GEELONG ECONOMIC FUTURES 2016

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CENTRE FOR REGIONAL AND RURAL FUTURES

G21
GEELONG REGION ALLIANCE

CITY OF GREATER GEELONG

JUTURNA

Executive summary

This report identifies and analyses five (5) emerging economic opportunities in the Geelong region with strong credentials for attracting large-scale investment and in turn creating sustainable economic futures.

Together, the chosen projects are estimated to attract investment of around $AUD2 billion. Only one project is considered to require significant government investment; only 15% of investment requirements involve government funds.

The development of ideas was led by local insight, supported by expert assessments where relevant. Ideas were taken from concepts to the point where broad business models and investment criteria could be established.

The five (5) emerging opportunities were chosen because they all build on existing Geelong and region strengths or legacy infrastructure and knowledge; they show prospects for being taken in new directions with fresh investment.

The report considers four of the five opportunities to be ready to proceed to market scrutiny. The fifth is at the concept stage only (i.e. Commercialised international education and training in farming and agribusiness).

One project (Avalon) could unlock large asset recycling opportunities for State government.

Key numbers for five prospective Geelong region projects:

(Ordered by scale of investment):

	Emerging economic futures project	Est. capex $AUD (FTE)
1	**Avalon – Victoria's future freight precinct** **Other benefits:** Facilitates major asset recycling at Melbourne (Dynon Road) and North Geelong rail yards, potentially of same scale as cost of project	$1 billion (c. 3,000)
2	**Irrigated agriculture using secure recycled water supplies** **Other benefits:** Delivers potential new water sales revenue stream to government	$600-800 million (tbc)
3	**Australian Animal Health Laboratory Geelong** **Other benefits:** Government funding to unlock subscription revenues of up to $30 million *per annum*	$300 million (N/A)
4	**Industrial scale advanced carbon fibre manufacturing in Geelong** **Other benefits:** Incorporates license fee revenue to Deakin University recognising its significant investment in Carbon Nexus and AFFRIC to date	$70 million (80)
5	**Commercialised international education and training in farming and agribusiness** **Other benefits:** Concept stage only	Concept stage only
	Total Geelong and region investment (FTE)	**$AUD 1.97-$2.17b (c. 3,080)**

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Glossary of Terms

AAHL	Australian Animal Health Laboratory, East Geelong
ABS	Australian Bureau of Statistics
AFFRIC	Australian Future Fibres Research and Innovation Centre at Deakin University, Geelong
ASEAN	Association of South-East Asian Nations
BSL	Biosecurity level: the 4-level framework for grading biosecurity risk (1 being lowest, 4 being highest)
CCMA	Corangamite Catchment Management Authority
CF	Carbon Fibre
Class A recycled water	Water recycled to the point where it is usable for growing human food crops which are to be consumed raw
Class C recycled water	Water recycled to the point where it is usable for growing human food crops that will be boiled/ processed, or for stock fodder
CRC	Co-operative Research Centre
CRO	Contract Research Organisation
CeRRF	Centre for Regional and Rural Futures, Deakin University
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEDJTR	Victorian Government Department of Economic Development, Jobs, Transport and Resources
FTE	Full-time equivalent – a labour force measure
G21 Alliance	Economic development body for the Greater Geelong, Surf Coast, Queenscliff, Golden Plains, Colac-Otway local governments
GL	Gigalitre – a measure of water volume equivalent to 1,000 megalitres or 1 billion litres
GCEID	Geelong Centre for Emerging Infectious Diseases
MOU	Memorandum of Understanding
MW	Megawatt – measure of electrical energy output equivalent to 1,000 kilowatts or 1 million watts
OECD	Organisation for Economic Cooperation and Development
PDI	Peter Doherty Institute for Infection and Immunity, the University of Melbourne
Potable water	Term describing water considered safe for human consumption and food preparation
QIMR	Queensland Institute of Medical Research
SARS	Severe Acute Respiratory Syndrome: a life threatening viral zoonotic disease
TAFE	Technical and Further Education
TEU	Twenty-foot equivalent unit - a standard measure for shipping containers
VCAMM	Victorian Centre for Advanced Materials Manufacturing
WHO	World Health Organisation
Zoonosis	A disease which can be transmitted to humans from animals

“The report has focussed on the legacy economic structures and advantages – physical, knowledge-based, etc. – which are capable of giving Geelong a distinct global competitive advantage in the future...”

Introduction

The *Geelong Economic Futures* report is a collaborative effort between Deakin University, the City of Greater Geelong and the G21 Geelong Region Alliance to identify credible, large-scale economic growth opportunities in the Geelong region. It is conceived as a template for a productive approach to regional development - one led with local input and then supported by governments and the markets.

The report has focussed on the legacy economic structures and advantages – physical, knowledge-based, etc. – which are capable of giving Geelong a distinct global competitive advantage in the future, with the right attention to further development in these areas. In this sense, the report is not so interested in ‘ticking boxes’ on the usual broad and general spectrum of potential regional development, but focusses instead only on that which appears to have the most claims to uniqueness or genuine commercial and economic advantage *in situ*. This follows emerging economic theory concerning trade and development; the methodology page below expands on this understanding.

The intention is to identify market investment or partnered government-market investments, at a large scale. Where deemed relevant, it touches on the public policies surrounding these fields, to give a foundation for further work on the sort of attractive policy settings that would make investment happen.

Through the process, the authors consulted widely with Geelong regional practitioners in the fields of examination, with globally eminent expertise in relevant areas, and with market investment parties, so the end result is as attractive as possible to market and partnered government - market investment.

Candidate selection

The project was proposed in early 2015 and over the course of a year informal efforts were made between the Centre for Regional and Rural Futures (CeRRF), Deakin University, the City of Greater Geelong, the G21 Geelong Region Alliance and the consultant (Juturna) to consider prospective 'economic futures' for more formal examination. In January 2016, noting that there were many potential candidates, formal work began, addressing five prospective regional 'economic futures':

1. **High-security, low-cost water solutions to drive high-value, drought-proofed regional farming;**
2. **CSIRO's Animal Health Laboratory Geelong playing a collaborative lead role in Asian biosecurity/infectious disease response;**
3. **Victoria's largest, lowest-cost interstate and seaport road and rail freight terminal being built at Avalon, adjacent the airport;**
4. **A carbon fibre manufacturing industry capitalising on Deakin University's world-leading Carbon Nexus research centre;**
5. **Geelong as Asian hub for commercialised training and education in agriculture and agribusiness to meet Asia's food security needs.**

Project background and sponsorship

The project was conceived in 2015 by the funding parties in discussion with Juturna, which had solicited the concept as an alternative, market and community-led approach to economic development, following better economic principles of how trade develops (see *Project methodology below*). The project was contracted in February 2016. CeRRF is the contract manager and coordinator of the project on behalf of all collaborators. A steering committee was formed representing the funding parties and eminent leadership and expertise in relevant fields.

Membership of the steering committee is as follows:

- **Dr David Halliwell** – Director, Deakin University Centre for Regional and Rural Futures (Chair)
- **Ms Cora Trevarthen**, Adviser to the Vice-Chancellor, Deakin University (Secretary)
- **Mr Andrew Ashbolt**, Managing Director, Arrow Funds Management Ltd
- **Ms Elaine Carbines**, Chief Executive Officer, G21 Geelong Region Alliance
- **Mr David Downie**, Strategic Adviser, Centre for Regional and Rural Futures (CeRRF)
- **Mr Luke Fraser**, Principal, Juturna Infrastructure P/L (Project author and manager)
- **Mr Brett Luxford**, Investment Manager, City of Greater Geelong
- **Mr Dan O'Brien**, Chief Executive Officer, Incolink, former Deputy Secretary Regional Development Australia

Project methodology

The task involved developing a market-facing analysis of five (5) productive development opportunities for the region. The methodology applied in this respect represents a somewhat different approach to convention and deserves explanation.

1. Applying better economic theory to origination effort

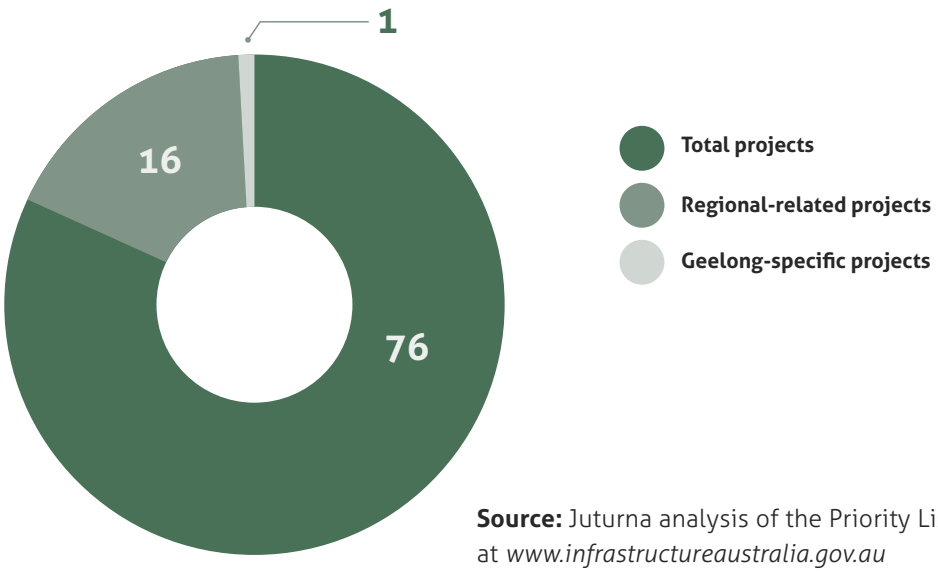
A specific economic hypothesis drove the project: in economics, traditional trade theory has focussed on 'comparative advantage' – that is, taking advantage of the differences that each place has to offer, usually so as to achieve 'economies of scale' as a way to become successful. Less attention has been paid to the concept addressed by Nobel Laureate Economics Professor Paul Krugman of the increasing additional benefits to be found in localised external economies which become globally dominant for more reasons than simply lowest cost. This theory opens the possibility that any economy might renew itself and find new growth not only through economies of scale or comparative advantage, but by also focussing development effort on the specific physical or intellectual advantages of a place: this might be the result of historical accident – for instance, building a new economic future from a particular facility or infrastructure network that happens to be there already: with the right attention, the new structure can become a global leader.

It can also relate to networks of local individuals - their talent and intellectual property ('information spill-overs') and the availability of a range of specialised providers in a given local field. New information technology can bring these things together and make such places globally competitive, under the right conditions. Silicon Valley is an oft-quoted example of this phenomenon.

2. Who is best-equipped to lead the origination effort?

There is a question of who is best placed to identify Geelong's economic futures and move them forward from basic concept to something tangible. Regional development is challenging, judged by the relative absence of non-capital city projects in Infrastructure Australia's most recent (2016) *Infrastructure Priority List* (Figure 1).

Figure 1: Infrastructure Australia *Priority Project* List February 2016 – How regional cities fared



Source: Juturna analysis of the Priority List, available at *www.infrastructureaustralia.gov.au*

Geelong received only a single project on this premier list: even this was only a commitment to examine the prospects of a rail freight connection from the Port of Geelong to the Murray Basin in North-West Victoria. None of the list's regional city projects were afforded 'high priority status' by Infrastructure Australia.

Agencies at Commonwealth and State levels generally play the leading (if not sole) role in originating such projects. Yet the subsidiarity principle suggests responsibility should flow to the level of government best positioned to deliver solutions.

This report set out to test the thesis that local industry, community and government probably have unequalled insight into the legacies and future potential of their own region - and that this insight need only be leavened with specialist expertise where necessary to identify robust, preferably fully-commercial opportunities.

The participating parties hoped that this approach would be successful and thereby offer a useful complement to future efforts of State and Commonwealth governments in pursuing good regional development outcomes.

GREATER
GEELONG
900KM²
LARGEST REGIONA
ECONOMY IN VICTORIA
$10BILLION
ANNUALL
POPULATION OF ALMOST
300,000
AT 180,000
CITY OF GEELONG
RANKS
↓ HOBART
& ↑ TOWNSVILLE

Geelong and region economic profile and the choice ahead

The G21 Geelong regional area is an approximately 9,000 square-kilometre region comprising the local government areas of the City of Greater Geelong, Surf Coast and Colac Otway to the south-west, Golden Plains to the north-west and Queenscliff on the Bellarine Peninsula – is the largest regional economy in Victoria, producing over $10 billion dollars annually in Gross Regional Product (ABS statistics). In relative terms it is also a more diverse industry base than the rest of regional Victoria, with a regional population of almost 300,000 people. At 180,000 people, the City of Geelong itself ranks just below Tasmania's capital city Hobart and above North Queensland's Townsville in size. In international terms, Greater Geelong compares well for scale with cities like Malmö (Sweden), Bergen (Norway) and Newcastle (United Kingdom).

In recent years Geelong has faced well-documented challenges in employment as the city transitions from its traditional manufacturing base to a more service sector-oriented economy. This major transition comes in the context of generally low regional economic growth across Victoria: in the decade to 2002-2012, growth in gross regional product broadly halved from the levels of the preceding decade (ABS statistics). The last Geelong-level labour market forecasts were produced in 2013 (Juturna for Regional Development Australia, 2013).

This analysis indicated that over the coming ten years, the City of Greater Geelong was likely to shrink as a percentage of the total Victorian labour force. More recently, Deakin University and the City of Greater Geelong have undertaken economic modelling and analysis of the likely shape of the Geelong labour market in the immediate future (Keneley, Dimovski, Stevenson 2014).

This work suggests that while the loss of traditional sectors like manufacturing will present structural adjustment challenges such losses are likely to be more than offset by new job growth and regional economic output in other sectors, such as the services sector, health and education – overall, a stable and cautiously positive picture. This report proceeds from this context, but focusses on the productive potential of the region.

While a net rebalancing or slight growth in employment levels might appear satisfactory, the policy objective should be to pursue highest-productivity jobs which create a higher quality of life and more value for the community, and ultimately for the national economy as well. Inherently, such jobs are more likely to be in the private sector and they are more likely to be export-oriented. Geelong, with well-respected education and research institutions, an international seaport and airport and expertise in areas of Asia region high demand, such as agriculture and advanced materials, can choose to 'shape' its economy to these ends.

If not, the 'path of least economic resistance' is more likely to bring about a lower-productivity service sector economy, as a satellite city/dormitory suburb to Melbourne (soon to be a metropolis of 5 million people). Too much acquiescence to such a model implies correspondingly lower quality of life and economic output.

This report examines projects that can contribute to highest-productivity growth ambitions for the region's future.

Emerging Economic Futures: five candidates

Irrigated agriculture using secure recycled water supplies

Key numbers:

Estimated scale of investment opportunity
c. $AUD600-800 million (market-designed and built water pipeline and treatment infrastructure)

Estimated direct employment creation
To be determined by the precise mix of farming activity undertaken with the high-security, low-cost water.

Likely types of permanent jobs created
Can be expected to have a particularly high seasonal workforce and potential for high-value, high-technology farming roles, water engineering management roles, food services value-adding and transport and logistics jobs.

High-security, low-cost water infrastructure to drive an expanded, higher-profit Geelong farming sector

- This project examines high-value farming and food services secured by delivering low-cost and reliable water supplies. This appears achieveable by piping some of the region's abundant recycled water to a scalable high-value growing area.

- Geelong has a long historical involvement with farming and satisfies many core requirements for successful commercial agriculture ventures. But lack of high-security, low-cost water holds the region back from very large and productive new commercial investments. It also places the farm economy at risk in the context of a warming climate.

- This project addresses water availability risk and price in a highly-innovative, sustainable and regionally-specific approach. It takes advantage of regional availability (*via* strategic pipeline and water treatment investments) to harness plentiful, renewable amounts of recycled water at regional water treatment plants.

- This can drive secure farming of more profitable, export-focussed crops such as fruit and vegetables, nuts, as well as value-adding food services for export. The project also considers the vital water rights needed to make such an endeavour commercially viable and robust.

Geelong, the region and agriculture – three underlying production strengths, one critical constraint

Strength 1: Soil composition and its growing potential - The region's soil composition and temperate coastal climate rate as mostly medium quality and in places very good for farming. Two major constraints relate to lack of irrigation opportunity, urban encroachment and small areas, suggesting a need to move solutions to higher value irrigated product – using limited land, more productively (see Table 1).

Strength 2: Efficient transport logistics - Geelong is a major logistics centre and the port of Geelong is Victoria's largest soft bulk commodity seaport. In addition, Geelong is well situated for food production distribution to the Melbourne markets as well as for air and sea export through Tullamarine airport's freight centre and the Port of Melbourne container terminal respectively.

Strength 3: Trained workforce - The region possesses a talented farming workforce which is already well-versed in agriculture and which plays a prominent role in the region: 2013 census data (ABS) reveals over 2,400 businesses in agriculture, forestry and fisheries in the G21 Geelong Alliance region. This represented almost 11 per cent of all businesses, which is higher than the national average percentage for these business sectors (ABS). These farms are backed by globally-leading centres of training, research and education, such as Marcus Oldham Agricultural College, the Gordon Institute and Southern Farming Systems research centre.

Geelong is more water-secure than most regions, but still lacks high-security, low-value water for farming

One fundamental input to successful agriculture is high-security water - and this remains a challenge to optimising food production and its value as an industry. With the advent of the Geelong-Melbourne water pipeline in 2012, Geelong is one of the few regions in Australia that can claim near total water security – its access *via* this pipeline to the wider State water network – including the north-south pipeline and the Victorian desalination plant at Wonthaggi ensures basic water security.

However, the price function in this water grid means that in times of scarcity, Geelong region agriculture remains at risk of being 'priced out' of water. This lack of high-security, low-cost farming water limits the ability to make large and patient investments in high-value agriculture. It also suggests even smaller parcels of Geelong region farming land are not being used as efficiently as they could be. This appears to be borne out in Table 1 which points out limited irrigation capability as a major constraint on some of the region's best soil profiles.

Table 1: Top agricultural land classes in the Greater Geelong region: capabilities and constraints

Land Class	Description	Constraints	Farming System
1	Alluvial river terraces and deposits along Barwon, Moorabool rivers and Sutherlands Creek	Small areas, limited irrigation	Intensive agriculture, intensive cropping, intensive grazing
2	Central Peninsula: mottled duplex sandy loams	Urban intrusion, limited irrigation capability	Intensive cropping, intensive grazing
2	Bellarine Hills: black friable clays	Urban intrusion contour, limited irrigation capability	
2	Barrabool Hills/Waurn Ponds: red and yellow duplex soils	Urban intrusion, soil compaction	Limited intensive agriculture
2	Lara Lake: Little River red duplex soils	Urban intrusion, soil compaction	Broadacre cropping
2	Staughton Vale: alluvial red duplex clay loams	Compaction	Broadacre cropping
3	Basalt Plains	Incidence of stone, soil compaction	Broadacre cropping
3	Mt Duneed Basalts: grey-brown duplex soils	Waterlogging, compaction, salinity	Associated cropping
3	Moolap alluvium	Low fertility, urban intrusion, small allotments	Broadacre cropping, intensive grazing
3	Lower Peninsula	Waterlogging erosion	Intensive grazing, broadacre cropping
3	Swan Bay	Waterlogging, erosion, salinity	Intensive grazing

Source: City of Greater Geelong Planning Scheme (2007)

In more detail: Geelong region farm water constraints

Like elsewhere in Australia, most regional water discussions have focussed on securing ground water and rainfall: sinking bores, capturing run-off through dams etc and securing offtake from river systems, notably for irrigation. There are two connected problems in this approach:

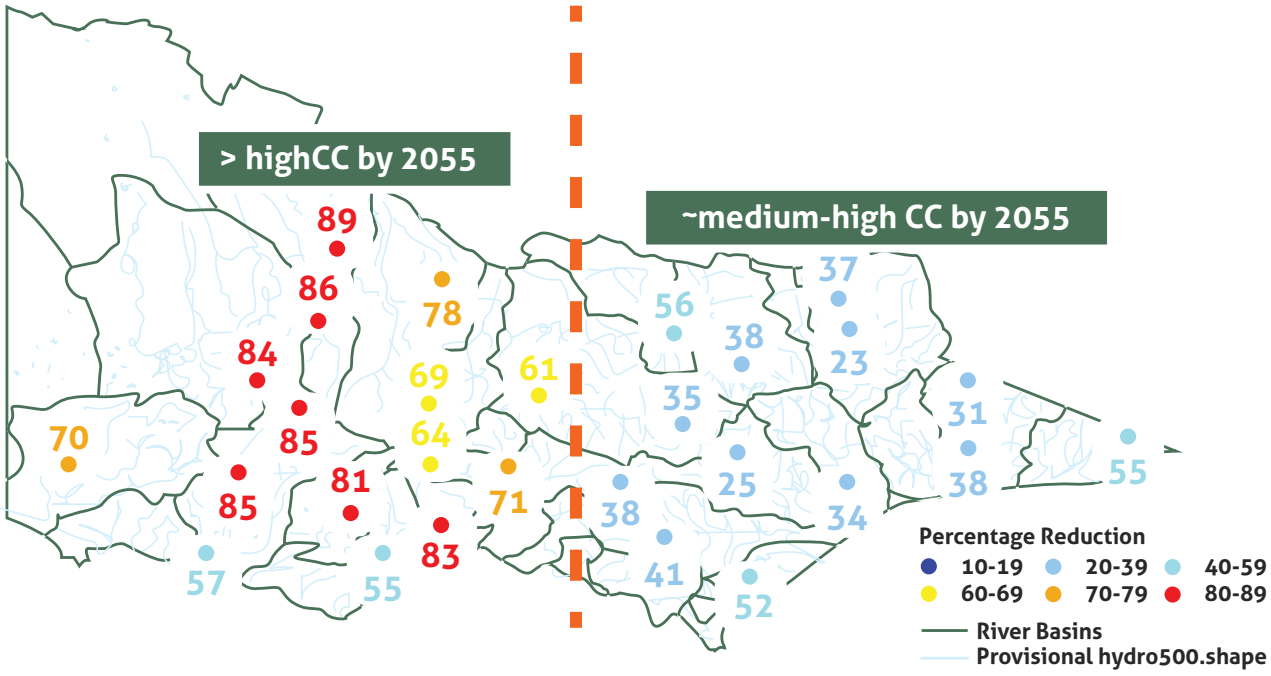
1. Farming water can often be subject to scarcity - In Australia, economic reforms have established a market for trading in water - water has a market-determined 'price'. When this is paired with a warming climate and the prospect of intermittent droughts, the price of traditional rainfall and runoff water supplies for agricultural use will increase as water becomes scarcer – in other words, rainfall/runoff/storage risk is being imputed into the farm water price. This can (and at times, already does) price farmers out of the market for water. In simple terms, in times of drought or water scarcity, some forms of farming either do not go ahead or become borderline unprofitable. Figure 2 reveals the impact on runoff on water availability under Australian Bureau of Meteorology climate warming scenarios. It shows a significant stress on water availability in the Geelong region. More generally, a good example of the impact on stream flows, particularly in the west of Victoria, is Avoca at Coonooer (near top left of Figure 2) with a 19% decrease in rainfall translating to an 86% decrease in streamflow (i.e. 4.6 times) – which may also reflect impacts of changing seasonality of the rain. The Moorabool river catchment in the Geelong region is classified as one of the most severely flow-stressed waterways in Victoria (CCMA 2009). A warming climate places in question any strategy which relies on powering Geelong regional irrigation infrastructure from river systems.

2. Farming is subject to investment uncertainty due to water scarcity risks - Water scarcity and the high prices that accompany it can erode the competitiveness of the Geelong region's farm products both domestically and internationally: turbulence in product supply and price due to water scarcity dissuades long-term investment and offtake. There is no shortage of global and domestic interest in Australian agriculture, but water uncertainty - its price impact and production volatility - is a barrier to Australian agriculture.

These challenges can lead to an assumption that low-security, lower-value agriculture is simply 'the way it is' in farm investment. This appears an unnecessarily pessimistic view of farming in regions like Geelong, where alternative high-security water solutions appear open to farming, given the right scalable approach to commercial agricultural water infrastructure.

"major infrastructure projects are too often designed by the public sector, rather than by market proponents whose balance sheets are more directly incentivised to provide the leanest and most innovative solutions..."

Figure 2: Percentage reduction in Victorian river system flows under climate change scenarios



Source: Australian Bureau of Meteorology

The region is making major gains in water infrastructure, but high-security farming water is still not available

In recent times, the Geelong region has been active in pursuing infrastructure solutions to improve matters. A notable achievement is the Bannockburn irrigation zone, developed by the Golden Plains local government in partnership with the Commonwealth and State governments. The 18km pipeline can service a nominal area of 3-4,000ha of intensive production and the council has zoned a precinct for this purpose west of the Midland Highway near Lethbridge, but this step was not driven by pre-existing commercial market subscriptions for such land development.

With the project now *in situ*, council reports two intensive poultry farming development applications are pending for the precinct. Council's 10-year business case and plan for the Golden Plains pipeline is to drive $160 million dollars in regional investment and generate 700 jobs. But the challenge for this project remains its reliance on a rainfall and runoff source: in times of water scarcity, the price function of water can dictate that it shifts to higher-value uses than farming.

Netherlands: international high-value farming benchmark for the Geelong region

The Netherlands is the world's greatest example of the high-value that agriculture can achieve when secure, low-cost water and other foundation factors are in place. Total land area of the Netherlands is only 41,000 square kilometres: this is only four times the size of the Geelong region considered in this report. Yet from this small parcel, the Netherlands has become the world's second largest food exporter. With over $78 billion in food exports in 2015, the Netherlands exports almost two and a half times as much agricultural value as Australia.

The Netherlands can achieve this level of performance because it chooses to focus on high value and value-added food (cheese, vegetables, fruit, beer, cut flowers, bulbs, chocolate etc), rather than low-value commodities (eg grains, which are imported to Holland for value-adding). It also has a ready market of around 500 million European consumers for high quality products.

Agriculture represents 15% of the Dutch export economy. Its high-value nature means that the farming sector is not reliant on subsidies to farm low-value crops, like much of European farming. In this way, the Netherlands is a net payer to the European Common Agricultural Policy, rather than a subsidised farmer (Source: US Department of Agriculture Foreign Agricultural Service Country Report, Netherlands 2015). All of these qualities attract major investment: the Netherlands is ranked in the top ten countries for foreign direct investment.

Preconditions for Dutch farming success include secure water access: for example, if the Netherlands was forced to rely on the highly-volatile Australian 'rainfall and runoff' farming model and its uncertain rainfall patterns, the high-value Dutch agricultural success story would be impossible to achieve. Apart from secure access to water at stable prices, the Geelong region has most of the other preconditions that the Netherlands enjoys: it has a skilled and experienced farming and food services workforce; it has high quality agricultural research and education expertise; it enjoys export friendly government trade policies, plentiful land, access to high-quality transport and logistics and a regional export market in Asia that has been estimated to contain over 500 million middle class consumers (**Source:** Brooking Institution: defined as those who earn between $10-100 dollars per day).

Other things being held equal, solving the Geelong region's water requirements through large-scale and long-term investments in recycled water pipeline infrastructure can help the region to move to the 'Dutch model' of high-value, export-focussed farming, with all of the stability and economic and social benefits this brings.

Addressing the problem: new sources of high-security, low-cost water for Geelong region agriculture

This project examined alternative farm water solutions which would not rely on rainfall and runoff for a solution, because this cannot assist the farming community in times of water scarcity - when the price of water increases dramatically. The project examined alternative local sources of water which might be lower cost and more reliable. It found a potential source of this water in extremely large amounts of recycled water supply at the two water treatment plants which service the wider region – much of which is sent out to sea as waste product. Recycled water is also referred to as Class C water. It is harvested from stormwater and sewage sources and then subjected to remediation processes at the water treatment plants to remove pathogens and other harmful waste products. Class C water can be further treated through a range of measures to create Class A and potable water. Not all farming requires such water, but higher-value crops tend to do so.

- **Werribee water treatment plant - c.80 gigalitres of recycled water annually.**

- **Black Rock water treatment plant – c.15 gigalitres of recycled water annually**

This represents a combined alternative water source of around 95 billion litres. At present, almost all of the Class C water at the Werribee and Black Rock treatment plants is pumped either into Port Philip Bay (from Werribee) or Bass Strait (from Black Rock).

The Werribee water in particular is also presently turned to ecological purposes, which will require some offsetting. Much of this water has no price and the government does not produce a revenue stream for this resource. Pumping the water into the sea attracts its own costs and is not without some environmental health risks. This project considered the prospects for harnessing an indicative 50-60 per cent of this water, either through independent pipelines from the two treatment plants, or in a pipeline network for more scalable farming outcomes. Expertise in water engineering and treatment of recycled water and offsetting environmental uses for this waste water was brought to bear to examine how such a project might be approached, what factors would condition commerciality and how water rights and trade-offs would need to be approached.

Historical approaches to this opportunity: why they have failed

The opportunity presented by the recycled water at Werribee and Black Rock is not new – it has been observed for several years. Over that period, there have been various attempts by Geelong's farming sector to access this water. This project has not examined these attempts in great detail, but it suffices to note here that the approaches appear to have lacked scale and as such, may well have been sub-commercial. For instance, building a pipeline to move some of this water would be extremely expensive for a typical Geelong region farm operation, or even for several farmers.

What is more, the development of a large-scale pipeline, the negotiation of long–term secure water rights for an unvalued water resource and the management of offtake from multiple users are not core areas of expertise for most local governments or farmers: many parts need to come together to facilitate a scalable and secure project.

Equally, these are matters that may not necessarily be the highest priorities of water authorities, who have a range of other customers to service. All of these factors appear to have resulted in a failure of the market to develop this opportunity further.

In parallel, there have also been a handful of studies and pilots led by government to harness this water for commercial farming. This has extended to plans such as the Moorabool River and Sutherlands Creek proposal (2004) and the Balliang project (2002), both of which have been unsuccessful.

The authors analysed these projects. The common thread was that they were supply-led rather than demand-led strategies: water authorities and other government parties had commissioned and led the proposals and projected market uptake, rather than

secured subscriptions before proceeding further. It appears these projects were driven as much by the desire to meet various government water recycling targets than by clear commercial interest and efficacy considerations.

The need for government to provide long-term proponent rights over such water (discussed below) in order to provide security to the market investor is another matter which does not appear to have been explored thoroughly in past efforts. This project acknowledged these past shortcomings by placing its focus on a grower-driven process of sufficient scale as to be facilitated by water authorities and government, rather than led by these parties.

Key factors to project viability

A pipeline or pipelines will harness recycled water at Werribee and/or Black Rock for regional agricultural purposes. Key success factors:

1. **Underpinned by commercial investment principles in water rights and product demand**
   A commercial pipeline investment of many hundreds of millions of dollars will require a return on that investment. Typically, this sort of asset lends itself to an investor with an appetite for long-term, illiquid investments, such as a superannuation fund. For such investors to take an interest, two major factors need to be resolved:

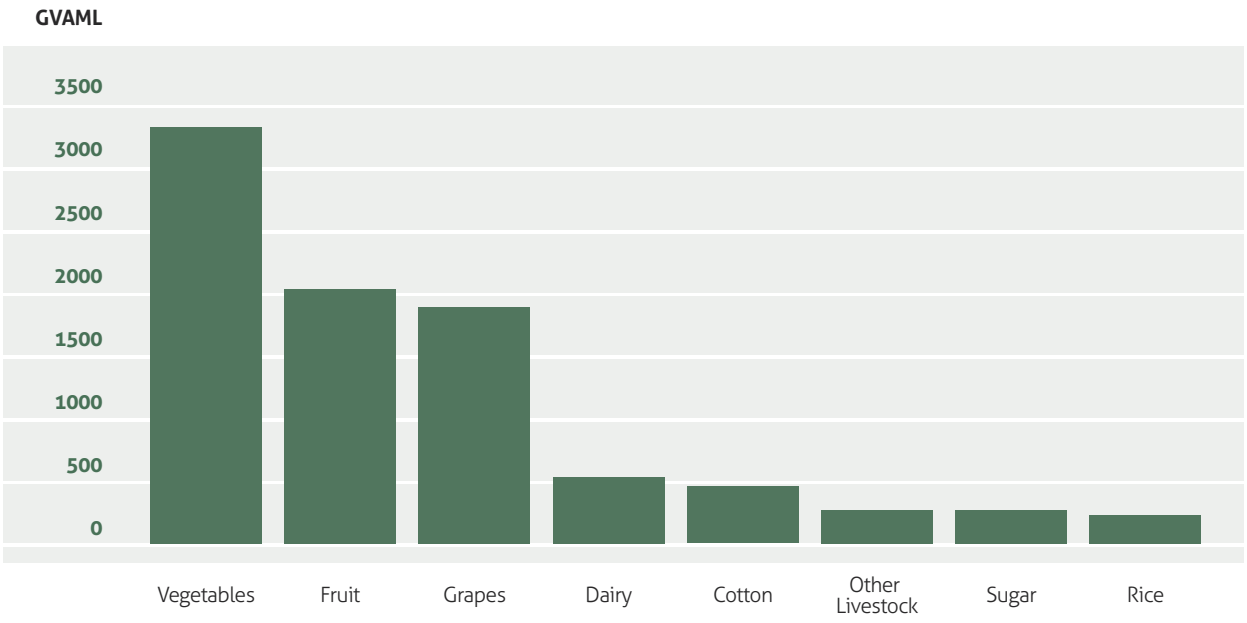
   a. **Bestowal of long-term water rights -** The Victorian government would need to grant long-term water allocation rights to the proponent, on a first-use basis, consistent with legislative provisions and at a negotiated price. Without holding secure access priority over the water supply, a patient water infrastructure investor would be unlikely to invest in the project, as their pipeline would be underwritten by farming interests who were in thrall to spot prices for this water. In this sense, the investment requires a monopolistic right in order to function, but these aspects have been considered by the report and such arrangements are provided for under Australian competition principles.

   b. **Clear and reliable market demand for end-product -** products grown using recycled and treated water will need to find a reliable market and command the right prices on a consistent basis if a patient investor is to receive acceptable returns. In this sense, the project requires maximum attention to securing long-term offtake contracts with food buyers. Interviews conducted in both Australia and China suggest that there could be a mix of domestic and export demand for products grown by the pipeline.

2. **Commercially viable in scale**
   The pipeline project will need to be sufficiently large in scale, so as to move a large amount of high-security, low-cost water to a large prospective farming area. Scalable investment is important. Interviews conducted with experienced water engineers in this field, which took into account exemplar projects around Australia, envisage a scale of construction of between $600-800 million dollars for a pipeline capable of wheeling no less than 50 gigalitres of water to a dedicated Geelong region growing zone. More precise capital expenditure is highly influenced by the distance from the treatment plant to growing area, amongst other factors. This report considers that a more detailed costing is best determined by a commercially-led design process, informed by grower expertise and market demand functions around specific products (see below).

3. **A food production mix which is optimised for the Geelong region -** A related issue to securing long-term food sales is choosing produce that reflects a balance of high value, relative to their water input costs and good local production fundamentals. Not all farm produce represents the same value when measured in terms of water input:

Table 2: Gross value added ($) per megalitre of water used in irrigated agricultural production



NB In some cases these data may underestimate the GVA per megalitre of water used due to such factors as the planting of a second crop on flood irrigated land.

Source: ABS data (2004), quoted in Australian Treasury *Water and Australia's Future Economic Growth* (2005)

Whatever is grown also needs to be regionally appropriate in order to succeed in Geelong region growing conditions. In this respect, interviews with Southern Farming Systems and other parties have suggested that a range of fruit and vegetables, poppies and limited nut varieties such as walnuts would present in-principle high-value growing proposition for such an irrigation project. Interest has also been flagged from the region's intensive pork producers.

4. **A build-and-design process led by a market proponent rather than the public sector -** a consistent problem for infrastructure projects in Australia is high build costs. There are a number of potential reasons for this, but a prevalent one is that major infrastructure projects are very often designed by the public sector, rather than by market proponents whose balance sheets are more directly incentivised to provide the leanest and most innovative solutions. Given the very high capital costs involved in irrigated pipeline and water treatment relative to low operating costs, it is vital that any design and development process is market-led, to minimise up-front capital outlays for the project.

Precise ownership and control arrangements within this pipeline project are of secondary importance. One model might see a fund develop the pipeline which would in turn service a consortium of growers on take-or-pay water contracts. The grower end could resemble a cooperative model. There are a range of ready market solutions available.

Indicative outcomes – size of farming and water pipeline opportunity

As a part of this project, experienced irrigation engineers with specific expertise in recycled water pipeline development were asked to consider likely construction and operating costs for a pipeline to carry a minimum indicative 50 gigalitres (50,000 megalitres) of water from the Werribee treatment plant to a nominal intensive growing region south west of Geelong. For cost development purposes, the infrastructure was expected to allow for the full amount of this water to be pumped in several months, rather than across the whole year, which would represent a more realistic use of the water, given incidences of high rainfall harvest and prolonged drought episodes.

A number of growers were interviewed to establish likely production costs and water input requirements. This work was necessarily indicative and could not be considered a formal business case, as key inputs such as precise crop profile and value-added aspects, water price and land values cannot yet be established – the precise destination for the pipeline is a function of what crops are grown. In turn, crop viability is in part reliant on water input costs – etc. However, using some indicative parameters the report found that a secure recycled water allocation of this kind for green vegetable production could yield a 10,000 ha high-water-security growing area, making for a water input to growing area ratio of approximately 5 megalitres per hectare. The project also gave consideration to the prospect of smaller scale pilots, but the strong view of experienced water engineers consulted was that the project needed significant scale to be commercially viable.

Key numbers:

Estimated scale of investment opportunity
$AUD 300 million for AAHL facility renewal and capex to support the masterplan, driving an ongoing base of subscription revenues in the order of $30 million per annum

Estimated direct employment creation
No direct new workforce component, but provides core infrastructure for larger Geelong region collaborative commercial opportunities

Australian Animal Health Laboratory (AAHL) Geelong:

Asia's future collaborative hub for infectious disease and biosecurity preparedness and research

- AAHL in East Geelong is a strategic element of Australia's response to outbreaks involving the most dangerous micro-organisms; it plays a vital role in testing and vaccine development. AAHL is a critical component for protecting Australia's multi-billion dollar livestock and aquaculture industries - and the public - from emerging disease threats. AAHL boasts physical containment capabilities and skilled personnel found in less than half a dozen other places worldwide.

- In the past, AAHL has perhaps lacked the funding, independence and sufficient collaborative outlook to forge strategic alliances to benefit its own revenue and research efforts. This has inhibited AAHL's ability to play its core role of biosecurity preparedness and response as well as to pursue more productive regional collaborative opportunities.

- AAHL is the closest such facility to Asia, which faces grave emerging threats from exotic zoonotic diseases (i.e. diseases that spread from animals to humans). Asian nations' response potential remains generally weak. AAHL can play an important role in an improved collaborative effort. To do so, AAHL must go beyond its planned facility renewals and undertake targeted infrastructure upgrades to almost double productive capacity and promote commercial collaborative training and research with local/Asian partners, both government and non-government. This promotes new revenue sources for the facility.

- This project develops an Asia-wide collaborative vision along with targeted capital works which together can make AAHL and the Geelong region Asia's true centre for collaborative infectious disease and biosecurity preparedness and research, as well as a facility for research into lethal antibiotic resistant 'superbugs'.

This in turn presents unique commercial opportunities to create a world-leading cluster of skills and services in and around Geelong. It also promises new sources of income for AAHL and associated leading institutions across the country. It does so while protecting and enhancing AAHL's key biosecurity role.

- While AAHL maintains Asia region collaborations, these are often at the facility level and would benefit from more strategic government to-government relationships that foster broader collaborations as well as better subscription revenues to AAHL, which in turn build wider investment opportunities for the Geelong region as Asia's collaborative centre for disease preparedness and response.

AAHL Geelong – world-leading infrastructure and skills, 'Asia's facility'

It was evident from the inception of the Geelong Economic Futures project that if there was anything in Geelong or the region that could truly be considered of unparalleled international significance, it was the Australian Animal Health Laboratory. An enormous facility by world standards, AAHL was conceived in the late 1970s as a biosecurity containment and research facility, ostensibly to protect Australia from foot and mouth disease, anthrax and other threats to the agricultural economy. The construction involved a very high-degree of investment in very high-quality and large-scale specialised infrastructure.

With over 50 airlocks, the facility contains negative pressure infectious diseases high-containment laboratories of a scale unparalleled globally. AAHL provides the optimal environment for dealing with new and unknown threats to biosecurity, including suspected incursions of exotic diseases. Unknown and novel pathogens can be studied for the purpose of developing immunological and molecular biological diagnostic tests, including assays that could initially require the use of live organisms for animal challenge or disease characterization. Challenge studies with particular pathogens in large animals (but also small animal disease models) can be used for clinical trials and pharmacodynamic and pharmacokinetic (drug handling) studies of potential therapeutic agents directed against these pathogens. This environment is required for work on the world's most dangerous infectious diseases such as Ebola and other lethal haemorrhagic illnesses which affect humans.

The management and staff at AAHL are highly trained and dedicated. AAHL also includes the people and the skills for much of what is required of a 'Contract Research Organisation' (CRO) that could tender for and provide capacity for development of assays, assessment of immunopathology, and performance of trials, all of which can be performed at the highest levels of biosecurity - a clear competitive advantage of AAHL in Australia and across Asia.

For the next-to highest international level of biosecurity, *Physical Containment Level 3*, the facility contains the equivalent of a full soccer pitch footprint of laboratory space, backed by world leading bio-imaging research software. This allows for research into zoonotic diseases such as Hendra virus, and indeed it was the AAHL facility that developed the global vaccine to this life-threatening disease in 2011. For the very highest level of biosecurity, *Physical Containment Level 4*, AAHL boasts secure lab space the equivalent of two tennis courts – perhaps 80% of the world's total floor space for this type of science. As Figure 3 reveals, there are only a handful of facilities worldwide with a comparable function, but to date none can boast the scale of research labs for larger animals.

Figure 3. Map of main high-level disease containment facilities worldwide: Geelong is Southeast Asia's only regional facility (Source: AAHL)

Approach to analysis

Positioning AAHL as Asia's collaborative centre for infectious disease research and cures would allow Geelong to occupy the position amongst Asian nations as the region's most important collaborative biosecurity and disease prevention precinct – this in turn builds a base for commercial and scientific collaboration and an expansion of sundry world-leading capabilities in the Geelong-Melbourne region.

Global leadership experience in this field is now centred on Geelong; regional institutional linkages are rich

In addition to having key facilities, AAHL and two related facilities are at present led by three of the world's most eminent infectious disease research centre directors (AAHL Director Kurt Zuelke; Director of Deakin University's Geelong Centre for Infectious Disease Research (GCEID) Soren Alexandersen, and Dean of the Faculty of Veterinary and Agricultural Science at the University of Melbourne John Fazarkely). This remarkable assembly of global scientific leadership in one small area is judged by expert assessment to present an unprecedented talent base for pursuing an Asia-wide collaborative strategy in the Geelong region. AAHL has a national remit but its location in Victoria, a State highly supportive of science, technology and innovation, provides ready access to world-leading institutions, and to experts in the relevant fields of virology, immunology, and vaccine development. For example, an academic association with Deakin University in research and education is well established with a supportive Vice-Chancellor and close engagement with the new Geelong Centre for Emerging Infectious Diseases (GCEID); other important Victorian linkages include the Peter Doherty Institute (PDI), the Walter and Eliza Hall Institute of Medical Research, CSL Ltd/ Bio21 Institute, and the Burnet Institute as well as the University of Melbourne Faculty

of Veterinary Science. Productive linkages are already established locally with Biosecurity Victoria and the Office of the Chief Veterinary Officer as well as the AgriBio Centre (a joint agricultural research and diagnostic facility of Victoria's Department of Economic Development, Jobs Transport and Resources as well as Latrobe University).

Asian demand for this capability is unprecedented, but AAHL must rise to the challenge

AAHL is the closest and most significant infectious disease research laboratory to Asia. It is of particular importance to emerging regional economies which face disastrous socio-economic risks from dangerous zoonotic diseases – diseases which mutate and shift from animals to affect humans. Illnesses such as Zika virus, Avian influenza and others are concerning for Asian countries with increasingly large urbanised populations, (in some cases) less advanced health sectors, live animal markets, no indigenous high-level containment laboratories and inadequate skills and infrastructure in this complex field.

National and international concern about preparedness for diseases caused by viruses such as Ebola, Zika, SARS, Avian influenza and trade-sensitive veterinary diseases such as bluetongue virus and foot and mouth disease is at a high level. Enhanced support could be the cornerstone of Australian government demonstration of preparedness through relevant specialist expertise, exceptional facilities, strategic alliances, all "linked-up" for greater regional biosecurity. Support for training is absolutely critical for those in Australia and across the world who may need to work with or undertake research on these infectious agents, including skilled technical personnel, researchers, veterinarians, epidemiologists, pathologists and clinicians.

Another field of significant scientific concern is the emergence of so-called 'superbugs' – diseases which are fully-resistant to available antibiotics. Expert assessment from within AAHL and more broadly considers this to be another field of research and preparedness which would be prospective for the facility.

AAHL reports that many Asian countries have already negotiated MoUs with AAHL and are enthusiastic to deepen the collaboration. Leading western infectious disease non-government organisations and pharmaceutical companies alike are also recognising the unique opportunity that AAHL facilities present in reducing the time it takes to make research breakthroughs for new vaccines. Yet to date, no strategic framework exists to guide this collaboration, or to attract large and stable collaborative cash flows to AAHL.

A regional and global issue such as emerging diseases provides an opportunity for regional engagement with partners in the spirit of "collaboration with respect" as occurs with organisations like the World Health Organisation's Collaborating Centre for Influenza. It is considered that AAHL can position itself to be a focal point for international engagement on aspects of biosecurity with international appeal because of its location in Australia – a stable investment environment, with strong institutions and democratic government promoting innovation.

Preparing for a leadership role – AAHL infrastructure renewal and new capital investments

AAHL was designed with a 100-year life span and being over 30-years old, is overdue for a third-of-life modernisation and renewal. Now is also the opportunity to pursue capital enhancements – to increase the productivity of existing floor space and build a new collaborative training and research laboratory. Expert infrastructure renewal and capital upgrade plans have been produced in concert with the masterplan, aimed at maximising investments and collaboration from other governments throughout Asia, from non-government organisations worldwide and from the pharmaceutical industry, which relies on facilities such as AAHL to test its new developments.

Details of AAHL's renewal and capital upgrade program remain sensitive from a number of perspectives and have not been published here.

Table 3: Legacy challenges and opportunities for AAHL

Challenge/ opportunity	Comment
Physical	The facility is overdue for maintenance and renewal. Regulatory accreditation requires overhaul to keep AAHL's procedures fully compliant with best practice globally – some upgrades are necessary to maintain accreditation standards required by pharmaceutical companies. CSIRO analysis anticipates new capital works could double productive floorspace potential.
Capacity	The nature of the facility and its overriding requirement to always be ready to respond to a major biosecurity incident means that it cannot operate at capacity. Planned capital works are in part targeted at roughly doubling the productive capacity of existing floorspace and providing new commercial opportunities in government-to-government and industry training and testing, while also increasing the inherent surge capacity in response to national biosecurity threats.
Collaboration	Current AAHL leadership has broader collaboration as a primary focus: in recent times both Deakin's GCEID and Barwon Health have developed a research and collaboration presence on the AAHL site. Feedback from a broad base of interviewees in the infectious disease sector suggests AAHL has not always had a strong history of open, active collaboration with other research facilities in Australia.
Strategy	Interview and analysis suggest the overall Australian approach to emerging infectious disease/biosecurity response lacks clearly enunciated structure, especially as there is no clear hierarchy or collaborative protocol for how AAHL best coordinates with other leading facilities nationally or in Asia generally. This suggests that national health funding in infectious disease prevention and biosecurity response is not operating as efficiently as it might, or with the range of domestic collaborations that may be possible. Likewise across Asia, AAHL scientific collaborations remain at an institution-to-institution level. For example, there is little strategic understanding of AAHL's capabilities across the ASEAN membership. This prevents greater regional attention in terms of collaborative investments.
Financial structure	The facility exists as an entity within wider budgets of its owner, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and foundation partner in the Commonwealth Department of Agriculture. AAHL's future development and renewal is limited in a fiscal sense by the available annual outlays of these agencies. Neither agency's budget is growing and AAHL itself has faced staff cuts of late. Cash flows from leasing of testing floorspace on commercial terms to pharmaceutical companies do occur, but such flows are uncertain. The nature of its ownership and control structure has meant that AAHL has not been in a position to raise its own capital and develop new infrastructure and collaborative offerings with either market or non-government organisations, or with other foreign governments. AAHL remains in a sense a 'line item' within wider monolithic agency considerations.

A subscriptions revenue model

The project conducted interviews with AAHL and CSIRO senior management and has interviewed wider eminent scientists at other institutions in this field. It has also refined its views by consulting past CSIRO and Department of Agriculture leadership. New approaches to growing revenue were considered.

When paired with an effective, government-to-government level masterplan for the facility, it was concluded the renewal and upgrade program can create new subscription-based revenue streams to increase the capacity of the facility for biosecurity outbreak response in animals, as well as for zoonotic diseases. AAHL leadership advised the project that the following scale and type of subscriptions should be considered feasible in a mature state, subject to an effective masterplan being in place and assuming AAHL has some flexibility to develop these opportunities. AAHL leadership also confirms that this scale of operations and subscription would not threaten AAHL's core biosecurity response role (which has clear priority access to all aspects of AAHL resources), but would instead enhance that capability:

Table 4: AAHL annual subscription revenues by category, assuming effective masterplan, upgrades and capital works

Type of subscription service	Realistic annual value (mature, $m)	Comment
Asia-wide government-to-government collaboration with key countries	20	Beginning to occur at much-reduced scale, limited by infrastructure constraints and level of engagement (ie facility-to-facility)
Pre-clinical and clinical testing with governments and non-government organisations	7	Already occurring at much-reduced scale
Commercial lab-space leasing to pharmaceutical companies	3	Already occurring at much-reduced scale

The project sought specialist legal advice on the ability of AAHL to act with more commercial autonomy in this regard. Advice received is that there are no legal barriers to doing so and one can expect the current CSIRO leadership to approve of this approach. In all of this, the core animal biosecurity response capacity of AAHL retains priority and indeed would be enhanced.

“the renewal and upgrade program can create new subscription-based revenue streams which in turn increase the capacity of the facility for biosecurity outbreak response in animals, as well as for zoonotic diseases...”

Master strategy and infrastructure solution for AAHL

In light of research and feedback to date, the project has settled on a two-tier approach to making AAHL a centrepiece of infectious disease research in Australia and the region. In so doing it also offers a way for AAHL to move to a different model of financial control and authority – a model where the government still owns and controls AAHL in the public interest, but where AAHL has new opportunities to raise collaborative capital and an increased focus on regional Asian collaboration. The model would be divided into two main aspects (below). Both aim to deliver an enhanced animal biosecurity testing and response function, which is and will remain the principal deliverable of the facility. Parties to this report are confident this role can be significantly enhanced through the approach advocated, without compromising AAHL’s core mission.

1. ‘AAHL as Asia’s collaborative centrepiece for emerging infectious disease research’
Eminent expertise has worked with AAHL’s senior management to develop an overall strategy to make AAHL a centrepiece of Asian Infectious Disease Collaborative Research. Doing so attracts the maximum potential cash flows to AAHL from commercial pharmaceutical companies and from non-government organisations and foreign government agencies through Asia. It also offers a master strategy to the Australian government for aligning more efficient infectious disease and biosecurity response efforts nationwide, across all institutions. This is expected to yield considerable efficiencies.

2. New capital developments at AAHL to position for a collaborative regional leadership role
At the same time, AAHL’s Director has prepared a capital works program that would substantially increase the productivity of the facility’s laboratory floorspace, as well as establishing a new facility on AAHL’s grounds that could act as a PC3 commercial training facility and laboratory - a collaborative national and international facility for research scientists. Along with a thirty-year facility renewal, the new capital works can make the AAHL collaborative masterplan a reality.

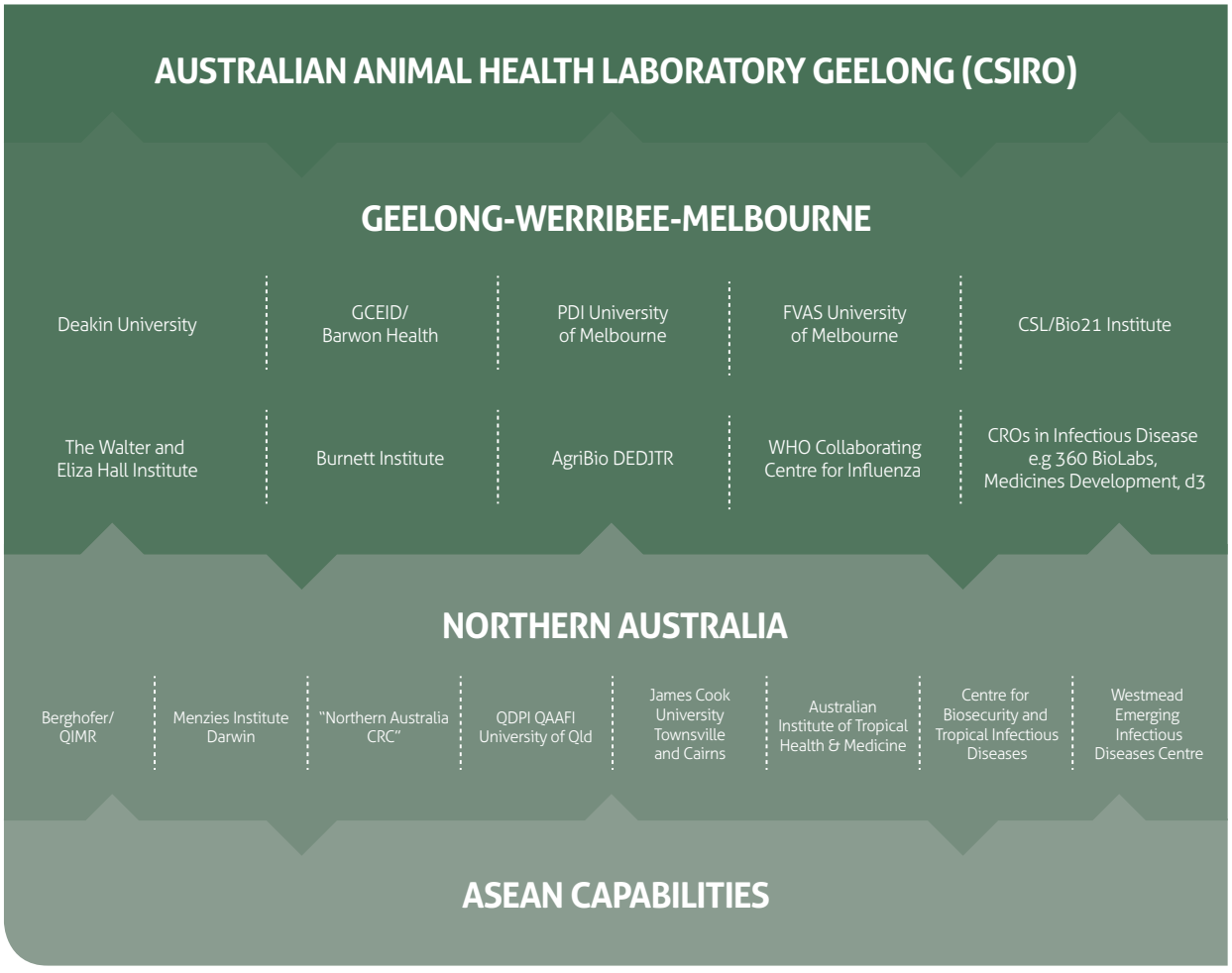
Potential wider Geelong regional opportunities flowing from the strategy

Initial interviews have suggested that these strategies could be complemented by wider developments in the region to make Geelong a genuinely global centre for infectious disease training education, research and response. These are appropriately matters for such institutions to consider for themselves in the first instance. No assumptions are made in this regard by this report, but for illustrative purposes, wider developments might be expected to extend to:

- A potential infectious disease high-security human containment capability, potentially provided by a regional health institution – an important capability to support a genuine global centre for such activities;
- A potential school of infectious disease studies, thereby providing a through-life undergraduate to post-doctoral workforce supply pipeline to the AAHL facility, and the same capacity for those in veterinary and animal practices in related public health facilities;
- Possible biomedical start up activities in the region based on proximity to AAHL and sundry institutions, following the example of start-up activity at acknowledged global biotech 'hubs' such as Boston, Baltimore or Pittsbugh in the USA.

Figure 4 describes how a master strategy for AAHL helps to outline a robust infectious disease strategy for the Geelong-Melbourne scientific community, the wider Australian infectious disease and biosecurity institutions and, as an example of a grouping, ASEAN nations generally.

Figure 4: An AAHL-centred spectrum of biomedical infectious disease research providers



Key numbers:

Estimated scale of investment opportunity
c. $AUD 1 billion (if market-led); triggers similar scale Crown asset recycling at existing railyards

Estimated direct employment creation
c. 3,000 permanent (see global/domestic benchmark discussion below)

Type of permanent jobs created
Road and rail transport, intermodal operations, distribution centre logistics

Avalon: Victoria's future inland freight precinct

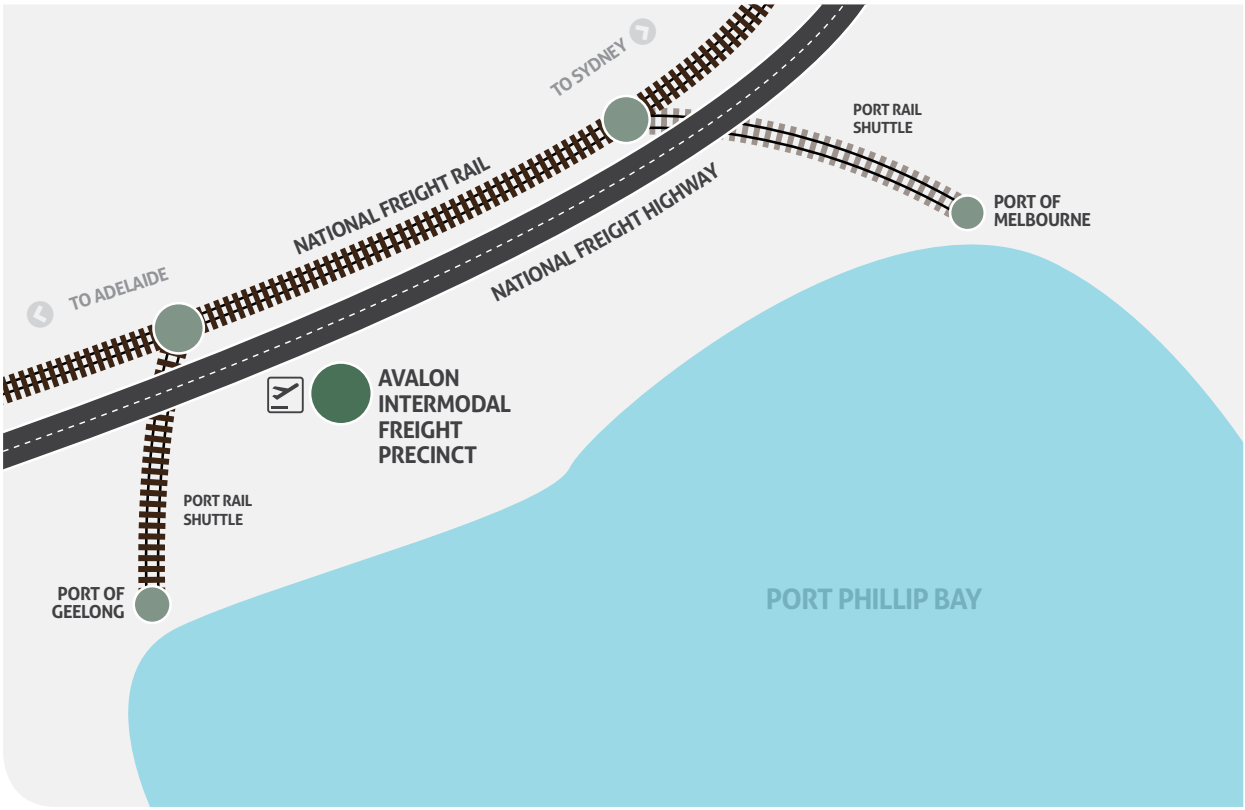
'Dominant road/rail freight transport and handling precinct for Victoria and its major seaports'

- This project proposes the Avalon site – 60kms south-west of Melbourne adjacent Avalon international airport - as the most efficient long-term inland freight terminal for Melbourne and Victoria, the southern terminal of any viable Inland Rail and (eventually) the land component of an efficient new successor to the Port of Melbourne and associated freight operations.

- Worldwide, major trade centres (like Melbourne) seek to co-locate their freight in large-scale, open-access road, rail and warehousing centres on the cheapest available land, strategically positioned near to infrastructure but preferably decades away from residential encroachment. These sites either act as large-scale road and rail freight terminals and warehousing operations, or as 'dry ports' which directly (but remotely) support the logistics of a nearby major seaport - or both. Ports use such places to assemble freight without the congestion and cost of doing so on the wharves. These places can bring major savings to freight customers, create large employment in logistics, reduce congestion and increase amenity to the wider community. Melbourne does not yet have such a facility. Avalon can become that facility.

- Associated benefits of such a development include regional employment, Avalon international airport development and potentially dramatically reduced costs for development of a best practice new seaport for Melbourne in the decades ahead. The project also considers strategic land redevelopments on VicTrack rail yard sites at North Geelong and Dynon Road adjacent the Port of Melbourne which brings additional asset recycling opportunities to governments in Geelong and Melbourne.

Figure 5: Schematic of an Avalon freight precinct supporting interstate, intrastate and seaport trade



Background: intermodal freight terminals and dry ports

Maximum scale and least cost are the goal for freight operations: the more concentrated the product and the lower the transport input costs, the cheaper freight will be; in turn more customers will use the service. Location has a strong operational role to play: if interstate, intrastate and port freight can arrive directly to major distribution centres, clients at this site avoid paying for another 'leg' of a journey by truck to their own warehouse. Sites where this occurs are known in the United States as 'inland terminals'. They improve the freight share of rail, which relies on higher freight densities to be competitive with trucking.

Seaports – especially ones located in major cities – can find preparation of containers and consignments of bulk commodities hard to perform at port, due to high land values, congestion and community resistance. These 'dry ports' provide an off-site, lower-cost solution to this challenge.

This report finds in-principle viability for Avalon in both operational contexts – interstate freight and seaport freight:

Interstate freight: interstate and regional road and rail freight lacks scale and multi-user facilities

Greater Melbourne is home to many different interstate and intrastate trucking depots, which are generally company-based. This is understandable, but lack of a large, multi-user facility limits the role of rail, as rail must be freighted to many different company depots. Melbourne – and therefore Victoria – has no single, scalable major container and bulk product terminal to drive more competitive freight services.

Seaport freight: road and rail logistics constraints are observable at the seaports of Melbourne and Geelong

Road and rail access to the **Port of Melbourne** is challenging. The interstate rail freight terminal at Dynon Road adjacent port of Melbourne is obsolete and inefficient for large scale rail freight operations. Melbourne's new Webb dock has no rail freight connection at the present time. Equally, high productivity road freight access to the port is limited.

The **Port of Geelong** is Victoria's largest bulk commodity port, but its 2013 Port-City masterplan (City of Greater Geelong) noted challenges for efficient landside access: developing further stockpiling and rail access arrangements at the port will be expensive and challenging from both planning perspective and infrastructure investment perspectives.

Global benchmark: Centerpoint Intermodal Centre, Chicago IL, (USA)

Centrepoint Intermodal Terminal (Joliet-Elwood) is located 60km from Chicago, Illinois. It services Greater Chicago's 9.5 million people by linking them with US east and west-coast sea ports in an efficient fashion. The 2,400 ha site has capacity for up to 6 million twenty-foot equivalent unit shipping containers (TEU) and is already operating at around 3 million TEU – making it larger than the current Port of Melbourne. It brings together two major US railways as well as other rail, trucking and logistics firms.

Thanks to economies of scale and convenience, over 40 major freight distributors such as Walmart, Home Depot, DSC Logistics, Georgia Pacific, Potlatch, Sanyo Logistics, Maersk/Damco Logistics, California Cartage and APC Logistics have brought their major regional distribution centres to the site. The site offers 30 million square feet of collocated warehouse space, all served by direct regional, interstate and international freight. For the Joliet half of the facility alone site construction employed 5,900 people, while by 2010 the intermodal terminal, warehousing and trucking functions had created 8,900 permanent jobs (Source: Cowhey Gudmundson Leder Ltd (2010)).

Alternative to Avalon? The *Western Interstate Freight Terminal* (WIFT) plan, Truganina

The Victorian Government has stated plans to develop an interstate road and rail freight distribution centre closer to Melbourne than Avalon, at Truganina, near Hoppers Crossing. There is as yet limited published detail on this proposal, but it appears that the site is intended only to service interstate freight movements, rather than provide container and bulk product assembly and rail shuttle services to the Ports of Melbourne and Geelong. In this context, Avalon deserves consideration as a potentially more significant, lower-cost and 'shovel ready' site for both interstate freight and port freight functions. A simple side-by-side analysis of relevant comparators has been provided to illustrate the logic behind this assessment (see Table 5).

Table 5: Avalon and Truganina (WIFT) as major intermodal freight sites: some comparative analysis

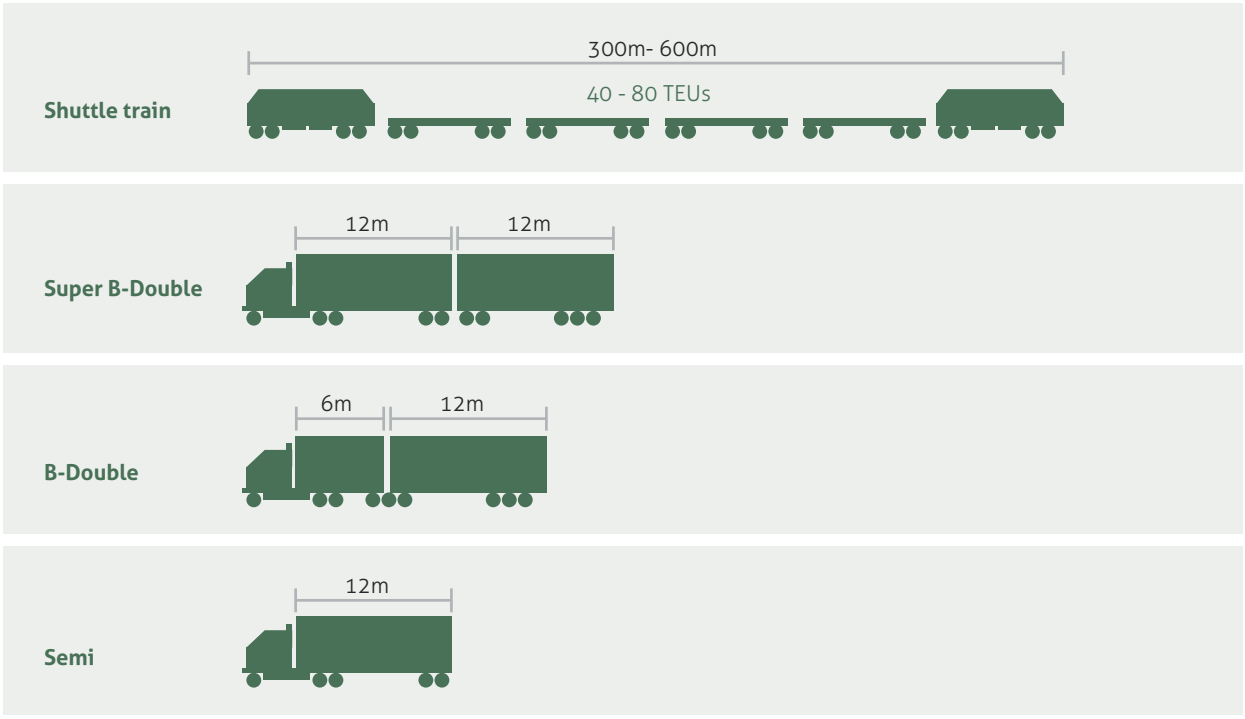
Key success criteria	Avalon	T'nina	Comment
Siting			
Site proximity to centre of Melbourne?	60km	28km	Both distances are within observed North American best practice parameters.
Is site aligned with Melbourne's longer-term Outer Western Ring Road plans?	Yes	Yes	Truganina lies on the proposed alignment of a future Outer Western Ring Road and interstate standard gauge freight line. Avalon lies 35km to the south west on the existing highway and rail which would connect directly to the same network.
Does site have sufficient development space for scalable interstate rail and intermodal activities (ie 1,600-metre rail balloons, scalable warehousing, etc?	Yes	Possibly	Avalon has residential encroachment-free land availability on a similar scale to Chicago's Centrepoint intermodal. It is not clear whether Truganina could access the same operational space without encountering residential encroachment risks in the longer-term.
Cost of industrial land to developer/operator?	Lower	Higher	Being substantially closer to Melbourne, Truganina displays higher nominal land values than Avalon.
Site capital improvement requirements			
Is the site proximate to existing national standard gauge railway alignment?	Yes	No	The national standard gauge railway runs less than a kilometre from the Avalon site, making connections, sidings and balloon loops relatively inexpensive. An entirely new standard gauge rail alignment would need to be built through Melbourne's outer west in order to reach Truganina.
Is the site proximate to an existing major intercapital highway network?	Yes	No	The Avalon site is directly adjacent the Princes Highway, which links to Adelaide, Melbourne and Sydney. The Truganina site is not adjacent to Melbourne's existing Western Ring Road and substantial truck freight would need to travel on local roads to access the Western Ring Road or the Princes until such time as an Outer Western Ring Road could be built. The latter is not currently budgeted by governments for construction.
Does site have existing alignment available for rail shuttle to the Port of Melbourne and Geelong?	Yes	Unclear	The Avalon airport passenger rail masterplan made provision for a freight rail alignment between the eastern side of Avalon airport and the Port of Melbourne at Dynon Road. There is capacity to run a similar port-rail shuttle alignment westwards from Avalon to link into the existing Port of Geelong standard and dual gauge rail connections.

Key success criteria	Avalon	T'nina	Comment
Urban encroachment considerations			
Is residential development on the boundaries of the site a strategic risk for operations in the longer term?	No	Likely	The City of Greater Geelong is the planning authority for the Avalon airport precinct. The present airport masterplan preserves rail access and industrial development lands adjacent the airport. Residential development occurs on the Lara (western) side of Avalon only, leaving the eastern side nominally available for large-scale freight operations adjacent Avalon international airport. It is unclear whether the operational demands at Truganina are fully reconcilable to the significant residential growth that has occurred in the wider region over the past decade.
Operational considerations			
Is available land sufficiently large and flat for scalable inland port and distribution tasks?	Yes	Yes	
Can the site service both interstate freight and port containerised, break bulk and bulk freight as well as container repositioning to and from the Ports of Melbourne and Geelong?	Yes	No	The purpose of the WIFT is interstate freight servicing, not Port of Melbourne and Port of Geelong stockpiling, staging and repositioning *via* rail shuttle.
Does the site have potential to become the landside operational component of a new seaport for Victoria to replace the Port of Melbourne?	Yes	No	Subject to maritime planning and investment assessment, the position of Avalon adjacent Point Wilson pier, the *in situ* road and rail links, land development availability and lack of urban encroachment mean that and Avalon freight precinct would significantly lower the barrier to entry for a major new port investment. Access to such an arrangement would be a matter for negotiation with the Department of Defence (Commonwealth government) in the first instance.

Moving Geelong and Melbourne port freight off road and on to rail at Avalon *via* port shuttles

Avalon presents an opportunity to improve the competitiveness and market share of rail for interstate and intrastate rail operations. Expert advice suggests rail alignments are available to assemble freight parcels and rail them by short shuttle trains to and from the existing Port of Melbourne and Geelong rather than employing trucks. The following table shows nominal efficiencies for container/bulk goods movements if freight moving to and from Melbourne and Geelong ports are assembled, disassembled and distributed from Avalon *via* short shuttle trains:

Figure 6: Freight efficiency comparators: port rail shuttle container services to seaports versus truck freight



Source: OECD

Likely wider benefits of an Avalon freight development

1. An effective southern terminal for Australia's Inland Rail project
The Inland Rail project seeks to build a direct standard gauge rail freight connection between Melbourne and Brisbane's ports. The concept is over 20 years old but remains unfunded. Until very recently, this project has overlooked the lack of a southern 'hub' rail and road distribution centre of a scale and efficiency which would allow trains to compete effectively with trucking for interstate east coast freight share. An Avalon intermodal represents the least-cost solution to this challenge, as the site is lowest cost (interstate freight trains already run past the Avalon site every day and evening) is adjacent the Princes Highway and free of direct congestion for distribution purposes.

2. Job development in the Geelong region
A large-scale rail freight, road freight and major company distribution centre at Avalon brings a large amount of 'blue collar' jobs. In this sense it is an important social policy opportunity for transitioning some of Geelong's legacy workforce to productive employment in reach of the city. It holds similar opportunities for the Wyndham community. This is important given the drastic loss of manufacturing and other blue collar jobs in Geelong. The last in-depth labour forecasts of the area were completed by Juturna in 2013 and included Wyndham. They flagged challenges for Wyndham as well as Geelong in providing blue collar transition work. Avalon freight precinct can be a substantial answer to this challenge, in a local setting for both communities' workers for commuting purposes.

this sense, the development of the Avalon freight precinct also hastens viable development of Melbourne's second airport.

4. Potential highly-beneficial billion dollar asset recycling implications
An additional benefit of the Avalon dry port is its ability to free up existing rail yards in Melbourne (Dynon Road, perhaps 5 hectares of the wider Dynon Yards site) and Geelong (North Geelong, 18 hectares). Part of the project's objective is to examine the likely scale of opportunity and value for these sites with an alternative highest and best use. Development at Avalon could see these assets revalued for higher use, allowing the Crown to borrow against significantly increased asset valuations. The project could not identify extant alternative valuations for these sites but notes that

"Over 57 billion tonne-kilometres of freight travel through Victoria, but for now, flows are dispersed across many sites and not linked efficiently to the seaports. Avalon has the opportunity to become the large-scale efficient terminal for much of this movement..."

3. Improved investment and infrastructure development climate for Avalon international airport
A major freight investment at Avalon could dramatically alter the business case for development of vital Avalon International Airport infrastructure. A passenger rail link to Avalon – for which a detailed masterplan and alignment already exists - could be constructed far less expensively if this was constructed in alliance with a wider project to construct the Avalon port shuttle rail corridor to Dynon Road at Port of Melbourne. In

in 2014 Major Projects Victoria's E-Gate project suggested redevelopment of the total Dynon Road rail site as unlocking a $3-4 billion dollar investment.

5. Much lower barriers to entry for a future Port of Melbourne replacement
Looking further into the future, the availability of a 24-hour best practice Avalon inland freight distribution centre less than a kilometre from the Department of Defence's Point Wilson explosive ordnance port would considerably lower the scale

of investment required to develop an efficient new successor port to the Port of Melbourne as and when that requirement becomes pressing in the decades ahead. This report has not examined the maritime aspects of the Avalon site, but notes that the availability of lowest-cost landside freight services close to Port Philip Bay will influence an overall Point Wilson business case very positively.

Technical considerations

Construction costs and employment generation
Leading operational and engineering expertise interviewed for this project suggests the vision for Avalon is a practical one. Avalon's development will require connection of the nearby standard gauge national rail line to the site. Experienced and respected rail engineering and operational planners advise that rail alignments exist for this purpose and necessary Princes Highway overpass works are feasible. Heavy truck access requirements for the site are likewise considered minor.

There do not appear to be significant engineering or operational barriers to the success of such infrastructure, other than establishing commercial interest. In assessing construction cost and works required, analysis to date suggests rail, road and site development requirements would be less costly than the current Moorebank intermodal site in Sydney, which is in a staged build - estimated total cost $1.5 billion. Job creation is harder to predict, but for indicative purposes this report considers a workforce of around a modest proportion of the Chicago Centerpoint benchmark (ie c.3,000 Avalon jobs) would not be an unreasonable figure for a mature Avalon facility, which would service a catchment of almost 5 million people.

By comparison, Moorebank proposes 7,000 jobs for a similar operational scale and an economic contribution of $9 billion dollars to the NSW economy (see its website *http://www.micl.com.au/the-developer/benefits-of-the-combined-precinct.aspx* - site accessed 6 April 2016).

Moorebank is a structural template for developing the Avalon freight precinct concept further
This report notes that the major Avalon Defence land parcel is currently leased to the Avalon airport group. Questions over the development, ownership and control of the site will need to be considered, but the recent example of the Moorebank Development Authority – like Avalon, a (former) Defence department site - offers a template for productive development in this regard. Another model involves the site being owned by a non-freight party which sold subscriptions to multiple freight practitioners.

Demand analysis – establishing Avalon's commercial credentials

Interviews with several leading Australian freight and logistics practitioners evinced widespread intuitive support for the pursuit of the Avalon freight precinct concept. However, it was clear from interviews that the scale of such a precinct was beyond any single logistics provider's appetite to envisage. As such, there is a market failure for identification and analysis of the commercial opportunity. For now, no individual Australian freight practitioner necessarily commands the exclusive volumes that would make the Avalon precinct commercially viable.

This is not unusual – observed practice in dry ports and larger intermodal terminals in North America, for example, shows that such sites are successful because they are multi-user, open-access facilities and indeed, are often owned/operated by property development firms rather than by a single freight company (Centerpoint PL which owns the Chicago facility and several others is a good example of this structure).

Avalon freight precinct: what are the available freight volumes?
Provision of such detailed operational analysis fell outside the scope of this report. However, basic freight tonnages from which answers can be derived is available and could be developed *via* a government-funded process which drew on multi-party freight operational expertise:

Table 6: Victoria's annual road and rail freight volumes:

Freight task	Freight volume per annum	Comment
Rail interstate	12.2 billion tonne-kms	
Rail intrastate	0.4 billion tonne - kms	
Road interstate	16.5 billion tonne -kms	
Road intrastate	27.6 billion tonne - kms	Includes 12.4 billion tonne – kms of Melbourne road freight
Total	56.7 billion tonne- kms	

Source: Bureau of Infrastructure Transport and Regional Economics *Infrastructure Yearbook* 2015. Rail figures are 2009-10: the last available data year; all road figures are 2013-14 figures.

Table 7: Port of Melbourne and Geelong annual freight tasks

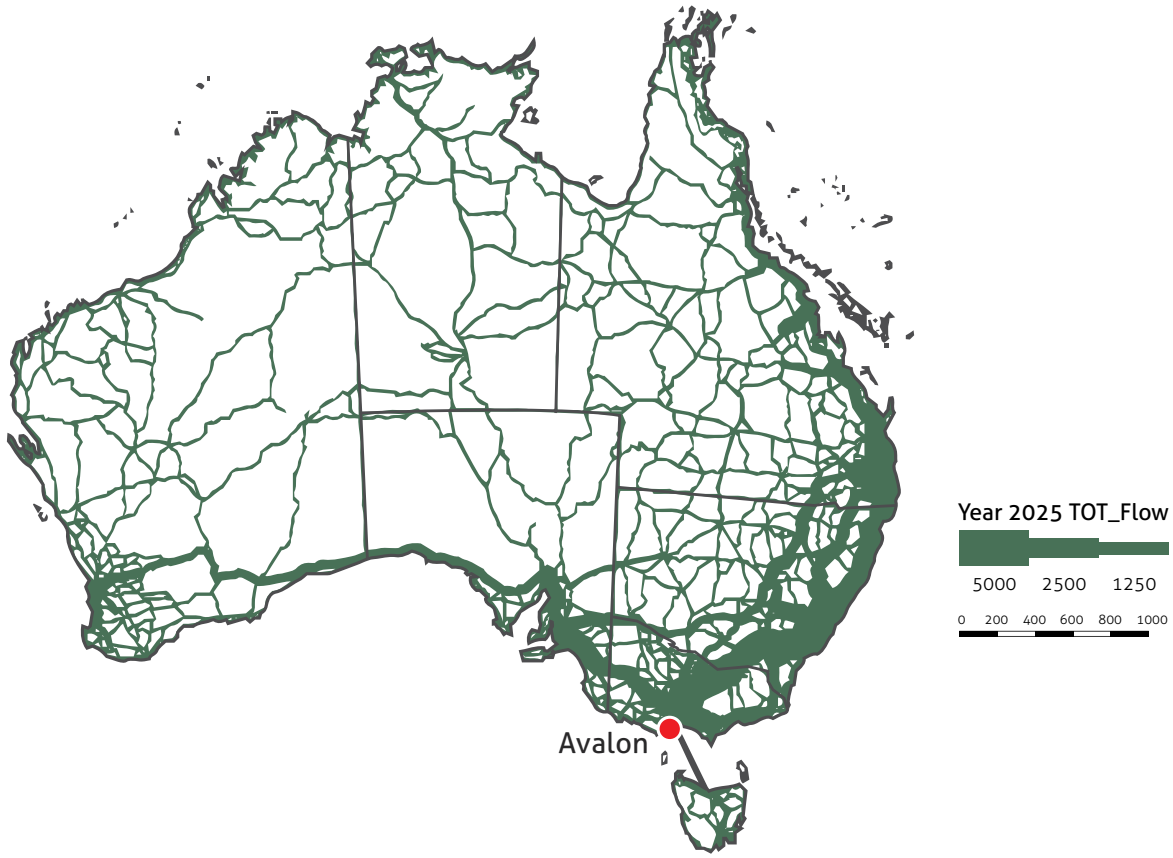
Port	Container volume	Bulk/break bulk volume
Port of Melbourne	2.53 million TEU	19.7 million tonnes
Port of Geelong	N/A	13.5 million tonnes

Source: Port authority annual reports FY13-14. Note that non container figures include liquid and dry bulk, break bulk and car imports. 8 million tonnes of Geelong bulk product is liquid bulk, the majority of which does not have a requirement to move off site (ie used at the adjacent refinery).

Avalon -the efficient pivot for Southern Australian freight operations?

Nationally-significant road freight volumes are concentrated on Victoria and Melbourne. For now, flows are dispersed across many sites and not linked efficiently to the seaports. Avalon has the opportunity to become the large-scale terminal for much of this movement:

Figure 7: Commonwealth Government inter-regional road freight tasks projected 2025 by volume



Source: Bureau of Transport and Regional Economics Working Paper 66 p. 51 (2006)

Identifying a successor port to Melbourne: Avalon freight precinct as catalyst to a lowest-cost solution

Late in the development of this report, the Victorian State government made the decision to open analysis of when a new major seaport to service Melbourne and Victoria will be required, and where that new seaport should be located. This decision brings the Avalon precinct into sharper focus.

In May 2016 the Victorian government tasked Infrastructure Victoria - its statutory infrastructure advisory body - with identifying the best timing and location for a new Victorian container seaport to replace the Port of Melbourne, which is currently

located at the mouth of Melbourne's Yarra river. Infrastructure Victoria announced on the 8th of July 2016 that it had begun this work and that a principal objective would be to examine the merits siting a new seaport for Melbourne somewhere on the bay coastline towards Geelong.

Avalon, Point Wilson and Baywest – the benefits of the Avalon precinct

The Avalon site, 60 kilometres west of Melbourne, is on this coastline. It is directly adjacent the Point Wilson explosives pier – an existing facility aligned to the Geelong shipping channel which has served the Department of Defence since the late 1960s and which has a concession to operate on this coastline, which is otherwise covered by the global convention on sensitive ecological wetlands (Ramsar).

Part of the terms of reference require Infrastructure Victoria to consider:

'impacts and requirements that a second major container port would place on surrounding and supporting infrastructure, and the impacts – including the costs to Victorian taxpayers – of any complementary infrastructure investments that may need to be considered'.

(See Special Minister of State Terms of Reference for Infrastructure Victoria online at *http://www.infrastructurevictoria.com.au/sites/default/files/images/Terms%20of%20reference%20-%20Advice%20on%20Victoria's%20second%20container%20port.pdf*)

Leaving aside the sea channel and port potential of this site as a future Baywest successor port siting (a matter which presumably will be investigated by Infrastructure Victoria) a functional Avalon freight precinct will almost certainly offer the very lowest cost solution to road, rail and warehousing and distribution infrastructure requirements of the Port of Melbourne's successor. As indicated in this report, the availability of pre-existing national highway and railway infrastructure adjacent the site make access to key 'land-side infrastructure very significantly cheaper here than other locations around Port Philip Bay and certainly compared to Port of Hastings road and rail connections.

Infrastructure Victoria's analysis of the likely remaining efficient life of the current Port of Melbourne site has implications for further development of the Avalon Freight Precinct. For example, the provision of shuttle rail freight services from Avalon to the current siting of the Port of Melbourne may be non-economic if Infrastructure Victoria analysis finds that a successor port should be constructed and operating in the near term. In this context, the Avalon – Melbourne rail shuttle operational life may not be sufficiently long to recover the cost of capital of such an investment.

Together with the need to establish viable future volumes for an Avalon freight precinct, these are the sort of topics which Infrastructure Victoria can shed light on with detailed economic and operational analysis, led by industry operational and investment expertise.

Industrial-scale advanced carbon fibre manufacturing in Geelong

Key numbers:

Estimated scale of investment opportunity
c. $70 million for a 1,500 mtpa carbonisation production line, scalable to larger tonnages and for precursor fibre production, combined with licensing rights to Carbon Nexus non-aeronautical plant construction and operations IP

Estimated direct employment creation
80

Types of employment created
High technology engineering and production management

Geelong as home to the world's leading non-aerospace carbon fibre industrial scale manufacturing plant

- Carbon fibre is an advanced material with no close substitutes and unparalleled development paths for productive manufacturing uses. Historically, carbon fibre research and development has been driven by the aeronautical industry, but the non-aeronautical part of the market has the greatest future potential for growth and diversification.

- In recent years, Deakin University has committed over $50 million dollars into the Carbon Nexus research facility and the Australian Future Fibres Research & Innovation Centre and sundry elements. Carbon Nexus is now acknowledged as a world-leading research and commercialisation vehicle, specifically for non-aeronautical products. Carbon Nexus has several collaborative agreements in place with SME-type enterprises, which involves contributing underpinning infrastructure and technology and acting as research incubator for promising commercialisation projects. Deakin University and its facilities such as Carbon Nexus have been a key in the success of Geelong carbon fibre businesses such as Carbon Revolution, which manufactures wheels for high performance vehicles and recently signed major supply contracts with Ford USA.

- Through the world leading expertise and breakthrough technology and practice of Carbon Nexus, a Geelong based carbonisation production facility can be constructed around 30% less expensively than the global benchmark and carbonisation product can be

produced approximately 30% cheaper than the global benchmark price (ie for $USD14/kg rather than a standard $USD20/kg.

- Geelong has other underlying success factors in place to allow it to become a leading advanced manufacturing centre for non-aeronautical carbon fibre research, design, commercialisation and scalable manufacturing.

- This report provides a global context and considers the case for industrial-scale carbon fibre manufacturing in Geelong.

Background

The Australian Future Fibres Research and Innovation Centre (AFFRIC) opened in 2013 at Deakin University, Geelong. AFFRIC was a partnership between Deakin University, the Victorian Centre for Advanced Materials Manufacturing (VCAMM) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The venture linked to Deakin's longstanding efforts in the fields of composite materials and advanced fibres. AFFRIC represented an investment of over $100 million dollars. Today Deakin University retains sole ownership and control of Carbon Nexus.

Carbon Nexus is acknowledged to be a world-leading centre of excellence in the field of industrial carbon fibre research and commercialised application testing, with some of the world's leading expertise employed at its Waurn Ponds site. In this sense, Geelong distinguishes itself as a prospect for advanced industrial manufacturing of carbon fibre: nations such as China already possess carbonisation and precursor manufacturing facilities, but Carbon Nexus' ability to deliver cutting-edge manufacturing innovation has the potential to distinguish Geelong products from lower-value, 'commodified' carbon fibre. This represents a world-leading source of advantage and a reason to build in Geelong. Carbon Nexus' director advised the project that specialised knowledge in industrial carbonisation methods allows a carbonisation plant to be constructed for around 30% less than global benchmarks. It also allows Geelong carbonisation operational costs to run approximately 30% below the global price. (Geelong's many claims to sustainable competitive global advantage for manufacturing are discussed further below).

To date, Carbon Nexus' business model has been analogous to a cooperative research centre – public funding is provided to applied research alongside associated undertakings with commercial start-ups involved in research. Small batches of carbon fibre are produced to service these ends. The Carbon Nexus facility produces only tens of tonnes of carbon fibre annually; a typical commercial (smaller scale) industrial production line would manufacture 1,500 to 3,000 tonnes per year. To date Carbon Nexus has provided critical innovation support to successful local carbon fibre parts manufacturers such as Quickstep, Carbon Revolution and Unidrive.

Global context: aeronautical and industrial carbon fibre sectors and their relevance to Geelong

There are two main sub-sectors of the carbon fibre market – the *aeronautical* (for aspects of aircraft construction) and *industrial* (encompassing industries such as automotive, marine, sporting goods, alternative energy, health-care, industrial machinery, consumer products and manufactured goods, etc.). It is important to appreciate the difference in order to understand where Geelong's global competitive advantage lies.

The high-performance aeronautical market is more mature than the industrial market, as from at least the 1970s it has to a considerable extent been military and then civil aviation which has led the development of carbon fibre technology overall. Due to the long testing and qualification processes required to meet the extreme safety and performance standards for aeronautical applications, aeronautical carbon fibre requires significant investment and very long lead times to commercial outcomes. For example, consultation for this report heard from one local aeronautical part manufacturer that a passenger aircraft aileron would require a minimum of $3-4 million in research capital and require in the order of a decade of intensive testing and accreditation before commercial acceptance.

“Carbon Nexus’ specialised knowledge in industrial carbonisation methods allows a carbonisation Geelong plant to be constructed for around 30% less than global benchmarks. It also allows Geelong carbonisation operational costs to run approximately 30% below the global price…”

In comparison, industrial uses for carbon fibre, such as in automotive, have taken somewhat longer to become a focus, but this sector is generally considered to have much more expansive growth prospects in future: there are no shortages of future commercial applications for world-leading commercial fibre manufacture. Deakin’s Carbon Nexus facility has claims to be a world leader in research supporting this sector and local companies such as Carbon Revolution are building a reputation as leading global innovators in end products.

Market opportunity for Geelong and Carbon Nexus

With several highly-innovative local industrial carbon fibre parts manufacturers now enjoying international success and expanding forward orders, the prospects for Geelong hosting a world-leading non-aeronautical carbon fibre manufacturing plant should be strong. However, the inherent demand for a sector does not mean that it can be produced just anywhere in an efficient and sustainable way. Industrial carbon fibre manufacturing already takes place in several global locations. Many countries in Asia, Europe and North America have production plants in place. Many places globally have lower wage structures than Australia and more aggressive tax treatments to lure new industries.

Early advice from producer interviews is that most of the smaller carbon fibre commercials clustered around Deakin find supply of high quality raw product at an acceptable cost and with suitable logistics support a major hurdle to further domestic expansion and commercial growth. Small batch production of carbon fibre for input to these ventures is prohibitively expensive for running more economic production runs of commercial orders. This acts to retard the growth of these local firms. At present larger-scale raw carbon fibre precursor and processed product alike must be sourced from overseas. In the longer term, the lack of available domestic raw and processed product and an inability to harness greater research and development effort to market applications is likely to see successful domestic carbon fibre firms such as Carbon Revolution relocate offshore to access these inputs to their business.

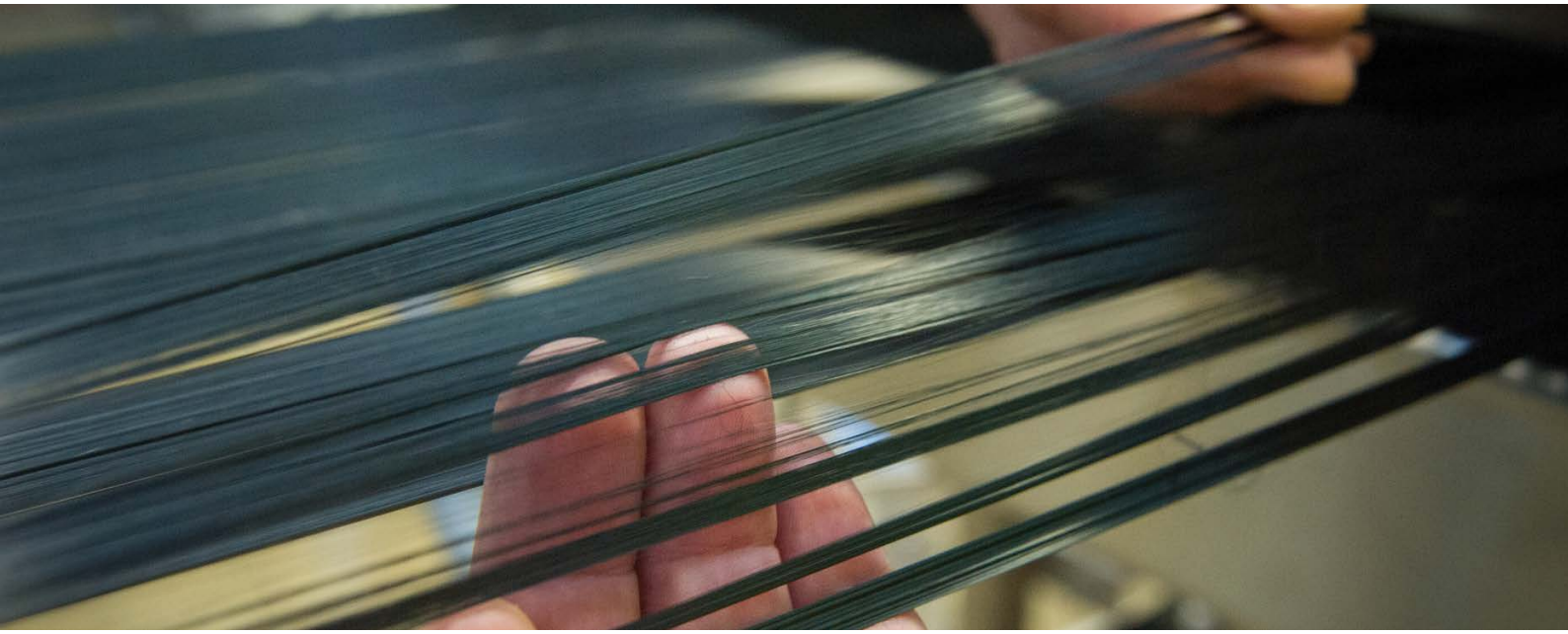
This report examined the many input factors that go towards the sustainable success of an industrial carbon fibre manufacturing plant. It established these factors in consultation with leading global industry practitioners. These factors and Geelong’s competitive claims against each of them are listed in Table 8.

Table 8: Major inputs to a sustainable industrial carbon fibre manufacturing industry – Geelong's claims

Factor	Present	Comment
Global leadership in industrial CF research and development	Yes	Carbon Nexus represents a critical source of competitive advantage for a Geelong-based industrial carbon fibre manufacturing plant. Carbon Nexus' expertise and breakthroughs in industrial carbon fibre production processes can cut production costs by 30% from present global benchmarks.
Globally leading skills in construction and development of industrial CF carbonisation production lines	Yes	Carbon Nexus has refined its ability to develop cutting edge industrial carbon production lines through its research support to overseas-based carbon fibre companies. This experience, combined with key personnel at the site, allow Carbon Nexus to create c.30% capital cost savings for factory construction.
Established local customer base to drive sales revenue and innovative product development	Yes	Deakin University and Carbon Nexus already have strategic relationships with Australian carbon fibre product manufacturers with forward sales and strong futures, such as Carbon Revolution, Quickstep and Unidrive. A number of other Australian firms are using large amounts of carbon fibre. Carbon Nexus maintains close collaborative relationships with global customers such as BMW and Ford USA.
Access to a highly-skilled workforce	Yes	Thanks to its long association with companies like Ford Australia, Geelong is a traditional manufacturing centre with many sub-contractor specialist manufacturers. Some of these firms have already made a successful transition to advanced manufacturing. Deakin University's well-established commitment to technological research and advanced material fabrication, design and engineering combined with the Carbon Nexus facility itself provides an ongoing source of highly-trained carbon fibre manufacturing sector staff. Carbon Nexus and several local companies have worked with The Gordon to develop two specialised training courses, one for carbon fibre production operators and the other for composites manufacturing technicians. This will help ensure the rapid availability of skilled workers.
Access to industrial scale power supplies	Yes	A typical carbon fibre carbonisation plant producing 1,500 tonnes requires approx. 4.5 megawatts in electrical energy supplies (3 MW during normal operation and 4.5 MW peak during start-up). A precursor manufacturing plant supplying the required amount of precursor would require a further 16 MW. Discussions with the Australian Energy Market Operator (AEMO) confirm that this power is available from the local grid, which could provide greater loads to allow for a scalable plant. In the long term, green energy solutions will complement and most likely substitute for brown power to the plant – enabling the plant to meet expected future requirements to minimise the carbon footprint of fibre manufacturing.

Factor	Present	Comment
Access to a nearby chemical refinery for precursor product	**Yes**	Viva Energy's Corio Refinery confirms an interest to consider providing precursor chemical support to a carbon fibre precursor chemical engineering and production process, if a precursor production plant was to be added to a carbonisation production line at some future point.
Access to scalable industrial land	**Yes**	Advice from Carbon Nexus suggests that the first stage of a scalable carbon fibre manufacturing facility would require at least 7 hectares of flat land, with an additional 5 hectares for a precursor manufacturing facility. This is readily available across several locations, including North Geelong, the Geelong Regional Employment Precinct and possibly the former Alcoa aluminium site at Point Henry.
Proximity to competitive logistics	**Yes**	Geelong and the region is well served for global logistics: it has a port and terminals capable of hazardous chemical storage for the delivery of any manufacturing inputs and nearby airports for export.
Proximity to agglomerated service providers and start-ups	**Yes**	Access to a large amount of highly-specialised service providers and entrepreneurs is important for any manufacturing endeavour. The proximity to Melbourne ensures that a Geelong-based manufacturing plant has access to all of the agglomeration economics of a leading international city.
Supportive government policy settings for advanced manufacturing in the region	**Yes**	Geelong's local government and industry are highly supportive of an advanced manufacturing future. The Victorian State government has made a specific policy commitment to structural transition of traditional manufacturing economies like Geelong, which in recent years has lost its car manufacturing base. Victoria's Automotive Transition Plan provides $46.5 million dollars for support to traditional car manufacturing areas like Geelong and retraining of its workers. In addition Australia's Commonwealth government's Smart Cities innovation plan presents an opportunity to recast Geelong as an advanced manufacturing, high-skilled, export-oriented city.
A stable investment environment for global capital	**Yes**	Australia is a settled democracy, with respected court systems to adjudicate on contractual disputes and strong intellectual property and patenting laws. The Geelong region is free from major natural disaster risks and is situated in close proximity to emerging Asian markets and time zones.
A compelling standard of living to attract and retain high technology workers	**Yes**	Geelong's high standard of living provides an excellent hygiene factor for the attraction and retention of global excellence in personnel for a non-aeronautical carbon fibre manufacturing plant.

Factor	Present	Comment
A strategic relationship with a multinational end user/producer of non-aeronautical carbon fibre product	Not yet	The long-term success of a Geelong manufacturing facility may rely on the presence of a global leader in either end-user products (such as automotive or industrial parts) or in carbon fibre manufacturing. A strategic relationship with this partner ensures necessary capital can flow to construction and licensing - and that ongoing development opportunities will be supported for their commercial value in a fully vertically-integrated setting.



Conclusion: Geelong has strong claims to become an advanced and sustainable manufacturing centre

This report considers that all of the most important factors are in place in Geelong to create a globally-competitive manufacturing operation: the presence of Carbon Nexus in particular and access to Deakin University's wider skilled research in advanced fibres means that Geelong would be extremely well-positioned to manufacture cost-superior, high-innovation product, which would help a Geelong manufacturing and research venture distinguish itself from existing, especially Asian-based facilities which can tend to the more commodified end of the production spectrum.

Any investment development process will need to consider how any future plant interacts with Carbon Nexus, whose world-leading innovative position is a crucial ingredient to the sustainable success of such an advanced manufacturing sector in Geelong.

Key numbers:

Estimated scale of investment opportunity
N/A – concept stage only

Estimated direct employment creation
As above

Types of employment created
Agricultural and agribusiness educators, trainers, supporting personnel

Commercialised international education in farming and agribusiness:

'Australia's most valuable asset to support food security in our region and the world is our knowledge base in agriculture' **(Office of the Australian Chief Scientist, 2012)**

Prospects for a Geelong-based, commercialised food security offering to Asia

- The rapid economic growth of China, India and Asia generally has made attaining food security a major Asian policy objective. To date, Australia's agriculture sector has focussed on growing food more productively for these markets and securing better trade access to them. This has encouraged arguments about Australia becoming 'Asia's foodbowl', but this prospect is unrealistic for a number of important reasons.

- The Geelong region's legacy of excellence in agricultural education and research might help secure Asia's food security objectives by a different route: Geelong could expand on its excellent domestic agricultural training and education record to provide large-scale commercial services to Asia and Eurasia in farming, food services and agribusiness – in doing so, this could become the nexus of an Australia-wide network of specialised agricultural training and education institutions serving this vast regional market.

- This project examines the potential for blending a customer-driven amalgam of parties in and around Geelong to test and establish this export opportunity– expected content could range from commercial offerings in practical certificate type training to tertiary and even postgraduate education and research offerings, with the curriculum driven by an Asian and Eurasian client base.

Barriers to Australia becoming 'Asia's food bowl'

While the remarkable growth of the Asia-region economy has encouraged thinking about how Australia can capitalise on its historic strengths in agricultural exports, there are a number of factors preventing Australian farming from becoming a 'food bowl' for Asia:

- **Insufficient production volume** - Australia is calculated to be around 1 per cent of world food production. So, while Australia produces high quality foods and remains export-focussed (e.g. beef – Australia one of the largest exporters in the world, from a smaller herd size than some other countries) Australia does not produce volumes to satisfy the growing calorific demands of Asia in the 21st century:

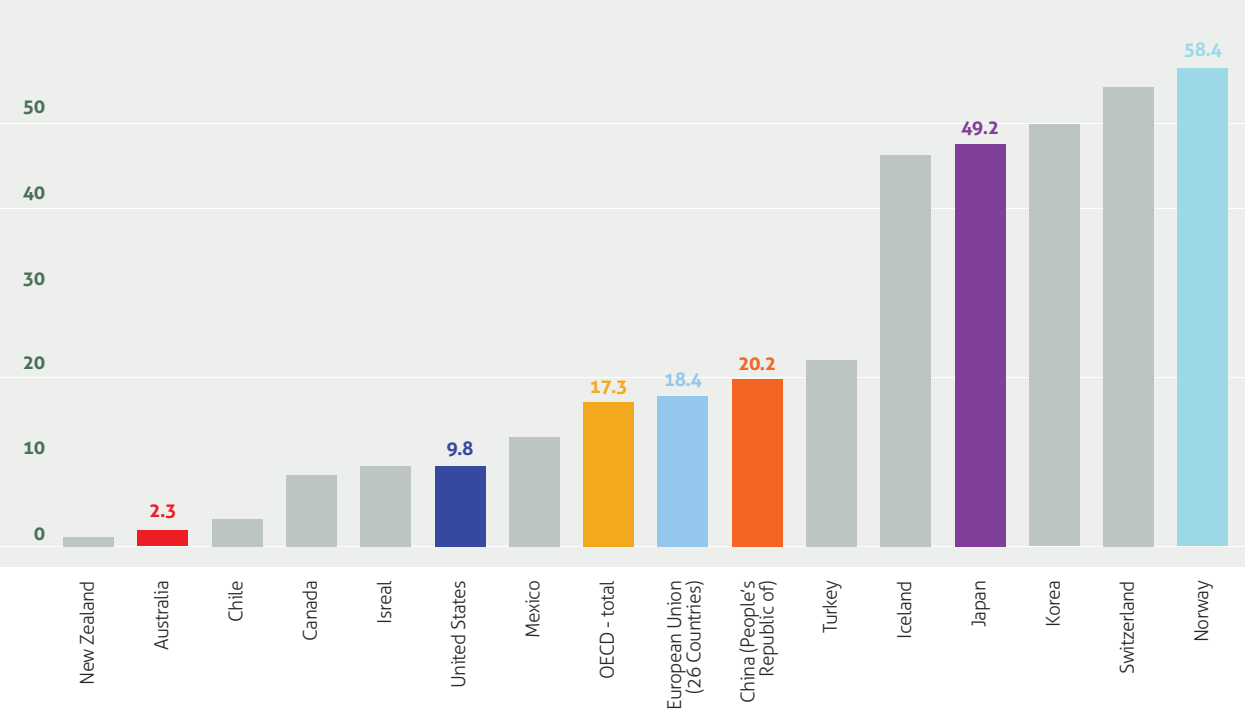
'*...world population is already over 7 billion and projected to grow to over 9 billion by 2050. We produce enough food to contribute to the diets of less than 1 per cent of those people, and less than 2per cent of people living in Asia'. (Chief Scientist Occasional Paper 5, 2012)*

- **Farm productivity growth slowing -** Australian on-farm productivity – which together with new farm land development determines the ability to grow more - is reducing steadily or at best holding, but not growing overall.
- **High-security, low-cost water and its infrastructure are generally unavailable -** As outlined in the irrigated agriculture project (see above), water is a critical determinant of agricultural sustainability in Australia's future under even the mildest warming climate scenarios. Traditional rainfall and river flows combined with a lack of pipeline or grid infrastructure mean that many historical agriculture sectors face uncertain futures. Although the Geelong region is relatively well-served under future scenarios, it nevertheless faces transitions to farm practice and commodity mix that will impact food production. As raised in the irrigated agriculture project the failure to secure water infrastructure solutions has also influenced the production profile of Australian agriculture towards lower-value commodities which are more tolerant to high volatility in water supply, in contrast to highest value crops and more value adding, which demands more stability from water inputs (see the irrigated agriculture project, above).

Australia's farming/food services skills and research capacity has not yet realised commercial value

One of the defining attributes of Australian agriculture is its efficiency (Figure 8): Australia ranks with New Zealand as the least-subsidised farming nations globally.

Figure 8: Producer payments from government as % of total farm income 2014 – selected countries



Source: OECD data (2014)

Can Geelong fashion new commercial products from existing skills and knowledge?

At the same time, Australia is acknowledged globally as a leading source of agricultural research and development expertise. To date, this knowledge has in large part been viewed as a 'free good', with institutions tending to transmit this knowledge as a form of international development aid, such as *via* the Crawford Fund.

In cases where emerging economies clearly have no ability to access such skills and knowledge, this is a worthy objective. However, many such aid recipients – notably China - are fully capable of operating on an entirely commercial basis for the transfer of such skills and research expertise: for these places, food security represents a very high public policy priority. A systematised and tailored commercial offering could offer significant benefits to the food security objectives of such countries.

This project therefore takes a fresh perspective on the enormous inheritance of farming knowledge and skills that Australian farmers, colleges and research institutions have amassed. Given Asian food security challenges, there is a high demand for these countries to establish domestic farming and food services capabilities.

The Geelong region has a rich history and infrastructure of being a leading farm practice and educational centre. This project endeavours to open discussion about the prospect of Geelong acting as a first mover in the commercialisation of farming, food services and agribusiness skills, education and research to a growing Asian market which places a high value on attaining food security.

The project consulted with several leading agricultural education figures, who advised that they were not aware of other formalised efforts in Australia or overseas to develop such a commercialised product. This project therefore opens the possibility of the Geelong region taking a lead: developing a new industry for the region, with the potential to draw on a network of institutions nationwide in offering a targeted commercial product to interested Asian and Eurasian customers in governments and the private sector.

Key Geelong-region institutions represent the opportunity

- **Marcus Oldham Agricultural College** is a leading undergraduate agricultural college, with over 50 years of history, specialised in farming and equine management. Marcus Oldham alumnae are prominent in leadership roles in agriculture and agribusiness globally. At present, the facility educates between 150-200 students annually – it has also introduced postgraduate studies in agribusiness.

- **Southern Farming Systems** at Inverleigh, Golden Plains Shire is Australia's leading specialist research and development institution in high-rainfall farming practices. It is a farm-driven, not for profit research organisation assisting farmers in high rainfall zones to achieve maximum sustainable cropping outcomes.

- **Deakin University** has its main campuses in Geelong, one of which is adjacent the Marcus Oldham Agricultural College at Waurn Ponds. Deakin is already involved in agricultural health and medicine teaching and research streams and has its Centre for Regional and Rural Futures located at the Waurn Ponds campus. Deakin University is one of Australia's most Asia-engaged tertiary institutions.

- **The Gordon Technical and Further Education (TAFE) College Geelong,** established in 1887, is one of the largest regional technical and further education (TAFE) colleges in the State of Victoria. It is an established provider of short course and certificate training. It maintains close collaborative links with Deakin University and Marcus Oldham Agricultural College as well as increasingly strong education provider networks into Asia.

Added to this, an Asia/Eurasia-facing offering based around these Geelong institutions could be strengthened by involvement on a networked or alliance basis from other centres of specialised farming excellence across Australia. This would be of particular relevance to northern Australian educational and training institutions involved in tropical and/or sub-tropical farming specialisations, given that much of Asia experiences these climates.

Key future discussions and structures

1. An Asia-facing agricultural training and education precinct in Waurn Ponds – the need for a precinct masterplan

In consulting with the various key institutions to this concept, it became clear that the educational precinct at Waurn Ponds was worthy of master planning attention, as a catalyst for physical considerations of how any future market-facing agricultural offering might be best developed.

For now, the Deakin University Waurn Ponds campus and the Marcus Oldham Agricultural College occupy a total of approximately 550 hectares of land in Waurn Ponds. There are additional land holdings adjacent these institutions in the form of the Christian Secondary College (currently developing its own tertiary education degrees), as well as the new Epworth Hospital complex, which likewise has a strong teaching focus. To date, no masterplan has driven these different developments to optimised overall outcomes.

“Geelong as a first-mover in the commercialisation of farming, food services and agribusiness skills, education and research to a growing Asian market which places a high value on attaining food security…”

All of these facilities will require dedicated transport infrastructure as they grow in future and as the city grows around this precinct. Development of a longer-term common vision or at least suite of options for this precinct would be a sensible first step towards considering the capacity for an Asia-facing commercial farming and agribusiness training and education concept based at Waurn Ponds.

2. Linking service buyers and sellers very directly is a productive path for considering future investments

Another clear feedback from interview of key Geelong institutions was the need for the demand for such commercial courses to be evident before further planning was considered. This is an appropriate response which accords with the feedback received by the authors on a visit to China (March 2016) which sought views from Chinese government and market actors for the concept. This met with a favourable reception, but it was stressed that control over curriculum in a fee-paying setting would need to be with the paying customers.

Accordingly another first development step for this concept would be to create structures for direct negotiation between State and corporate Asian/Eurasian customers in the agriculture/ agribusiness training and education space and the relevant Geelong institutions.

Depending on demand for different courses, this sort of direct negotiation process would permit other relevant agricultural research, training and education facilities to be brought into targeted discussions at the relevant time. Such a process appears to offer the surest structure for developing beyond concept to an investment memorandum phase between prospective customers and providers and investors.

Practical next steps

This project has identified five robust and significant economic futures in the Geelong region, all of which draw on legacy strengths such as existing infrastructure, natural endowments, critical skills and knowledge spill-overs to present productive future industries for the region.

Together the projects represent around $2 billion in new investment in the Geelong region and they offer encouraging prospects for being commercially viable. What are the next steps to take towards securing such projects?

Firstly, it ought to be recognised that the opportunities identified are overwhelmingly commercial in nature. Even the AAHL project, although it relies on initial government funding, holds prospects for developing a more commercial approach to growing major revenues and expanding its own capacity. Accordingly, whatever next steps are envisaged should place priority on ensuring a sympathetic, market-facing structure is created to accommodate interested commercial investors. Where relevant, governments have a role to play in developing supportive and facilitating structures to promote this result, but they should not lead this further work, which, being commercial, should wherever possible be funded by the interested investors themselves. Doing so ensures that the projects are pursued as efficiently as possible.

This report has been overseen by a steering committee. This committee sees value in retaining a strong Geelong regional role in developing market interest in these opportunities. However, it also recognises that higher governments at State and Commonwealth level have important roles to play in helping the Geelong region to achieve market-based successes.

Accordingly, a first step to further productive development appears to lie in a memorandum of understanding (or similar) between all three levels of government. This would outline how higher governments are to work with prospective investors, with local industry, community and government to make the opportunities - and others like them - come to pass as quickly as possible, in the community interest.

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Consultation

Authors consulted the following parties, arranged in alphabetical order. No party was asked to provide formal endorsement of the project(s).

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- **Mr Peter Dorling**, Chair, Geelong Planning Authority
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- **Mr Graham Egleton**, Chair, Avalon Landcare Group
- **Mr Keith Fagg**, former Mayor of the City of Greater Geelong
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- **Ms Dolly Fu**, International Trade Facilitator Shanghai, China
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- **Mr Peter Toovey**, Foursight Principal, fmr Vice-President CSL Pharmaceuticals Ltd
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