of hydrogen in the region.

Partnership and collaboration for innovation

The Mallee Regional Innovation Centre has worked closely with a range of stakeholders to form collaborative partnerships that facilitate the pursuit of R&D projects. This includes the Victorian State Government who have committed through a grant of $1.7 million to the establish of the Centre.

The Centre also engages with local governments (Mildura Rural City Council, Swan Hill Rural City Council and Wentworth Shire Council), statutory authorities (Lower Murray Water, the Victorian Mallee Catchment Management Authority), industry peak bodies (Almond Board of Australia, Australian Table Grape Association, Citrus Australia, Dried Fruits Australia, Murray Valley Winegrowers Association) and other regional recognized organisations such as Mildura Regional Development and First People of the Millewa-Mallee Aboriginal Cooperation.

Critical Mass of Agencies

Mildura houses a hub of federal and state government agencies and departments and other key stakeholder organisations, with staffed offices open for the Inspector-General Murray- Darling Basin Water Resources and the Murray Darling Basin Authority. Hort Innovation have also indicated they will have a presence in the region through their Extension Officers.

Complementary to that, the region is already home to staffed offices for the Victorian Department of Land, Water and Planning, Victorian Department of Jobs and Precincts and Regions, Mallee Catchment Management Authority, Commonwealth Environmental Water Office, Agriculture Victoria, Parks Victoria, Lower Murray Water, Western Murray Irrigation, Regional Development Victoria, New South Wales Department of Primary Industry, ALTSA (Analytical Laboratories and Technical Services Australia), Bird Life Australia, Trust for Nature, Sunrise21 Mapping and Research, and the office of the First People of the Milewa-Mallee.

The region is also home to the SuniTAFE SMART Farm and the CSIRO have a presence through the Koorlong Field Station.

Industry knowledge and expertise is further enriched in the region by the presence of these organisations. The relationship the Centre has built and will continue to build with these stakeholders, will enhance the ability to undertake key R&D in the region.

Cross Sector Research

The Centre is not focused on a single industry or sector. As with the four focal areas of the Centre (energy, water, horticulture and the environment), there are many cross overs between them all. Industries can together face similar, if not same issues. These modern-day convergences mean that there needs to be avenues which allow for cross sector research and development work.

Region Specific

To take this a step further, energy is a key strategic consideration for any business or industry in the region. Decisions relating to risk and financial considerations are key to ensuring sustainability and success. This covers the consumption of, supply, demand, costing and in the case of solar farms, the grid and grid capacity. The concept of hydrogen becoming a resource for the region or production for export outside of the region presents many opportunities. This is most particular to transport and agriculture industries, which also encompass the supply chain businesses. See regional specific information provided below, including a case study of heavy-duty vehicles and information about the scale of agriculture in the region.

Climate Adaption

Climate adaption and preparation is a necessity for irrigated production and resource management in the region. Energy is an interictal component of adaption. See the Lower Murray Water case study provided – *Opportunities for hydrogen*. As the climate changes in the region, all businesses will have to consider what will impact on their ability to service their customers. In the case of Lower Murray Water, energy is core to their ability to deliver services to urban and rural customers.

The Mallee Climate Projections

The CSIRO has released the Mallee Climate Projections 2019 and they state that:

- by the 2050s, the climate of Mildura could be more like the current climate of Menindee, New South Wales, and Swan Hill more like Balranald, New South Wales. (3)
- by the 2030s, increases in daily maximum temperature of 0.8 to 1.6°C (since the 1990s) are expected. (1)

Rainfall will continue to be very variable over time, but over the long term it is expected to continue to decline in winter and spring (medium to high confidence), and autumn (low to medium confidence), but with some chance of little change.

Maximum and minimum daily temperatures will continue to increase over this century (very high confidence).

Zero Emissions

Further to this the Victorian State Government (2) has legislation that requires statutory authorities like water corporations to have a proactively work towards 42% reduction in emissions by 2050. For these targets be achieved, there will need to be innovation, new technology's and access to new energies.

Competitive advantage of the Region and stakeholders for a hydrogen economy

Opportunities and investment in hydrogen

Victoria is in a prime position to take a competitive advantage of a green hydrogen economy. We have resources that could be repurposed to support the production of hydrogen. This includes waste water from industry, renewable energy to make hydrogen, infrastructure, biomass and significant industry that could use this as a means to potentially reduce energy costs and reduce emissions.

Geographically, the north west of Victoria represents an ideal location for consideration of the production of hydrogen and use of hydrogen. There is land available for business development, there are growing industries, the region has a strong history of exporting internationally and delivery products across the nation.

Making assessments for hydrogen hubs will be critical in the early stages of developing the industry. Of note in the reporting released by the COAG Energy Council (3), there was a no solid explanation of what role and the what the potential of the regions is. It could be assumed that regions were not investigated at the time of reporting. The role of regions needs to be further examined.

Large presence of Heavy-Duty Vehicles

Heavy duty fuel cell vehicles are emerging as an important component for decarbonising the transport sector. For example, Nikola Motors (4), a U.S. maker of hydrogen trucks, launched a daring roadmap for 700 fueling stations across the USA and secured an 800-vehicle partnership with Anheuser-Busch to help decarbonise its freight fleet.

Horizon Fuel cell technologies have unveiled (September 2019) the first of the road-certified 42t fuel cell trucks made by Ford Motor Co joint venture company JMC – this delivery of 20 x 42t vehicles is part of a more aggressive plan in China to deploy 2000 zero-emission trucks by 2021. Each is capable of a 500km range.

The German delivery company Deutsche Post DHL announced in May 2019 (5), that it will deploy 100 fuel-cell powered trucks starting in 2020. We can therefore expect that heavy and light duty fuel cell trucks will become increasingly available between 2020 and 2030.

A truck can be filled with hydrogen in less than 15 minutes and the process of fuelling a fuel cell electric vehicle (FCEV) is similar to fuelling a diesel truck; hydrogen gas is pumped into the vehicle tank using a gas pump and nozzle that is similar to a traditional diesel pump.

As a tri-state inland hub that is the connector for Australia's main freight corridors, the Mildura region is an ideal location to develop a test centre for hydrogen powered trucks. An approximate accounting of local industry use alone suggest over 500 trucks in operation – a large number operating to major centres such as Brisbane, Melbourne and Sydney. Current electrolyzer technology can supply an electrolyzer-based fueling facility having the capacity to produce 480 kg/day, or 20 kg/hour, from a 2MW electrolyzer operating at 60% capacity factor. This facility would be capable of fueling 10 trucks per day, assuming an average purchase of 30-50 kg per truck, depending heavily on truck duty cycle.

A single hydrogen fueling station in the Mildura region operating with the excess solar capacity and with sufficient hydrogen storage is a very attractive option for an emerging decarbonization of the transport sector.

Through our engagements with local industries, a shift towards a Green Hydrogen economy would be impactful because:

- There are substantial businesses and service which are linked to the transport sector. This includes four retail outlets for trucks and 31 trucking companies within the region
- As a 'through' city many other trucking companies use trucking services in the region and have depots and drivers based here, even if their offices are outside the region.
- There is potential for the hub to become a significant refueling point, as Mildura is a core location of the freight corridor and is in essence the cross roads with intersecting highways to Sydney, Brisbane and Adelaide, Perth and Melbourne.
- The larger transport outfits in the region have onsite fuel storage
- The region has major processing plants and wineries which all take deliveries of fresh produce for processing. Examples include Australian Vintage who are one of the largest wineries in Australia. They have a processing capacity of 150,000 tonnes.
- In 2013 it was the Stock and Land reported that OLAM's Carwarp site (almond processing plant) had 208 delivering in peak harvest. Regional estimates now rank this as closer to 300 trucks a day in peak harvest.
- When comparing hydrogen to the use of a battery electric vehicle, hydrogen is reported as more attractive, in part because of the shorter time it takes to refuel.

The region also has industries which require the use of forklifts in their operations. These can be found in packing sheds, on farm, cool sheds, processing plants, wineries, factories and transport and logistic organisations. Further research is required in the region to accurately gauge the potential of industry that could use hydrogen or support a hydrogen industry in the region.

Renewables as an energy source

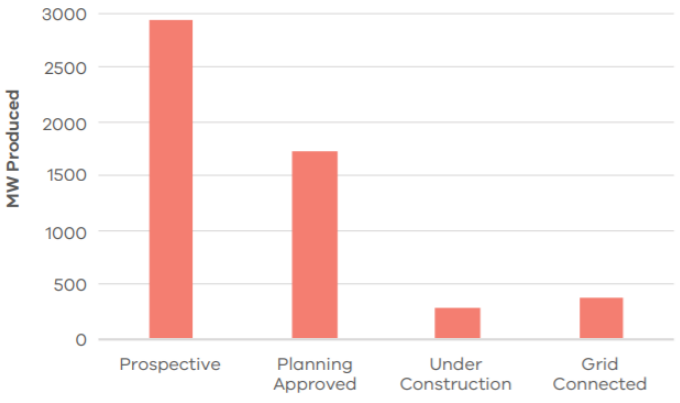
The North West of Victoria has become a key location for solar farms in the state of Victoria. As reported in the *Mallee Economic Growth Strategy 2018/2019* (6), there has been has been significant development in large scale solar projects. As the Lower Murray Water case study reports, solar farms in the region are operating at 50% capacity. This unused capacity could be used in the development of a hydrogen for use in the local industry.

Nineteen large-scale solar projects, valued over $2.8 billion, have either received planning permission, are under construction or are operational in the four municipalities across the Mallee. These projects have a combined energy capacity of 2380 MW (Figure 3-11), which exceeds the capacity of Victoria's largest coal fired power station Loy Yang A.

Planning departments within the four Mallee LGAs are aware of a further thirteen prospective solar farm developments, which have a regional energy capacity of 2,950 MW. Combined, they have a total potential energy capacity of 5,280 MW.

The region is also seeing investment in battery storage and this is expected to accelerate. Battery storage has the capacity of providing solar electricity at times of peak demand.

Figure 3-11 **Mallee Region Large Scale Solar Power Projects**



Source: RDV (2019) Loddon Mallee Renewable Energy Projects.

However further research is required to optimize the potential of solar energy for use in hydrogen production.

The solar generation capacity in the region is now clearly in excess of the customer demand in the region and any additional solar generation will continue to compound this situation. In addition, the existing transmission network does not have the capacity to deliver the excess solar generation to customers outside of the region. The recently announced interconnector between SA, NSW and Victoria will assist but there will still be excess solar generation even after this transmission line is commissioned. A hydrogen facility would be benefit from being able to access this excess solar generation capacity.

Biomass as a source of energy for hydrogen production

A biomass can be resourced in the production of hydrogen. It was reported by Sustainability Victoria in 2017 ABBA Factsheet Loddon Mallee that "…Based on modelled data, an estimated 2,207965 tonnes of organic wastes were generated in the Loddon Mallee Region in 2014-2015, representing 22% of the states total."(7) Further research is required in the region to accurately gauge the potential of biomass in regard to its use in hydrogen. There has been a significant increase in production in the region and this will increase the volume of biomass as a resource available within the region.

Agriculture – a large off-taker base for hydrogen

The Mildura region is a vital contributor to Victorian food production, producing 99.9% of dried and table grapes, 99.6% almonds, 86.2% citrus and 75.5% wine grapes for Victoria. The region is also home to strong emerging markets – now producing increased crops of pistachios and other nuts, olives and avocados.

The value of regional exports generated by the Mildura economy is estimated at $1.901 billion with Agriculture, Forestry & Fishing Mildura's largest exporter, generating regional exports estimated at $623.285 million and Manufacturing (mostly agriculture value add) $566.62 million. (REMPLAN Economy data provided by Mildura Regional Development)

In regions like the Mallee, Australia's Chief Scientist Allan Finkle's concept of provenance of hydrogen can be capitalized on. The region internationally has a reputation for clean/green produce.

In 2018/2019 the total export value for almonds was reported as $552 million (8) (65% Victoria & 24% South Australia) and for over $500 million for table grapes (9). The horticultural in the region is supporting the national goal of $100 billion of horticulture by 2030. However, water and climate considerations will challenge the agriculture industries ability to sustain this growth as they grapple with availability, increase local water demands due to increased evapo-transpiration, increase water prices due increased demands, increased heat stress on crops due to increased temperatures and increase the frequency and intensity of extreme events.

As noted in the 2018 Mallee Crop Report by the Mallee CMA –

The main crops, in order of dominance in the Mallee catchment are as follows:

- almonds; 24,485 hectares (30% of the irrigable area) predominantly grown in the Boundary Bend and Wemen river reaches;

- table grapes; 8,965 hectares (11% of the irrigable area) predominantly grown in the Robinvale and Mildura irrigation districts;

- wine grapes; 8,050 hectares (10% of the irrigable area) predominantly grown in the Colignan to Koorlong river reach and the Red Cliffs irrigation district;

- field crops; 5,685 hectares (7% of the irrigable area) predominantly grown in the Nyah and Boundary Bend river reaches;

- citrus; 4,135 hectares (5% of the irrigable area) predominantly grown in the Colignan to Koorlong river reach;

- olives; 3,815 hectares (5% of the irrigable area) predominantly grown in the Boundary Bend river reach;

- potatoes; 3,410 hectares (4% of the irrigable area) predominantly grown in the Boundary Bend river reach and the Murrayville Groundwater Management Area;

- dried grapes; 3,145 hectares (4% of the irrigable area) predominantly grown in the Colignan to Koorlong river reach and the Mildura and Merbein irrigation districts;

- and vegetables other than carrots and potatoes, 2,685 hectares (3% of the irrigable area) predominantly grown in the Wemen and Colignan river reaches.

p.7, Argus,S, 2018. (10)

Further research is required in the region to accurately gauge the potential of how agriculture can use hydrogen on farm or in local industry or business. Please see the Lower Murray Water case study provided as an example.

Gas pipelines for hydrogen storage and transport across states

The Mallee region is connected to gas through the Mildura Pipeline and via the Riverland Pipeline Systems of the Australian Gas Infrastructure Group (AGIG). The Riverland Pipeline connects through to the Moomba to Adelaide Pipeline. AGIG announced in January 2019 that they would be '…blending renewable hydrogen into the local gas distribution network in Adelaide' Infrastructure that connects through to the Mallee region has the potential to play an important role in the future as a means of delivery or exporting of hydrogen.

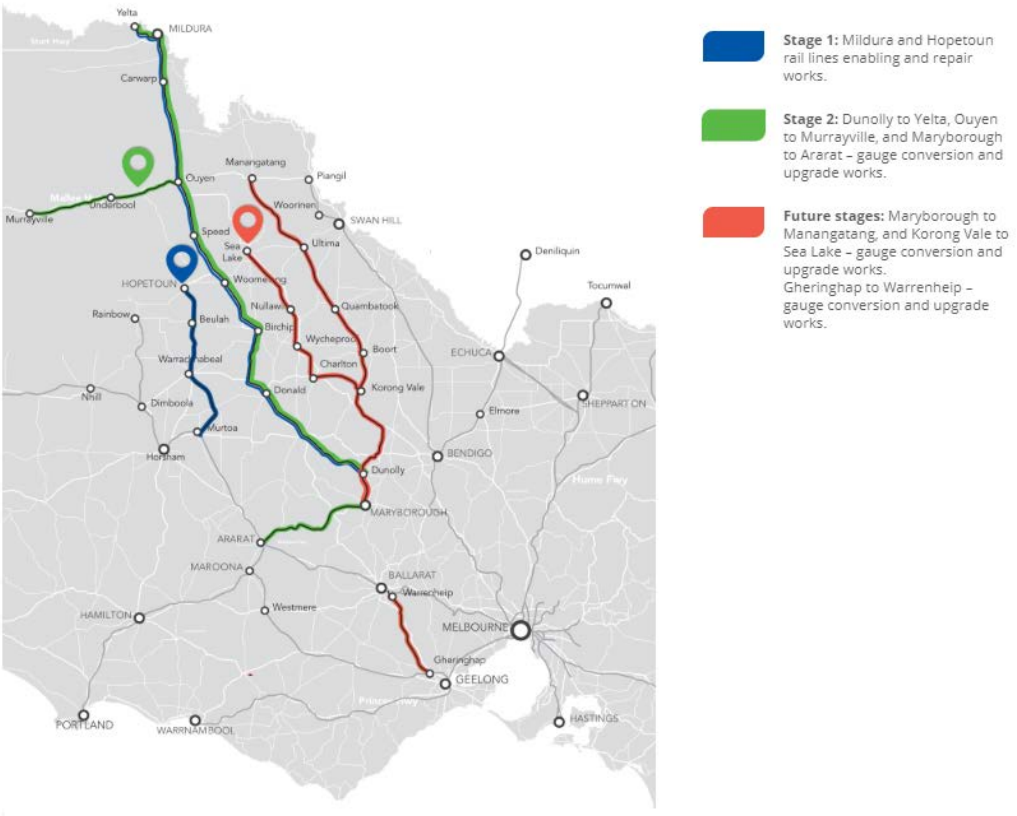
Rail

Rail has the potential to become a vital part of the hydrogen industry. As reported by the Victorian State Government, the Murray Basin Rail Project is:

> '…d*riving economic growth, creating jobs and providing a major boost to the transport industry, agricultural sector and regional communities. Once complete, it will improve rail freight services and reduce the costs of moving freight.*
>
> *By standardising and improving the rail network, the freight industry in the Murray Basin region will be able to deliver exports to Victoria's ports in a more efficient and cost-competitive way. An increased axle loading will allow higher volumes of product to be safely freighted across the network. This will allow trains to carry up to 500,000 more tonnes of grain each year.*
>
> *Following the upgrade, rail freight transportation is forecast to capture approximately 20,000 journeys currently undertaken by trucks. This will provide producers with an attractive alternative to road freight and improvements to local amenity. The project will also ensure the ongoing integrity of the rail track and improve safety on the lines.'*
>
> https://www.murraybasinrailproject.com.au/about (11)

Stages

The project is being delivered in a number of stages, which are outlined in the map below.



Natural Resources

The region is also home to conservation and natural environments of nature conservations and protected areas. The federal government has committed funds of $29 million for the Victorian Murray Flood Plain Restoration project (12), which has seven sites for implementation within the region with an estimated total construction cost of over $300 million.

The region natural assets are significant for attraction of tourists and cultural significance.

Further to the challenges of water, the region is challenged by low rain fall, water availability, water deliverability, climate change impact, regulatory framework and access to technical data of the region.

The region is also particularly vulnerable to climate change due and impacts of this are likely to be felt across the region most significantly in the coming decade as the region learns to adapt and change to its new environment.

Challenges which will need innovative solutions through research

Green hydrogen systems design to lower the cost of production. In the Transport sector, the biggest expense is fuel. A small change in fuel costs can have a large impact on the business. In addition, the potential for large solar farms in the region and lowering electrolyser costs can provide solutions for more efficient fueling options.

Recently the Australian Energy Market Operator (AEMO) reported that growth and speed in the establishment of solar (and wind) is some regions is causing 'unprecedented technical issues'(13). These issues have the potential to affect the stability and performance of the national electricity grid. For instance, within the region there have been significant periods of loss of power. Can hydrogen be used as a storage to flatten the peaks of production to provide better stability from renewables.

Skills and training requirements needed to grow Victoria's hydrogen industry

Technical expertise in energy, electricity and engineering is important for the hydrogen industry. The University of Melbourne has a strong capacity to train the future workforce. Pilot projects, such as a Mallee Hydrogen Hub, will provide a critical avenue for students, researchers, industry and government executives to work together to understand the economics and regulatory landscape pertaining directly to a hydrogen economy. Such a project will provide the necessary on-the-ground training to grow future expertise. Successful implementation of such green hydrogen economy hubs will place Victoria on the world map as leaders in the space.

Closing Statement

The Mallee Regional Innovation Centre believes that for the regions, further research and development is required to ascertain the value, resources and capabilities for regions to engage and become early adaptors in this new industry.

Energy, climate and water risks have transformed the business landscape for both horticulture and their support industries like transport. For farmers, environmental managers, service industries, supply chains and now boards, these are all pressure points and require risk assessment.

New energy options will complement the next wave of innovation that will assist horticulture and resource management and their service industries in remaining successful and sustainable. This will require funding for projects, delivery of projects, business incentives for early adaptors and education for the community generally and more specifically if the hydrogen industry is to grow.

Part of the challenge for regions is connecting into the correct networks to further the conversations about the opportunities. The Centre has made contact with Professor Ross Garnaut (who also visited the region in August 2019) from the University of Melbourne and after his visit he discussed the idea of a hydrogen plant in the region. We have also engaged with Dr Neil Thompson from the Queensland University of Technology.

The framework of the MRIC allows us to have feet on the ground, drive collaboration and participation, all with the outcome of having better and improved adoption of R&D. In this case, a contribution that can be made in contributing to conversation about hydrogen and the regions potential to be home to a hydrogen hub.

Further research is required in the region to accurately gauge the infrastructure, resources, industry and economic benefits in regard to hydrogen use and production in the Mallee Region, that could support industry, capitalize on renewable capabilities of the region and practical applications in local industry such as agriculture. The region could become a leader in the reduction of emissions and an example of a circular economy.

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13. Solar farms asked to reduce output as uptake challenges remote West Murray grid stability, 3 February 2020, https://www.abc.net.au/news/2020-02-03/mallee-solar-farms-asked-to-reduce-output-to-grid/11912848?pfmredir=sm&sf229423326=1

APPENDIX 1

Lower Murray Water - Case Study

Opportunities for hydrogen

Background

Lower Murray Water's (LMW) rural business comprises about 2,800 small to large agricultural businesses that compete mainly in global markets. Table grapes, dried fruit, citrus, avocados and wine grapes supply markets in Asia and Europe. Growers are acutely aware of the need for both quality and cost competitiveness of their products. The reliability of LMW's infrastructure to deliver water is crucial to maintaining quality. Because horticulture requires long term investment, customers value price stability as well as price competitiveness.

LMW pumps water from the Murray River and delivers water through a network of channels and pressurised pipes. The continued sustainability of the water delivery infrastructure depends upon LMW securing stable cashflows from its customers to fund the 20-year asset renewal and replacement master plan.

The electricity consumption of the LMW irrigation pumps peaks at around 14MW during summer with a total electricity consumption of about 32GWh per annum. The peak pumping period coincides with the highest and most volatile electricity spot prices and the coincidence of peak load and price volatility has the effect of amplifying electricity price volatility risk.

In 2016, LMW made a pledge to the Victorian state government to reduce emissions from its operations to 24,708 tCO2 (total carbon dioxide) 1 July 2025, a reduction of 39% from the baseline of 40,243 tCO2. LMW's irrigation pumps contribute 70% of LMW's total emissions.

LMW Objectives

LMW has three strategic objectives:

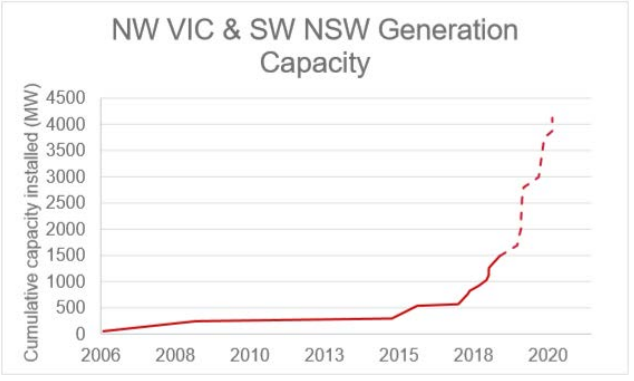
- Maintain the supply of water deliveries to our customers when they need it.
- Optimise the cost/risk of electricity and renewables.
- Meet our emissions Pledge obligations.

Situation and context

Electricity Grid

The LMW service area is supplied by three transmission lines, two from Ballarat and the other from the NSW transmission line to Broken Hill.

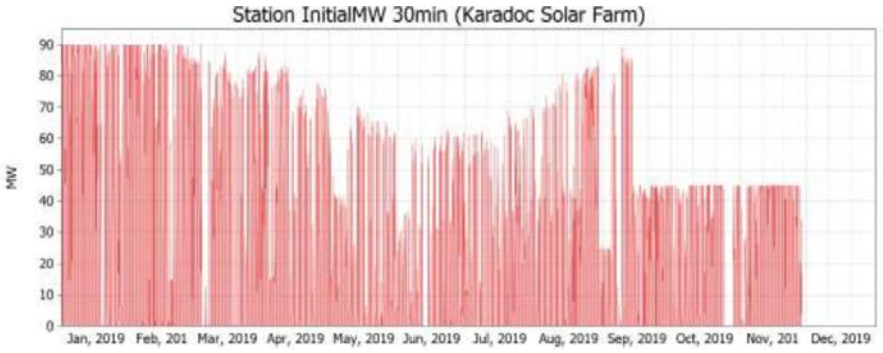
There have been a significant number of new solar and wind generation projects connected to this transmission network over the past few years and AEMO expects this trend to continue as shown in the figure.



In September 2019, the Australian Energy market Operator (AEMO) advised that these developments have increased the potential for widespread thermal and stability constraints on generation in our region.

Existing solar generators in our region are being constrained back to 50% of capacity to protect the grid against contingency events. An example of this is the shown in the figure below. The AEMO constraint on output

was applied from September (note there is no data for December). Fluctuations prior to that date are due to variations in solar output related to solar intensity. Typically, there is lower production during winter months than during summer months.



In late December 2019, AEMO issued a notice of a fault level shortfall at Red Cliffs of 312MVA (current fault level 638MVA) and that it will use reasonable endeavours to address the shortfall by 1 January 2021. This will include the need for new generators to provide system support and add to the cost of new renewable projects.

While it is not possible to quantify the probability of outages, the current situation has clearly increased the risk of loss of supply due to transmission outages. The recent loss of supply to the Robinvale district is an example of how this risk may affect LMW's operations.

The rapid development of solar projects in our region has created and oversupply of solar generation compared to demand and network capacity. This situation is anticipated to continue as new solar generation projects are developed.

Electricity and Renewable Markets

AEMO forecast a 560MW shortfall in generation in Victoria in peak periods during the 2019/20 summer. AEMO contracted with a number of market participants for demand response capability to offset the shortfall through its Reliability and Emergency Reserve Trader (RERT) scheme.

The rapid development of solar and other renewables has had a transformational impact on time-of-day electricity prices and price volatility. The volume of solar now connected to the grid has meant that the minimum daily net demand occurs during daylight hours. In South Australia, negative prices are common (see Figure) and this outcome and trend will also become common in Victoria.

Regulatory developments

Several regulatory changes are being considered by the Australian Energy Regulator (AER) for the region which may have a significant impact on reliability and electricity price:

- New transmission infrastructure. An 800MW transmission line connecting NSW, SA and Victoria through Buronga has recently been approved and will be constructed by 2022. This interconnector will enable existing solar plants access to market only and will be fully utilised on completion. Another interconnector between NSW and Victoria via Kerang is also likely to proceed by 2025. These will improve the reliability of the power network.

- An Intra-regional spot market is being considered for the region. This would mean the LMW service region would have separate spot price from the rest of Victoria.
- Marginal loss factors (MLF's) change favourably for LMW the more generation that is developed in our region. However, there are submissions being considered by the AER to change the way MLF's are calculated.

Emergence of green Hydrogen as a potential fuel source

There is evidence that the cost hydrogen produced by electrolysis is similar to diesel now and that the cost is expected to halve over the next 5 years[1].

Strategic Opportunity for LMW

LMW may provide a pilot study for the development of a hydrogen feasibility assessment.

The concept would be as follows:

- LMW installs back-up, hydrogen fuelled generation and associated storage and on-site solar plant to:
    - Mitigate the risk of network and electricity supply failure.
    - Participate in the electricity wholesale market:
        - Supply electricity to the grid when the spot price exceeds the cost of hydrogen-based generation.
        - Use electricity from the grid when the cost of electricity is below the cost of LMW's solar production and when prices are negative.
    - Participate in future AEMO RERT schemes as a source of revenue.
    - Reduce emissions to assist with meeting LMW's pledge obligations.
    - Reduce network charges by using the back-up generation to reduce the peak demand.
    - Use hydrogen to fuel LMW's vehicle fleet.

[1] Green Hydrogen Investment Program; November 2019. Victorian State Government, page 11.

Attachment 1. Electrical network and location of generation.