



World-class intensive integrated production hub in the Western Sydney Aerotropolis

NSW Government's Agribusiness Precinct

A pre-feasibility study for the NSW Department of Industry



February 2019

Key insights



Demand

The IIPH opportunity is underpinned by growing food demand (domestic & export) for NSW, with the Western Sydney Airport providing a central gateway for the State's producers.



Willingness

There is strong stakeholder support across the value chain (ie utilities, land owners, food producers, processors) for the IIPH and a willingness for each participant to work together.



Benefits

The IIPH provides the opportunity for up to 2,500 (FTE) jobs and an estimated total of 12,000 jobs including indirect jobs, \$2.8 billion revenue over 10 year full scale up and delivers fresh food production through an integrated circular economy.



Connectivity

The wider Western Sydney vision is underpinned by the Western Sydney Airport and broader infrastructure investment. The IIPH provides enhanced connectivity to support these efforts.



Momentum

The pre-feasibility study has built strong momentum behind the IIPH development which should be sustained moving forward. Action needs to continue.



Transformative

The IIPH demonstrates vision and leadership by the NSW Government to build for the future through innovation and technology adoption to drive real growth opportunity for the State.

Key findings



Significant positive economic impact (revenue and jobs)



Strong stakeholder support across the value chain



Positive ROI on intensive agriculture*



Availability of appropriate land



Availability of baseline utilities



Potential for regional connectivity to enable further value adding



Strong demand domestically and internationally for Australian fresh produce, market access and trade protocols need consideration

Recommendations



Further contemplate the role of government and governance model, including initiation of discussions with Western City & Aerotropolis Authority about fulfilling a lead role



Progress to a business case:

- Focus primarily on identifying appropriate land and determining the acquisition strategy
- Further assess availability of utilities and road and rail infrastructure, based on location
- Conduct detailed economic modelling including, identifying the financial impact of shared services
- Identify opportunities to create mutual benefits with existing and planned developments in Western Sydney, for example ensure seamless integration between the IIPH and WSA air-cargo services
- Work with State and Federal government to accelerate market access protocols for high potential products
- Continue stakeholder engagement

01 Executive summary



1.1 The objective of this report

The objective of this document is to provide a report that considers the development of a world leading IIPH within the agribusiness precinct adjacent to the Western Sydney Airport (WSA). The report builds upon the work already undertaken by the Department of Primary Industries (DPI), in consultation with various stakeholders both public and private.

1.2 Approach

A multidisciplinary approach was applied to the study enabling the development of a high level but comprehensive blueprint for the Intensive Integrated Production Hub (IIPH) leveraging global insights and subject matter experts from across industry. The blueprint was tailored to the specific market, regulatory, land use and planning environment of Western Sydney. Key activities included:

- a global market scan;
- a detailed literature review;
- building a revenue and labour model;
- detailed stakeholder consultations; and
- leveraging subject matter experts to test assumptions and inform recommendations.

1.3 About the WSA, Western Sydney Aerotropolis and IIPH

As one of Australia's only greenfield metropolitan airports in the last 50 years, the AU\$5.3 billion WSA is a transformational project for NSW. As a new international gateway to the nation, WSA will provide NSW businesses a competitive location in the Sydney metropolitan region and access to global markets. It will be a catalyst for economic growth and new jobs in one of the fastest growing regions in Australia.

Surrounding the airport will be a vibrant, world-class economic precinct – the Aerotropolis. The Aerotropolis will target industries such as defence, aerospace, advanced manufacturing, freight and logistics, agribusiness, health, education and tourism. This will be connected to the rest of the metropolitan region and auxiliary precincts through digital and transport infrastructure.

As part of the development of the Western Sydney Aerotropolis, the NSW Government is driving the creation of a world-class agribusiness precinct. The airport will uniquely enable curfew-free, 24-hour export of food from the Western Sydney region facilitated by an IIPH located in this agribusiness precinct.

The IIPH is intended to be a world-class, fully integrated intensive food production hub incorporating protected cropping horticulture, energy production systems, efficient use of water, waste, heat and CO²,

and will integrate across other industry sectors and the community. The IIPH will enable delivery from farm gate to the international consumer's plate within 36 hours.

1.4 Global demand for food

Sustainably feeding a global population of over 10 billion people by 2050 is considered one of the key challenges of our time, with predictions that more food will be required in the next four decades than all farmers in history have harvested over the past 8,000 years.¹ Significant opportunities exist for Australia to support and capture the economic benefits from this growing demand, particularly in Asia and Middle East. Demand is predicted to increase between 59 per cent and 98 per cent by 2050 in these regions.²

The Production Possibilities Report (PPR),³ prepared for the DPI addresses key climatic enablers, production possibilities and economic feasibility of particular activities at the WSA IIPH based on current land use, proposed activities and their economic values. This PPR informed the selection of activities to consider in the IIPH; products included horticulture, aquaculture and floriculture. For a full list of considered products refer to *Section 9 Key elements of an IIPH*.

1.5 World's best practice for intensive agriculture

There are numerous, exemplar agribusiness precincts located around the world, all with unique production focuses. Agriport A7 (A7) and Fresh Park Venlo (Venlo) are considered two of the most relevant for the purposes of this study, and have been referenced as a high level blueprint to inform design assumptions.

A7 and Venlo are considered the most advanced, operational, agribusiness precincts globally and represent best practice for intensive food production, minimised energy use (and re-production) and logistics. A7 has an on-site data centre, while Venlo receives tourist visitation and offers on-site education, research and development. These private facilities are based on a tenancy model, with low costs per user due to the circular economy principles in place that minimise energy requirements.

1.6 Land and location requirements

The availability of suitable land (250 and 500 hectares scenarios) for intensive agricultural production in the region directly surrounding the WSA site was examined. Through this high level analysis it was identified that there is suitable land available for an IIPH.

¹ National Geographic, 2017, Holland - agriculture sustainable farming

² Harvard Business Review, 2016, Global demand for food is rising – can we meet it?

³ Agrology, 2018, Production Possibilities Report.

This included identification of parcels that met agreed high level attributes including:

- suitable zoning and topography for greenhouses;
- privately owned with some parcels owned by multiple land owners;
- suitable integration with the proposed major road networks although further examination is required relating to truck movement and freeway access;
- appropriate access to utilities including traditional connection to electricity and the opportunity for innovative renewable solutions; and
- suitable water supply to the site, and recycling water options, are also available.

Land use planning arrangements will need to be considered on some possible locations. This includes restrictions related to the flight paths and areas directly surrounding the airport.

1.7 Key elements of the IIPH

This study estimated the high level financial and physical parameters of both a 250 and a 500 hectare (ha) site to inform stakeholders of the top line contributions and input requirements of an IIPH.

The blueprint for each site assumes that 10 per cent of the overall land will be allocated to shared services including logistics, food producing and waste management. Revenue modelling has assumed that land is allocated in 10 ha blocks, where 70 per cent of the bloc is productive (revenue generating) and 30 per cent is non-productive (non-revenue generating) and used for roads, access paths and office space. It is expected that tenants will acquire parcels in excess of 40ha to enable economies of scale.

A range of possible products were selected as examples of what could be grown on a future site.

Products used to estimate revenue potential included snack tomatoes, truss tomatoes, blueberries and capsicum.

Development of the IIPH is assumed to be staged over ten years. Development is assumed to be incremental based on the development of land over time as demand increases.

1.8 Revenue and labour potential

Based on the above assumptions, high level financial analysis indicates that the IIPH could generate up to **\$541 million pa** in revenue from a 500 ha site and **\$277 million pa** in revenue from a 250 ha site. Over ten years of operations the IIPH is forecast to generate revenue of **\$2,800 million** (500 ha) and **\$1,400 million** (250 ha) site. Opportunities exist to supplement revenue through further value add services such as food processing, logistics services, tourism, research and development. The revenue potential for these activities requires further analysis.

Analysis of workforce requirements indicates that the IIPH could generate up to **2,500 jobs** (FTE) on a 500 ha site and **1,300 jobs** (FTE) on a 250 ha site. Labour estimates are based exclusively on food production. There will be further labour opportunities associated with food processing, logistics services, tourism and research which requires further analysis. Analysis in KPMG's *Think Big, Think Fresh* report estimated that 12,000 jobs could be created through a fresh food precinct at WSA, however this includes estimation of jobs created outside the precinct including airport and logistics staff.⁴

The assumptions underpinning the model can be found in *Appendix 18*.

⁴ KPMG, 2017, Think Big, Think Fresh

The IIPH is estimated to require the following utilities on a per annum basis at full development:

Table 1-1: Overview of IIPH utilities

Resource	Estimated quantity per annum		Comments
	250 ha	500 ha	
Electricity	14,000 MWh	27,500 MWh	Estimation for both productive and non-productive areas
Gas	880,000 GJ	1,721,000 GJ	Estimates are based purely on heating requirements. Gas required may be doubled if gas generators are used to provide electricity to power the precinct.
Water	2,070 ML	4,050 ML	Total water (potable quality) requirement for crop water and humidification and cooling.

The IIPH is estimated to produce the following waste on a per annum basis:

Table 1-2: Overview of IIPH waste

Resource	Estimated quantity per annum		Comments
	250 ha	500 ha	
Waste water	From 135 ML to 185 ML	From 265 ML to 360 ML	Estimates vary depending on technology application
Green waste	14,100 tonnes	27,500 tonnes	Wet waste
Other solid waste	16,300 tonnes	32,000 tonnes	Wet waste

1.9 Capitalising on a future thinking approach

The IIPH presents an opportunity not just to be a 'food production' facility. The IIPH can adopt circular economy principles and be a first-mover in the use of technology that is creating a globally connected supply chains to drive better economic, social and environmental outcomes such as climate resilience and food waste minimisation. The IIPH can be blockchain enabled, SMART city connected through IoT, be a research, development and commercialisation hub, offer education opportunities and be a tourism attraction.

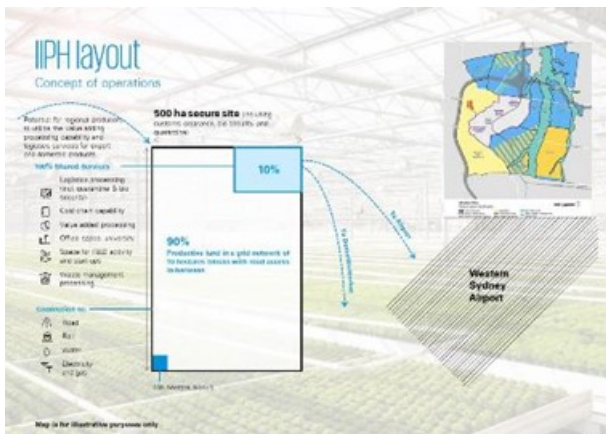
More on this can be read in Section 12 Circular Economy and Technology Considerations.

1.10 Concept master plan

The concept diagrams below represent the conceptual layout of the IIPH, the utilities concept of operations and the high level design principles to be applied in the development of the IIPH.

Larger images are included in Section 1.1 Concept Master Plan.

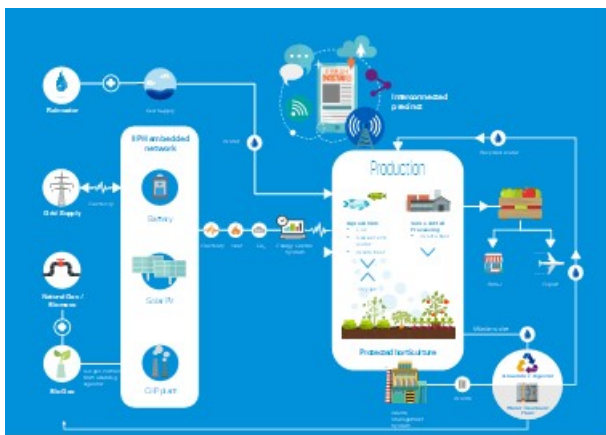
High Level IIPH Layout



The blueprint for each site assumes a 500 ha or 250 ha land parcel. 10 per cent of the overall land will be allocated to shared services including logistics, food processing and waste management.

It is assumed that productive land will be allocated in 10 ha blocks with 70 per cent of this allocation being productive and 30 per cent going to non-productive uses such as roads and office space.

Utilities Concept of Operations



The innovative case for utilities is underpinned by circular economy principles that seek to optimise the use of resources and maximise coordination within the precinct and beyond. The integrated solution is envisaged to incorporate, amongst others, onsite power generation, a rainwater harvesting system and a water treatment plant, a waste management system, and the use of biogas generated from the precinct's waste. This would involve either investment in onsite equipment or strategic partnerships with external providers.

Supply Chain Concept of Operations



Efficient, effective and a future focussed supply chain is a key principle of the precinct design and operation. This will enable product differentiation and margin uplift in both domestic and foreign markets. Key principles include:

- efficient and streamlined export logistics;
- access to cold chain infrastructure;
- access to transport infrastructure;
- innovative traceability solutions;
- predictive supply chain demand and risk management; and
- design flexibility.

1.11 Commercial considerations for the development of the IIPH and next steps

The development of IIPHs is new to Australia and this presents risks given our relatively small domestic market. However changing trends in farming systems, customer and consumer requirements, shared cost structures and export demand opportunities provide a strong case for the growth of food IIPHs.

Analysis indicates that the fundamentals required to develop an IIPH adjacent to WSA are in place, but noted the need for a commercial development pathway including consideration of an appropriate role for Government.

Based on identified options and assessment of similar global precincts, the recommended governance model for the development of the IIPH may be through a facilitated model. This may include the ongoing involvement of the NSW and Australian governments, to ensure alignment with the broader Aerotropolis development.

The NSW Governments', Western City and Aerotropolis Authority (WCAA) should undertake a more detailed assessment of how WCAA may lead the IIPH development.

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Inherent Limitations

This report has been prepared as outlined in the Section 3 Objectives of this report and Section 4 Completing this report. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

KPMG does not make any representation or warranty as to the accuracy, completeness, reasonableness, or reliability of the information included (whether directly or by reference) in the report, statements, representations and documentation provided by NSW Department of Primary Industries management and stakeholders consulted as part of the process, and / or the achievement or reasonableness of any plans, projections, forecasts, management targets, prospects or returns described (whether express or implied) in the report. There will usually be differences between forecast or projected and actual results, because events and circumstances frequently do not occur as expected or predicted, and those differences may be material. Additionally, KPMG does not make any confirmation or assessment of the commercial merits, technical feasibility or compliance with any applicable legislation or regulation of the NSW Governments Western Sydney Airport Agribusiness Precinct Integrated Intensive Production Hub (IIPH) Pre Feasibility study project.

KPMG have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

KPMG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

The findings in this report have been formed on the above basis.

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This report is solely for the purpose set out in the Section 3 Objectives of this report and Section 4 Completing this report and for NSW Department of Primary Industries information, and is not to be used for any other purpose or distributed to any other party without KPMG's prior written consent.

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Table 1-3: Abbreviations found in this report

Abbreviation	Meaning
A7	Agriport A7
AI	Artificial Intelligence
APHA	Animal Plant Health Agency
ARC	Australian Research Council
ASEAN	Association of South East Asian Nations
ASRS	Automated Storage & Retrieval System
BDC	Bio-renewable Development Centre
BIRD	Berry Impact Recording Device
CAPEX	Capital Expenditure
CEA	Controlled Environment Agriculture
CEAC	Controlled Environment Agriculture Centre
CFIA	Canadian Food Import Authority
CHP	Combined heat and power
CIEL	Centre of Innovation Excellence in Livestock
COFCO	Chinese National Cereals, Oils and Foodstuffs
CRC	Cooperative Research Centres
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSO	Civil Society Organisations
DAWR	Department of Agriculture and Water Resources
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EU	European Union
EXDOC	Export Documentation System
FAO	Food and Agriculture Organization
FTE	Full time equivalent
GDP	Gross Domestic Product
GPS	Global positioning system
GVP	Gross value of production
HA	Hectares
HVAC	Heating, ventilation and air conditioning
ICT	Information and Communications Technologies
IIPH	Integrated Intensive Production Hub
IoT	Internet of Things
IRR	Internal Rate of Return
IT	Information Technology
JV	Joint Venture

Abbreviation	Meaning
KB	Knowledge base research
KEC	Knowledge exchange and commercialisation
KPI	Key Performance Indicator
LEP	Local Enterprise Partnership
LPG	Liquefied Petroleum Gas
LTE	Long Term Evolution
LUIIP	Land Use and Infrastructure Implementation Plan
NAFIC	National Agri-Food Innovation Campus
NGO	Non-Government Organisation
NPV	Net Present Value
NSW	New South Wales
PPR	Production Possibilities Report
R&D	Research and development
RAM	Relation Account Management
RAS	Recirculating aquaculture system
RDI	Research, Discovery and Innovation
RoCRE	Rothamsted Centre for Research and Enterprise
ROI	Return On Investment
SAC	Smart Agriculture
SCY	Science City York
SME	Small and Medium Enterprises
SPV	Special Purpose Vehicle
TAFE	Technical and Further Education
UAE	United Arab Emirates
UHT	Ultra-high temperature
UK	United Kingdom
UKTI	UK Trade and Investment
USA	United States of America
Venlo	Fresh Park Venlo
VF	Vertical Farm
WCAA	Western City and Aerotropolis Authority
WHC	World Horti Centre
WSA	Western Sydney Airport

The objectives 03 of this report



The objective of this document is to provide a report that considers the development of a world leading IIPH within the agribusiness precinct adjacent to the WSA or surrounds. The report builds upon the work already undertaken by the DPI, in consulting with various stakeholders both public and private.

The report is designed to demonstrate the necessary requirements and considerations of designing and building an IIPH in the agribusiness precinct in the Aerotropolis; it is designed to provide the necessary information to enable the Government to consider evaluating the planning of the IIPH to 'priority' status. The study will feed into the information package being drafted by the NSW Government, and will ultimately highlight the need for a full business case on the IIPH.

This report:

- Identified key agribusiness hubs globally that can be included as case studies and examples of industry best practice (such as the Agriport A7 and Venlo in the Netherlands). Such case studies need to include features of those hubs that aren't applicable/transferable to the WSA Agribusiness Precinct.
- Production infrastructure suitable for placement in direct proximity of an airport – e.g. consideration of restrictions with glasshouses and reflection of light on aircraft movements.
- Resource requirements, both quantitative and qualitative:
 - Land
 - Energy (electrical, heat, etc.)
 - Water
 - Labour
- Infrastructure requirements, data connectivity, government support, high level market opportunities (domestic and export), integration with other precincts.
- Innovation, research and development and SMART cities.
- Using Circular Economy principles to identify opportunities to develop sustainable practices, such as:
 - Energy-grid tech, co-gen, biofuel, solar, geothermal
 - Zero waste
 - Cross industry opportunities
 - Construction and land use planning considerations
- Health, education, skills and tourism opportunities

04 Completing the report



4.1 A multidisciplinary approach was utilised in this study.

Key elements included:

- **Global market scan:** A detailed global market scan was conducted to identify examples of successful agriculture and food precincts. Global insights have been used to help inform the high level vision and design of the WSA IIPH with regards to site layout, production possibilities, shared services infrastructure options, governance structures and operating models.
- **Literature review:** A detailed review of publically available reports was conducted. This review provided insights to inform vision and strategic direction and context in relation to planned infrastructure developments within the Western Sydney region. Key notable reports included:
 - *Think Big, Think Fresh: A fresh food precinct at the heart of Western Sydney (KPMG);*
 - *Going Dutch: Opportunities for the Australian agri food sector (KPMG);*
 - *Talking 2030: Growing Australia's Agriculture industry (KPMG);*
 - *Production Possibilities (Agrology);* and
 - *Western Sydney Aerotropolis – Land Use and Infrastructure Implementation Plan (LUIIP) (The NSW Government Department of Planning)*
- Creating a circular economy precinct (*Institute for Sustainable Futures*)
- A full list of references can be found in *Appendix 21: Additional references.*
- **Revenue model:** A high level revenue and inputs (labour and utilities) model was created to help determine the revenue potential and labour requirement of the IIPH. Key assumptions within this model were informed through the PPR produced by Agrology and also through consultations with subject matter experts from across industry.
- **Stakeholder consultation:** 54 stakeholder groups from across the public and private sector were engaged with to help identify opportunities and constraints with regards to the development of an IIPH at WSA. Stakeholder engagement was undertaken in the form of both discovery interviews and workshops. A full list of the stakeholders can be found in *Appendix 20: Stakeholder consultation.*
- **Subject matter experts from industry:** were engaged with to provide strategic advice with regards to the more technical and commercially sensitive aspects of this study. This included the utilisation of subject matter experts to guide and inform the project, including a number from KPMG.

About the Western 05 Sydney Airport



5.1 About the WSA and the Aerotropolis

As one of Australia's only greenfield metropolitan airports in the last 50 years, the AU\$5.3 billion WSA is a transformational project for NSW. As a new international gateway to the nation, WSA will provide NSW businesses a competitive location in the Sydney metropolitan region and access to global markets. It will be a catalyst for economic growth and new jobs in one of the fastest growing regions in Australia.

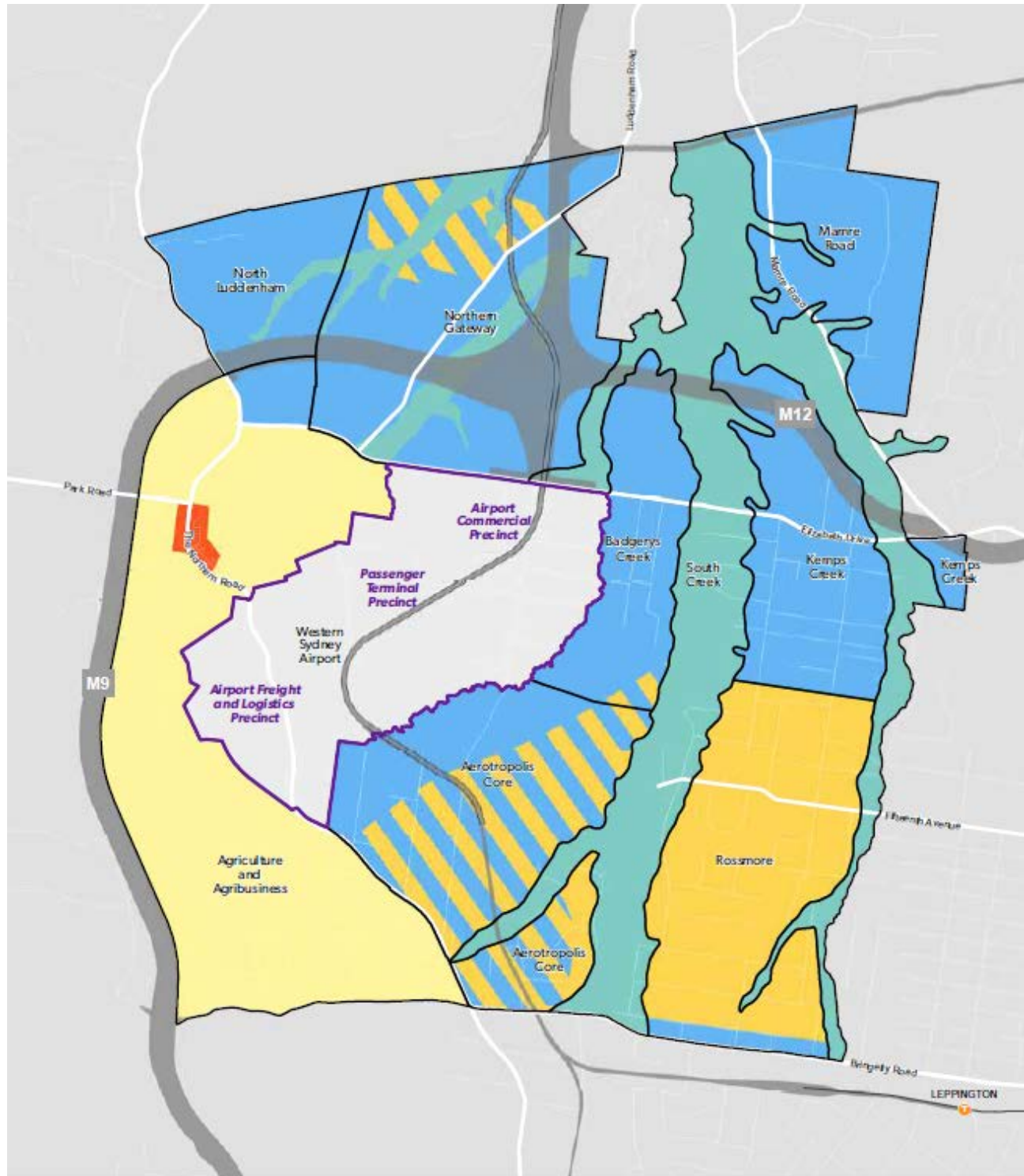
Surrounding the airport will be a vibrant, world-class economic precinct – the Aerotropolis. The Aerotropolis will target industries such as defence, aerospace, advanced manufacturing, freight and logistics, agribusiness, health, education and tourism. This will be connected to the rest of the metropolitan region

and auxiliary precincts through digital and transport infrastructure.

Some of the opportunities the Aerotropolis will bring include:

- Streamlining access to overseas markets, including overnight access to Asia;
- Enable connectivity to rural primary production centres for export opportunities;
- Increased national and international tourism;
- Infrastructure investment will provide better connections to regional cities, acting as a gateway for domestic and international travellers; and
- Be well connected to the surrounding areas via transport networks ensuring convenient access for the 10 million passengers and 28,000 strong labour force expected by 2031.

Figure 1: The Western Sydney Arotropolis - as outlined in the Stage 1 - Land Use and Infrastructure Implementation Plan



Structure Plan

Western Sydney Aerotropolis

- | | | |
|------------------------------|---------------------|--|
| Precinct Boundary | Agricultural | Non Urban Land |
| Western Sydney Airport | Luddenham Village | Mixed Flexible Employment & Urban Land |
| Proposed Transport Corridors | Flexible Employment | Urban Land |



5.2 Including an Integrated Intensive Production Hub

As part of the development of the Western Sydney Aerotropolis, the NSW Government is driving the creation of a world-class agribusiness precinct. The airport will uniquely enable curfew-free, 24-hour export of food from the Western Sydney region facilitated by an IIPH located in the agribusiness precinct.

The IIPH is intended to be a world-class, fully integrated intensive food production hub incorporating protected cropping horticulture, energy production systems, efficient use of water, waste, heat and CO², and integrate across other industry sectors and the community. The IIPH will enable delivery from farm

gate to the international consumer's plate within 36 hours.

The IIPH will need to leverage existing domestic intensive and indoor farming capabilities, and couple this with insights from global competitors, to encourage commercialisation of a large scale, holistic production, processing and food manufacture hub. The big-picture thinking of such a facility needs to take into account production types, energy, infrastructure requirements, utilities dependency, biosecurity, technology adoption, trade agreements and market access. In addition the IIPH needs to be forward-thinking, energy neutral (if not negative) and scalable to meet the ever growing food demand of Australia's large proximal neighbour export markets.

Global demand for food and linking this to 06 production possibilities



6.1 Growing demand for food

Sustainably feeding a global population of over 10 billion people by 2050 is considered one of the key challenges of our time, with predictions that more food will be required in the next four decades than all farmers in history have harvested over the past 8,000 years.⁵ Significant opportunities exist for Australia to support and capture the economic benefits from this growing demand, particularly in Asia and The Middle East. Demand is predicted to increase between 59 per cent and 98 per cent by 2050 in these regions respectively.⁶

In addition, rising levels of income per person are anticipated to translate into increasing demand for food, both in absolute terms and also on a quality-substitution basis. As the living standards across the world improve, those people in the lower income ranges will be able to purchase more food such that their daily calorific intake increases from subsistence levels to levels closer to the world average.⁷ People in higher income ranges are likely to adjust their buying behaviour such that they purchase better quality food products (either in terms of attributes like taste, substance, use of chemicals, producer provenance, etc.).

6.2 Food demand in Asia

This trend has already started to be seen, with the fastest increase in food consumption in countries where incomes have grown most rapidly.⁸ Australia's food production sector has benefitted from this rise in global incomes – especially income growth in Asian economies – and pull-through demand for basic and value-added agricultural products in Asia. Over the past decade demand for Australia's farm exports has been strongest from:

- China;
- India;
- Indonesia;
- the Philippines;
- South Korea; and
- Vietnam.

This strong rise in demand from emerging Asia economies is expected to be maintained into the short to medium term.⁹

The Asian market is expected to grow by over 750 million people by 2050. Asia is being transformed by the urbanisation and westernisation of the middle-class. There is a strong desire for high quality products, where provenance and safety are non-negotiable. Food safety scandals across Asian countries are driving this trend (e.g. the melamine

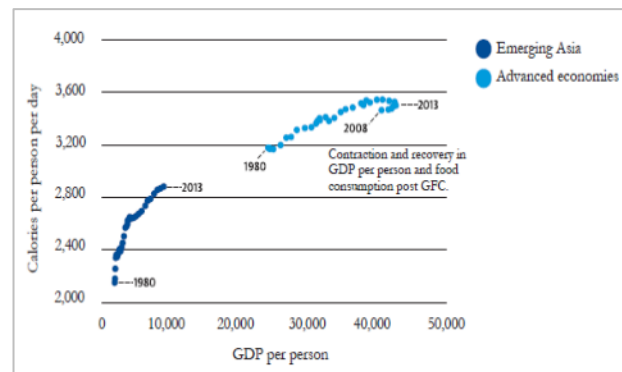


Figure 2: Changes in calorie consumption and GDP per person, emerging Asia and advanced economies 1980 to 2013. Note: GDP per person is measured in purchasing power parity (in 2011 AUD).

contamination of milk powder in China in 2011), which has led to such strong demand for Australian-sourced product that consumers can now only buy two cartons per purchase in Australia.¹⁰ Asian consumers want to buy the food that Australian's consume and that they can prove is made here.

While 'Brand Australia' is strong, it is essential that products come with the appropriate assurance, enabled by an efficient supply chain in order to get product directly to the end user. Australia's brand is crucial to driving our country's competitive edge and providing our exporter's with a comparative advantage. To ensure Australian businesses are globally competitive it is imperative that Australia has a brand that resonates in markets across the world. The IIPH has the potential to be at the forefront of supporting this brand through creating and exporting high quality that is verified Australian through immutable blockchain or similar supply chain management technologies.¹¹

6.2.1 Demand in China

In 2017, Australia and China's two way trade represented almost a quarter of our county's national trade, valued at \$183.4 billion. Clearly, China in particular represents an export opportunity for IIPH produce. In 2018, KPMG co-authored a thought leadership paper titled *Doing Business in China*. The paper surveyed 165 members of the China-Australia Chamber of Commerce (AustCham) and Australia China Business Council who are working to grow their business in China.

On the one hand, *Doing Business in China* demonstrated the existence of unparalleled opportunity, with Australia's trade and business investment in the country continuing to grow at double digit growth rates. The Australian food and

⁵ National Geographic, 2017, Holland - agriculture sustainable farming

⁶ Harvard Business Review, 2016, Global demand for food is rising – can we meet it?

⁷ KPMG, 2018, Talking 2030: Growing agriculture into a \$100 billion industry.

⁸ KPMG, 2018, Talking 2030: Growing agriculture into a \$100 billion industry; quoting ABARES, FAO and IMF Analyses

⁹ KPMG, 2018, Talking 2030: Growing agriculture into a \$100 billion industry.

¹⁰ KPMG, 2018, Talking 2030: Growing agriculture into a \$100 billion industry.

¹¹ Australian Government, 2017, Australia's Nation Brand

agribusiness sector is still relatively untapped in regards to this growth, but has begun to exponentially increase with “exports of certified, clean, healthy and environmentally friendly produce”.¹²

However, unique market demands, unclear laws, rising labour costs and market access all contribute to competitive, export challenges. In the survey, 30 per cent of the food and agribusiness firms asked found doing business in China ‘extremely difficult’, the highest of any industry. This is due to a range of reasons, most notably tough ongoing regulatory requirements and changed market demand.

6.2.2 Demand in the Association of South East Asian Nations (ASEAN)

While China presents a high volume of strong demand from one location, it would be negligent to not acknowledge that the ASEAN region has the fastest rate of population growth globally and that GDP is forecast to nearly double in the next decade.¹³ In 2017, Australia’s trade with the region grew by nearly ten per cent from 2016, reaching more than \$100 billion; this trade increase is creating demand for nutritious, protein rich, bespoke and health food products.¹⁴

As the ASEAN population’s affluence grows, their demand for lifestyle specific foods is shifting, for example the increase in the health and wellness category of foods. These foods are mainly associated with dietary trends, a need to manage diseases and to creating healthier lifestyles. These trends create immediate and long-term opportunities for Australia to continue to supply foods to fulfil these desires, and through developing technologies and strategies to improve their production, path to market and their local relevance (i.e. awareness of their health status and availability in market).

6.3 Production Possibilities Report – linking global food demand with new supply sources at the IIPH

The PPR,¹⁵ prepared for the NSW Government addresses key climatic enablers, production possibilities, and economic feasibility of particular activities at the WSA IIPH based on current land use and proposed activities and their economic values. The PPR was a critical input to this study and informed insights provided in *Section 10 Financial considerations for a successful IIPH*.

Four key steps were taken by the PPR to identify production activities that were both technically feasible and economically viable.

- **Existing land use was assessed to determine the current industries already established in the area and to understand the value these industries generate;** this was done using ABS data at the SA2¹⁶ level and found that:
 - Current gross value of production of the land slated for the Aerotropolis is \$169 million, or 25.7 per cent of the greater Sydney GVP, or 1.2 per cent of NSW GVP. The majority of GVP is derived from poultry production, however this is likely to be unsustainable as the airport becomes operational due to land use pressures, noise pollution and demand for other high-value products. Following poultry production, vegetables, eggs, nursery/flower/turf and dairy are the next most productive sectors.
 - Land use planning for the IIPH needs to consider both current and future production and the associated possible value derived from different sectors. The LUIP itself has already noted that long term retention of agribusiness in the Western Sydney area is prioritised, thus future industry planning needs to consider retention of some current enterprises, transition of other current enterprises and attraction of some new enterprises.
 - Ultimately the zoning of land, and in particular current residential housing, will impact upon the future of the IIPH and some policy issues will need to be addressed in this regard. Given that the total land available is relatively small and high value, the only suitable agricultural farming options for inclusion in the IIPH are going to be intensive production systems (not extensive ones).
- **The climatic conditions of the Aerotropolis region was examined to yield insights into limiting factors on future land use,** and the technologies that may need to be included in analysis; this was done largely using Bureau of Metrology data and showed that:
 - The temperatures experienced in the region are varied, with lows below zero and highs above forty degrees centigrade, however humidity is generally not an issue. The low temperatures of winter seasons however does indicate that heating will be required (however the cool climate does benefit some specific products).
 - Light levels in the region are on average 565,769 J/cm², sufficient for indoor protected cropping glasshouses, however additional lighting would boost production if low-cost energy sources could be acquired.

12 KPMG, 2018, Doing Business in China

13 KPMG, 2018, Food For Health ASEAN trends

14 KPMG, 2018, Food For Health ASEAN trends

15 Agrolgy, 2018, Production Possibilities Report.

16 Statistical Areas 2 (SA2) include: 1. Mulgoa – Luddenham – Orchard Hills (SA2 124031463), 2. Horsely Park – Kemps Creek

(SA2 127021518), 3. Badgery’s Creek – Greendale (SA2 127011505) and 4. Cobbitty Leppington (SA2 127011506). Note that these areas do include some land outside the Aerotropolis due to the fact that the Aerotropolis does not cover a specific SA region.

- Rainfall is summer dominant in Western Sydney, however even with the proximity of catchments near to the WSA, having a safe, continuous supply of water will need to be ensured.
- **Based on current land use and climate analysis, the PPR then identified technical production capabilities that would drive high-growth and value IIPH production**, the following were identified as financially, technically and socially viable and suitable for both domestic and global consumption:
 - Controlled-climate protected cropping production of vegetables (with the PPR specifically focussing on capsicum, lettuce/leafy greens, tomatoes and cucumbers) in Conventional Dutch Venlo style glasshouses and/or modern semi-closed glasshouses with evaporative cooling and positive pressurisations) – with significant financial yields and the possibility to incorporate advanced technologies that both improve production and mitigate environmental impacts without large land parcel requirements;
 - Berry production under poly-tunnel production or retractable roof production (in particular the PPR identifies blueberries) was identified as a high domestic and international demand product, however it is highly perishable and susceptible to climate/environmental challenges, so proximity to packing, processing and logistics direct to the airside facilities at the WSA would be vital to its success; and
- High-intensity land-based aquaculture (e.g. cold-water finfish such as salmon or warm-water finfish such as barramundi and Murray cod), is a technically viable however further financial modelling is required. More work is required to determine the land requirements, supporting infrastructure and utilities required to run a fish production facility and the impact if any on NASF Guideline C.
- **Economic analysis on the identified production sectors that are viable options for inclusion** in an IIPH were financially assessed over a ten year period, with an aggressive discount rate, and took into account capital outlay (excluding land purchase). The results showed:
 - The analysis took into account site assumptions (25-30 ha plots, with 40 ha becoming increasingly common), pricing of domestic products both current and recent historic, production yields, the cost of energy, water and gas and ROI timelines. A site capital cash flow forecast range of \$10.5 million to \$90 million for blueberries and semi-closed greenhouse vegetable production was determined, and when discounted an NPV of \$270,000 (broiler) to \$75.5 million (semi-closed snack tomatoes) and an Internal Rate of Return (IRR) of 10.2 – 25.3 per cent (broilers to snack tomatoes). It should be noted that the report is not exhaustive and, as such, there are other activities that could, theoretically be included in an IIPH.

World's best practice 07 intensive agriculture



There are numerous, exemplar agribusiness precincts located around the world, all with unique production focuses. A7 and Venlo are considered two of the most relevant for the purposes of this study, and have been referenced as a high level blueprint to inform design assumptions.


A7 and Venlo are considered the most advanced, operational, agribusiness precincts globally and represent best practice for intensive food production, minimised energy use (and re-production) and logistics. A7 has an on-site data centre, while Venlo receives tourist visitation and offers on-site education,

research and development. These private facilities are based on a tenancy model, with low costs per user due to the circular economy principles in place that minimise their energy requirements.

There are several key insights that can be leveraged from the A7 precinct and adopted in considering the design, product inclusions and operations planning for the IIPH. A case study on the A7 and Venlo can be found below.

The success of agribusiness precincts in the Netherlands is underpinned by a long cultural history of collaboration and industry led innovation.

Case Study 1: Agriport A7

 **Agriport A7 - Noord Holland, Netherlands**

 **HIGHLIGHTS**

What is it?

A7 (Noord Holland) is a modern project hosting 850ha zoned for Greenhouse park including large scale glasshouses and open field areas for the production of fresh vegetables as well as processing and logistics entities (450 hectares developed to date). The facility is the Netherlands' largest Greenhouse Horticulture Region and houses 100 ha of business park. The industrial park was officially opened in November 2008.

Key industry focus?

- Greenhouse park
- Business park
- Logistics and transport

Innovation type/s?

- Data centre
- Self-sufficient energy generation, including geothermal energy
- Participant-owned shared services

 **OVERVIEW**

Vision/Purpose

To produce intensive horticultural crops at scale leveraging shared investment in energy and logistics. Reducing impact on environment and creating energy self-sufficiency.

Achievements

- The first hyper-scale data centre has been operational at A7 since 2015.
- Two more plots of 70 ha and 55 ha are now available for data centres in the A7 area.
- Energy Combination Wieringermeer (ECW) has completed a geothermal energy project in combination with horticulturalists in Agriport. The geothermal energy project has been operational at Agriport since 2015 providing stable heat for heating the greenhouses.

Companies

- Hiemstra BV
- Agriport A7 BV
- Barendse-DC
- Gam Bakker BV
- Ruigewaard BV
- Peter Appel Transport
- De Palletcentrale
- Poeliersbedrijf Van der Laan
- Peter Mul boomverzorging
- Lunchroom De Tafel van Agriport
- Shell
- AcconAVM accountants en adviseurs
- Bakker Personeelsdiensten
- Crown of Holland
- Microsoft
- B&S Watering systems
- Van der Bel



Agriport A7 - Noord Holland, Netherlands

How does it work?

Europe's largest high tech greenhouses are based at A7. In large scale greenhouses, like in data centres, management of energy costs is the key to success. The 150kV underground power lines bring down the power costs and the 450MW of wind power at A7 makes it easier to meet the company's environmental goals.

A7 is located just 30 car minutes north of Amsterdam, where 60 per cent of all Forbes 2000 companies active in ICT have already established an office. Yet, A7 is located in a low density populated area and has therefore had less impact on the way people live and recreate. And compared to the urban Amsterdam area, the land prices are competitive.

The companies at A7 are interconnected in an ecosystem of industries that benefit most from world class infrastructure. The A7 location therefore offers many advantages for large scale data centre operations.

Expansion of data centres in the business park

Companies such as Microsoft, Alphabet, Amazon and CyrusOne are planning to establish data centres in the park as A7 is located near AMS-IX and Amsterdam Airport Schiphol. A7 is focused on applying circular economy principles at these data centres. A7 is located approximately 60km from the closest airport

- *Power generation:* The park utilises energy produced by the greenhouses to generate electricity for the data centres, whereas, heat and carbon dioxide produced from the servers of the data centres are used by the nearby greenhouses
- *The business park* also offers large plots and enables quick and smooth construction of data centres due to cooperation between the government and the project developer (the Regional Development Agency NHN, the Netherlands Foreign Investment Agency (NFIA), and the A7;
 - Microsoft has established two data centres in A7, whereas, Amazon announced plans to build a data centre located on a purchased plot of land of 24 ha at the facility;
 - In October 2018, CyrusOne announced plans to develop hyper-scale data centres in A7 and as per the agreement will have the option to purchase up to 33 ha of land to build a 270MW master-planned multi-data centre campus;
 - In 2018, Alphabet purchased 70 ha of land at the A7 and plans to use the land for the expansion of its data centres. According to Jack Kranenburg, commercial director of A7, the building permit has been issued in the name of Nimble, and estimates a data centre of around 3 ha on a plot of 24 ha.



CREATING AND MEASURING IMPACT

Measuring impact

- Commercial productivity – high yielding production
- High skilled jobs
- Creating new economies
- Circular economy – recycling of CO² and heat

Brands

- Microsoft
- Shell
- Crown of Holland
- Hiemstra
- Gam Bakker
- Accon avm



KEY INSIGHTS FOR WSA – IIPH

- ✓ Business park tenancy model
- ✓ Led by private sector
- ✓ World leading example for food production, logistics, energy and circular economy
- ✓ Co-operative geothermal heat source, leading to reduced energy cost for tenants
- ✓ Hosts Microsoft and Amazon data centres

Case Study 2: Fresh Park Venlo



Fresh Park Venlo - Venlo, Netherlands



HIGHLIGHTS

What is it?

- Fresh Park Venlo (FPV) develops and maintains functional and profitable housing for Fresh & Food companies at a dedicated food park in Venlo. The business park includes 130-ha of Private Food Park and more than 25 ha Business space.¹⁷

Key industry focus?

- Food
- Fresh produce
- Processing and distribution of fresh food

Innovation type/s?

- SMART Logistics Centre Venlo
- Cameras and vision system sorting



OVERVIEW

Vision/Purpose

Fertile breeding ground for cooperation and development of new food products and services.

Recent development

- In October 2018, Hines Europe acquired the business park from Royal ZON through perpetual leasehold right.

Companies – 100+ food companies and suppliers

- | | |
|---|--|
| <ul style="list-style-type: none"> • Frankort and Koning • Toyota • Port International • Berry Packing Services • Zon Fruits and Vegetables • Wetrion • Gial • Recycold Cool Solutions BV | <ul style="list-style-type: none"> • DEMIR • Hendrix fruits and vegetables • Landgard • EuroPoolSystem • Berden • GEA • Hagens Nedalpac |
|---|--|

How does it work?

- The FPV business area includes logistics companies, suppliers and producers in the field of the food industry on the ground, as well as companies in the field of storage and packaging industry
- FPV facilitates more than 100 companies in the food business through a dedicated Facility Management Services team and manages the public spaces on the park. However, lessee, owners and tenants are responsible for managing areas within the allocated plot boundaries
- The business park is a logistic hotspot linking the import and export ports of Rotterdam and Antwerp and the German and European market
- Suppliers procure locally / import vegetables from overseas for processing at the park facilities, conduct packaging procedures and transport to retail stores and wholesalers
- FPV offers business space to small-sized businesses and established food companies, along with investment and development of commercial spaces.

Fresh Park Venlo website, [Link](#); Fresh Park Venlo Occupants, [Link](#); About Fresh Park Venlo, [Link](#); Logistics Hotspot, Fresh Park Venlo, [Link](#)



Fresh Park Venlo - Venlo, Netherlands



CREATING AND MEASURING IMPACT

Measuring impact

- Accessible 152 million European consumers within a 9-hour drive. 2 train terminals within 1 km, 2 airports within 100 km and 2 ports within 200 km business area
- Sustainable supply and distribution channels as it provides tri-modal road, waterway and rail transport network
- 70 per cent of the growers are located within 100 km of Fresh Park
- Every year 80,000 containers are handled by ECT Venlo
- Includes a 5,400 ha Food And Logistics Centre Greenport Venlo zone
- Supports more than 50 per cent of the road and rail freight trade between Netherlands and Germany
- Some of the practice-oriented education and research institutions specialising in food and logistics are located in the Venlo

Brands

- Zon Fruit & Vegetables
- Landgard
- GEA Refrigeration
- Hendrix Fruit & Vegetables
- Securitas BV



KEY INSIGHTS FOR WSA – IIPH

- ✓ Offers space to small-sized businesses and established food companies
- ✓ Education and research institutions specialise in food and logistics
- ✓ Ideal location linking The Netherlands with the rest of Europe

A number of other precincts were examined at a high level in this report. These are outlined, in summary, in 15.1. In 15.2, an overview of education clusters related to the development and innovation of food is provided; it is proposed that a similar cluster structure could be achieved at the IIPH. Finally, 15.3 provides an overview of utilities and infrastructure considerations that leverages insights from the precinct case studies.

Table 7-1: Summary of selected, relevant agribusiness precincts

Name, Status & Country	Agriport A7 (Operational) Noord Holland, Netherlands	TruLeaf (Operational) Canada	AeroFarms (Operational) United States
Industry Focus	<ul style="list-style-type: none"> Protected cropping (paprika and tomato) Data Centre Tech Services 	<ul style="list-style-type: none"> Agriculture (leafy vegetables) 	<ul style="list-style-type: none"> Horticulture (leafy greens) Biology Engineering
Year Founded	2008	2011	2004
Funding source	Private	Private & corporate investment	Private
Land size (including glasshouses)	<ul style="list-style-type: none"> 950 ha total 850 ha of greenhouse park including large scale glasshouses and open field areas (450 ha developed to date) 100 ha business park 	Not available	0.64 ha flagship facility
Sustainability focus	✓	✓	
Processing facility	✓	✓	✓
Research farm / test labs		✓	✓
Circular economy focus	✓		✓
Co-working space		✓	✓
Accelerator / Incubator			
Insights for IIPH	<ul style="list-style-type: none"> Business park tenancy model Led by private sector World leading example for food production, logistics, energy and circular economy Co-operative geothermal heat source, leading to reduced energy cost for tenants Hosts Microsoft and Amazon data centres 	<ul style="list-style-type: none"> Data driven indoor farms Sustainable, low energy urban farming On-site protected cropping production gives an additional source of revenue Potential for income generated to be reinvested into research Licensing opportunities for tenants Global reach Example of stable production in any climate Continually innovating technology Real-life ROI measures of research and technology 	<ul style="list-style-type: none"> Most successful agricultural circular economy Example of benefits and capabilities of vertical farming Combination of digital, scientific, automation and engineering innovation Environmentally responsible farms

Name, Status & Country	National Agri-Food Innovation Campus (NAFIC) (Operational) United Kingdom	Rothamsted Centre for Research & Enterprise (RoCRE) (Operational) United Kingdom	SAC Iwata (Operational) Japan
Industry Focus	<ul style="list-style-type: none"> Life sciences Agri-Food Other industries - pharma, legal, environmental, IT and healthcare 	<ul style="list-style-type: none"> Agri-Food Biosciences Horticulture 	<ul style="list-style-type: none"> Horticulture – tomatoes, bell peppers, salad kale
Year Founded	2014		Early 2016
Funding source	Private and public	Private/Public	Corporate (Fujitsu, Orix, Masuda's Seed)
Land size (including glasshouses)	<ul style="list-style-type: none"> Approximately 2.78 ha office and lab accommodation 	400 ha	Approximately 5 ha
Sustainability focus			✓
Processing facility			
Research farm / test labs	✓	✓	
Circular economy focus			
Co-working space	✓	✓	
Accelerator / Incubator		✓	
Insights for IIPH	<ul style="list-style-type: none"> Provides space and infrastructure access to tenants Government supported Focus on research, providing research support for partners onsite 	<ul style="list-style-type: none"> State of the art facilities designed for scientific innovation Collaborative environment for start-ups, dedicated to the development of businesses Research support for onsite tenants No production capability 	<ul style="list-style-type: none"> Commitment to corporate collaboration to develop new business models Intended to generate new regional development and investment Focus on digital technologies including sensors, networks and clouds

Name, Status & Country	Techno Farm Keihanna (Operational) Japan	AgriGarden (COFCO) (Operational) China	Food Valley of China (Operational) China
Industry Focus	<ul style="list-style-type: none"> Horticulture – specifically lettuce 	<ul style="list-style-type: none"> Agriculture Commercial property 	<ul style="list-style-type: none"> Agriculture Food processing Animal husbandry
Year Founded	Late 2017	~2020	2012
Funding source	Corporate (SPREAD Co)	Government and corporate	Public (Weifang municipal government)
Land size (including glasshouses)	Not available	Approximately 1,011 ha	Planned 4,500 ha
Sustainability focus	✓	✓	✓
Processing facility	✓		
Research farm / test labs	✓		✓
Circular economy focus	✓	✓	
Co-working space		✓	✓
Accelerator / Incubator			
Insights for IIPH	<ul style="list-style-type: none"> Provides a model for stable production in any climate Focus on innovation to provide better outcomes Global reach Water recycling rate up to 98 per cent Using food technology to work towards a sustainable society 	<ul style="list-style-type: none"> Visionary social model for sustainable living Attempting to create an economy that depends more on research than trade Significant corporate sponsorship and government investment Closed loop system International engagement through Israeli government 	<ul style="list-style-type: none"> Government promotion of food industry transformation Cooperative deal with Netherlands food valley Platform for collaboration between China and foreign countries in agri-food innovation

Name, Status & Country	Peel Business Park (Planned) Australia	Food Valley (Operational) Netherlands	World Horti Centre (Operational) Netherlands
Industry Focus	<ul style="list-style-type: none"> • Agri-Food • Agri-processing • Bio-industries 	<ul style="list-style-type: none"> • Agri-Food 	<ul style="list-style-type: none"> • Floriculture • Horticulture - food • Technical services
Year Founded	TBC	2004	Mar 2018
Funding source	Government and corporate	Cooperation between companies, knowledge and educational institutions and government	Initial funding by three foundational industry partners, plus finance bond holders and government support
Land size (including glasshouses)	1,000 ha	Not available	About ~ 22,000 sqm of total area including: <ul style="list-style-type: none"> • 4,000 sqm with 40 classrooms for 1,300 students • 6,500 sqm state of the art research facilities • 10,000 sqm business to business area
Sustainability focus			✓
Processing facility	✓		
Research farm / test labs	✓	✓	✓
Circular economy focus			
Co-working space	✓	✓	✓
Accelerator / Incubator		✓	✓
Insights for IIPH	<ul style="list-style-type: none"> • Highly connected precinct • Heavy reliance on connectivity and smart energy • Focus on transport and logistics leading to job creation • Planned capacity to support research and development 	<ul style="list-style-type: none"> • Works collaboratively with other agri-food hubs across The Netherlands • Dedicated start-up company pathways • Created food valley society to encourage collaboration and innovation • Focus on innovation and societal challenges 	<ul style="list-style-type: none"> • 270 co-working spaces, hackathons and purposefully designed buildings create start-up friendly environment • HortiHeroes incubator helps identify and develop entrepreneurs • Connection to education to drive talent growth • Strong focus on collaboration between private and public sector • Sustainable energy features • International engagement attracts 25,000 professional visitors each year

Name, Status & Country	Fresh Park Venlo - ZON Food Group (Operational) Netherlands	Flanders' Food cluster (Operational) Belgium	Andalusia region (Operational) Spain	Atlantic Sapphire (Planned) USA
Industry Focus	<ul style="list-style-type: none"> Food Fresh produce Processing and distribution of fresh food 	<ul style="list-style-type: none"> Agri-Food system Food production Customised food and nutrition Research projects in fresh produce, meat 	<ul style="list-style-type: none"> Agribusiness Traceability and Big Data 	<ul style="list-style-type: none"> Fish production and breeding (Salmon)
Year Founded	2000	2005	2017	2010
Funding source	Not available	Combination of Government and membership funding	Partnership models between public admin, universities and technology centres, private companies	Private placement and paid-in equity
Land size (including glasshouses)	<ul style="list-style-type: none"> 130 ha Private Food Park >25 ha Business space 5,400 ha Food And Logistics Centre >35 ha warehouses 	Not applicable	Not applicable	3.5 hectares planned facility
Sustainability focus		✓	✓	✓
Processing facility				✓
Research farm / test labs	✓	✓	✓	
Circular economy focus				
Co-working space	✓			
Accelerator / Incubator		✓		✓
Insights for IIPH	<ul style="list-style-type: none"> Offers space to small-sized businesses and established food companies Education and research institutions specialise in food and logistics Ideal location linking The Netherlands with the rest of Europe 	<ul style="list-style-type: none"> N/A – no in-depth case study completed. 	<ul style="list-style-type: none"> N/A – no in-depth case study completed. 	<ul style="list-style-type: none"> Uses modern technologies and circular economy principles Creation of renewable energy (biogas) using the waste generated

International education clusters – Summary

Table 7 2: Summary of selected, relevant education clusters

Name, Status & Country	University of Arizona USA	Wageningen university Netherlands	Research Triangle Park USA
R&D Focus	<ul style="list-style-type: none"> Establishment of Solar Zone Advanced sensing & climate control lab for sustainable CEA Wastewater treatment and alternative energy 	<ul style="list-style-type: none"> Establish centres to support developments in the field of big data and data science Develop programs focused on re-designing the engine of biological productivity 	<ul style="list-style-type: none"> Agricultural biotechnology research
Year Founded	1885	1918	1959
Funding source	Public	Public	Public
Cooperation	<ul style="list-style-type: none"> Academic partnerships Industry partnership with solar energy companies Collaboration with government departments 	<ul style="list-style-type: none"> Public-private partnerships Confidential contract research Partners range from scientific governmental agencies, academic and business partners, NGO's, Civil Society Organisations (CSO's) and citizens 	<ul style="list-style-type: none"> Funding from state and local governments, nearby universities, and local businesses Provides co-working spaces for ag-biotech companies
Takeaways for IIPH	<ul style="list-style-type: none"> Providers researchers with infrastructure and resources to impact local and state communities Academic, industrial and government partnerships Contribute to agribusiness research to drive development of public policy and economic growth 	<ul style="list-style-type: none"> Research focused on sustainability and animal welfare Conducts scientific research in health food and living environment domain Ideal location owing to concentration of leading research centres, both private and public Offers technologies and patents to organisations 	<ul style="list-style-type: none"> Friendly ecosystem for ag-related start-ups Facilitates research collaboration and promotes cooperation Accessibility to nearby research universities has led to growth of ag-biotech firms

Name, Status & Country	Food Innovation Network New Zealand	Washington State University USA	The Roslin Institute (University of Edinburgh) Scotland
R&D Focus	<ul style="list-style-type: none"> • Food and dairy products • New product development 	<ul style="list-style-type: none"> • Address issues and challenges related to sustainable health 	<ul style="list-style-type: none"> • Human and animal lifelong health and welfare • Animal science such as improving animal welfare and production traits
Year Founded	2011	1890	1993
Funding source		Public	Public
Cooperation	<ul style="list-style-type: none"> • Public-private partnerships • Partners include educational institutions, Government agencies, private agri-tech companies, legal companies 	<ul style="list-style-type: none"> • Partnership with Government agencies, National institutes such as National Institute of Health 	<ul style="list-style-type: none"> • Partnerships with academic units in the UK - Scotland's Rural College, Global Academy of Agriculture and Food Security • Industrial partnership - Agriculture, pharmaceuticals and genetics • Local community partnerships - Easter Bush Research Consortium and Midlothian science zone and council
Takeaways for IIPH	<ul style="list-style-type: none"> • Provide product development and process optimisation services • Solves problems for entrepreneurs • Assists exporters and manufactures • Middlemen between investors and organisations 	<ul style="list-style-type: none"> • Focused on research for sustainable resources and health • Provide online and offline courses • Assists researchers with patents • Provides space for start-ups to function and operate 	<ul style="list-style-type: none"> • Study complex animal systems to enhance human and animal lives • Works with breeding companies to improve agricultural productivity and welfare of animals

Table 7 3: Deep dive into utility services at exemplar precincts.

	Key insights	Applicability to the WSA IIPH
Electricity	<ul style="list-style-type: none"> • In the Netherlands, greenhouses are commonly powered by combined heat and power (CHP) plants, which produce electricity and heat simultaneously. • Due to the relatively high heat requirement in the Netherlands, the CHP plants typically run at a level that produces more electricity than required for operating the greenhouses. Any excess electricity is supplied to the national grid, which generates additional income for greenhouse operators. • These CHP plants typically run on natural gas from the gas grid, though the use of biogas as an alternative has begun to gain traction in the Netherlands. • CHP plants are either collectively or separately owned by the individual greenhouse operators. The private electricity networks within the precincts are more commonly co-owned by the participating greenhouse operators. 	<ul style="list-style-type: none"> • Due to the warmer climate, greenhouses at the WSA IIPH would have a higher electricity load but a smaller thermal load relative to the case studies. The extreme summer heat requires some form of cooling to be implemented, with evaporative cooling being a potential efficient option as suggested in the PPR. Evaporative cooling commonly runs on electricity. • For the WSA IIPH, it is important to consider the cost competitiveness of using CHP units to generate electricity relative to sourcing electricity from the grid, while in the case studies, electricity is largely considered a by-product of operating CHP plants to produce heat. • If the CHP option is pursued, there is a potential for the WSA IIPH not to connect to the electricity grid, which represents a significant capital savings opportunity. However, this would also eliminate the option for the precinct to export electricity to the grid. We note that in the Netherlands various schemes were deployed to incentivise the investment in CHP units, including a special feed-in tariff for CHP electricity. In the case of the WSA IIPH, any excess electricity exported to the grid from the WSA IIPH would be treated under the general feed-in tariff scheme, in which the tariff rate has declined dramatically over the last few years , • As CHP plants typically run on natural gas, it is likely that the precinct would require a connection to the gas grid.
Heating	<ul style="list-style-type: none"> • CHP plants are commonly used to produce heat for greenhouses in the Netherlands. • More recently, some agri-precincts, such as A7 and Trias Westland, have invested in geothermal plants, which circulate hot water pumped from the ground to provide district heating. The use of renewable geothermal energy has led to a decline in the reliance on CHPs for heat. 	<ul style="list-style-type: none"> • Due to the warmer climate, greenhouses at the WSA IIPH are not expected to require as much heat to operate. • CHP or heating boiler plants could be deployed to provide heat to the greenhouses. More detailed technical analysis is required to tests the feasibility of geothermal at WSA. It is noted that less heating is required at the IIPH than agri-precincts in the Netherlands. We also note that the use of geothermal in the Netherlands is mainly for heating rather than cooling purposes. While the use of geothermal for cooling is possible, it is generally considered not as efficient, particularly in the context of greenhouses where more suitable cooling methods/technologies (such as evaporative cooling) are available. • As CHP and heating boilers typically run on natural gas, it is likely that the precinct would require a connection to the gas grid.

Key insights	Applicability to the WSA IIPH
CO ₂	<ul style="list-style-type: none"> Greenhouses use CO₂ emission from the CHP and heating boiler units to optimise photosynthesis and increase crop yields. The reduced reliance on CHP plants for heat has led to agri-precincts in the Netherlands seeking alternative source for CO₂. An agri-precinct in Westland, Netherland has a CO₂pipeline originated from a nearby oil refinery.
Water	<ul style="list-style-type: none"> Rainwater is typically harvested and used as irrigation water for greenhouses, supplemented with water from the grid. In the Netherlands, participating greenhouses at agri-precincts typically co-fund the rainwater harvesting system. In Europe, increasingly aquaculture farms have been developed in close proximity to greenhouses, a concept commonly known as aquaponics. Nutrient-rich waste water from aquaculture is used to irrigate greenhouses, while the aquaculture farms benefit from the heat and electricity from the greenhouses. ECF aquaponic system, which has been commercially deployed over a number of sites across Europe, represents an interesting case study.
Waste	<ul style="list-style-type: none"> Agri-precincts in the Netherlands are actively exploring the potential of harvesting biogas from green waste and general waste produced within the precincts or sourced externally. Biopark Terneuzen in Zeeland, Netherlands, represents one of the more successful cases of an integrated waste strategy. A key piece of infrastructure at Biopark Terneuze is the two-kilometre pipeline that transports CO₂and hot water (harvested from waste heat) within the precinct. Also, biomass produced from greenhouses is supplied to the on-site biomass power plant, which supplies heat, energy and CO₂to the greenhouses at a competitive price. The successful integrated waste strategy at Biopark Terneuzen shows that clustering creates benefits for all participating entities in the form of lower costs as well as lower environmental emissions.

Key elements 09 of an IIPH



8.1 Land suitable for safe development with good access and future growth

A number of parcels of lands have been identified that are considered appropriate for the development of an IIPH based on the below criteria:

- the size the land parcel will be between 250 ha and 500 ha allowing room for expansion to up to 800 ha;
- connection to current or future road and rail infrastructure;
- topography of the land should be suitable for building greenhouse style infrastructure and production facilities;
- minimise the number of land owners to enable ease of acquisition or development;
- connection to current or future utilities (energy, waste and water);
- located adjacent or close to the freight and logistics precinct;
- zoning must not be residential; and
- the land (and potential uses) should be able to meet airport safeguarding guidelines.

Each of these criteria are explored in detail in the following sub-sections.

Specific details regarding suitable locations for the Integrated Intensive Production Hub are considered to be commercially confidential at this stage and are therefore not described in detail in this report

8.1.1 Land size 250-500 ha with room for expansion

8.1.1.1 Agriculture and Agribusiness Precinct land

The original area of the Agriculture and Agribusiness Precinct land as identified in the LUIP was examined using the NearMap mapping tool, showing an approximate area of the whole precinct of 2,400 ha.

The precinct is made up of five main groupings:

- the land to the north of Luddenham with an approximate area of 740 ha;
- Luddenham town centre;
- land south of Luddenham but in the middle of the precinct adjacent the mooted freight and logistics/entry to the airport – approximately 250 ha
- land in the middle/south owned by Leppington Pastoral Company – approximately 527 ha; and
- land to the south made up of approximately 220 parcels of land (some land owners own multiple lots) with an approximate area of 650 ha.
- while there are some constraints as identified by the other criteria below, the precinct passes the initial test of the provision of 250 to 500 ha of land with the potential for future expansion to 800 ha.

The methodology for identification of suitable land was as follows.

8.1.1.2 Other suitable land

The potential area is not limited to the land as shown on the LUIP Structure Plan mapping. Identification of other land which might be suitable for the IIPH has been carried out using:

- proprietary mapping and aerial photography tool NearMap;
- NSW State Government property identification site SixMaps;
- Department of Planning and Environment (DPE) Portal;
- proprietary property database Corlogic (RPData);
- maps in the *Western Sydney Aerotropolis – LUIP*; and
- external site inspections have also taken place.

Land outside the current boundary of the Agriculture and Agribusiness Precinct has also been identified in this study. The total gross quantum of land identified is approximately 2,700 ha. It should be noted that this land is located to the South West, West and North West of the current site boundaries. It excludes land earmarked for residential development within the next 12-24 months.

Planning maps and figures have been provided in *Appendix 14*.

8.1.2 Connection to current or future road and rail infrastructure

The criteria for location appropriateness includes a consideration of access to the airport and road and rail infrastructure.

Current road infrastructure is in the process of being upgraded. This includes The Northern Road from Peter Brock Drive in the south to Glenmore Parkway in the north. This upgrade runs along the western side of the WSA precinct between the airport and proposed Agriculture and Agribusiness Precinct. Other land which has been identified is not as accessible. Access to Roads and Maritime Services (RMS) information shows limited further road upgrades or additions around the outskirts of the Agriculture and Agribusiness Precinct. This is not to say access does not exist (and internal roads will be constructed during development of the land) but local roads are inadequate and will be required to be upgraded to accommodate the types of high intensity development envisaged.

Future transport initiatives proposed by RMS will ensure good access to transport (road and rail) will be provided.

The November 2018 RMS presentation - *Aerotropolis Roads – Planning and Construction* outlines future projects which will benefit the Agriculture and Agribusiness Precinct will include:

- Outer Sydney orbital from Great Western Highway to Aerotropolis (10-20 years), provides a provision for the M9 motorway and a freight rail line

- M5 motorway extension from Liverpool to Outer Sydney Orbital (20+ years)
- Outer Sydney Orbital from Aerotropolis to Hume Motorway (20+ years).
- No rail is planned for the western portion of the Aerotropolis at present.

The main beneficiaries to the dual roads (The Northern Road and Outer Sydney Orbital) is both the agricultural land already earmarked for the precinct as well as the additional land identified by this study.

8.1.3 Topography of the land should be suitable.

In order to deliver the stated goal of the IIPH, to be a world-class precinct, the land must be suitable for the purpose.

In discussions with agricultural specialist stakeholders it is evident that the quality of land would not be suitable for the extensive growing of agricultural produce or grazing, but rather it would be suitable for the support of high-clearance greenhouse structures, administration buildings, cold storage and general warehousing purposes.

While it is evident that land should be able to be levelled to support the structures the cut and fill nature of modern construction techniques will enable land to be developed as long as severe topography does not prevent it. Further, there are a number of water courses through the selected site and environs which might prevent development in some areas.

Depending on the hub's final location, there may be a need to consider biodiversity values, for example, the presence of remnant vegetation on IIPH land could trigger offsetting requirements under state and federal environmental laws. The DPE is preparing a strategic biodiversity certification for Western Sydney growth areas and depending on the site selected, there may be an opportunity to align with this process.

Some of the main sites have been inspected and with development expertise and observance of the amount of cut and fill large industrial sites further north and east at Huntingwood, Ingleburn and Smeaton Grange can sustain and remain viable, it is considered the topography in the main is suitable.

The amount of poor terrain and water courses is more prevalent to the south and south west of the main Agriculture and Agribusiness Precinct site as shown in the topographical mapping of the State Government Six Maps shows.

8.1.4 Minimise the number of land owners.

The purpose of this criterion is to enable faster more orderly development of the land. This is achieved with greater speed, efficiency and cost when large land owners are involved over smaller parcels. It is commonly held that a smaller parcel of land will enjoy

a higher rate per ha to purchase than a larger lot. Therefore over a wide area it creates superior viability of an enterprise or development to develop large parcels.

It is well recognised the area to the South of the precinct contains approximately 220 lots of land with many individual land owners. On the other hand Leppington Pastoral Company owns approximately three large lots for a slightly smaller area (650 ha vs. 527 ha).

Notwithstanding a number of different land owners it is still possible to develop multiple lot land on the proviso the land owners group together as one in order to negotiate a sale. As long as the use of the land is higher and better than the current use this might be viable. However larger land parcels may provide a superior outcome.

Using mapping tools and land identification software large land holdings in sufficient numbers have been identified in all areas of the Agriculture and Agribusiness Precinct and IIPH with the exception of the southern portion and the Luddenham town centre.

8.1.5 Connection to current or future utilities

Access to water, sewage, drainage, power, gas and telecommunications cabling is vital to the success of the agricultural enterprises.

The efficient creation of economies of scale around the utilities lies in the close proximity of the enterprises who use them. Multiple different enterprises will be grouped around areas such as the main entrance of the logistics and freight entrance on the mid/east portion of the IIPH, Luddenham town centre, or North Luddenham around the flexible employment land and south east adjacent to the Aerotropolis core. The shape of the whole IIPH as identified allows relatively easy access to these points.

It is of course not certain where these utilities will be placed, however once it has been recognised these services are required, the market (developers and investors) will ensure to protect the viability of their investment that sufficient costs are built into feasibilities to ensure utilities are available.

This will affect the value of the land, however the expected better use the IIPH and its associated enterprises may assist in the ability for the developer or investor to pay more.

The further the identified land is from the main centres the greater the pressure is to provide self-developed services. New methods of the delivery of utilities by developers and specialised companies are bringing these costs down.

At this stage it is not possible to say with certainty the Agriculture and Agribusiness Precinct land will be located close to utilities however the earlier it is

planned, and given its location to airport and other main centres, the likelihood is high.

8.1.6 Located adjacent or close to the freight and logistic precinct

The initial precinct planning document shows the Agriculture and Agribusiness Precinct to be adjacent the Airport Freight and Logistics precinct.

As referenced above in the roads discussion the upgrade of The Northern Road and future construction of the Western Orbital will enable land further removed to be nevertheless close in delivery time. Off-ramps to the Orbital are being planned, crossroads and access to The Northern Road are direct.

Land identified outside the current precinct will not enjoy the same access however new internal roads will be designed to provide wide access to the appropriate vehicles. Land values will reflect superior or inferior access and it might be that activities not requiring immediate close access will benefit from being more remote.

8.1.7 Consider zoning of land

Planning controls determine the uses to which land may be put. Through the method of placing land zoning on land in a carefully considered set of planning instruments the orderly and effective future development of land can take place.

The current planning controls over the Agriculture and Agribusiness Precinct land is controlled by two Local Government Councils being Liverpool (for the majority of the land), and Penrith. The land zoning varies from Rural (dominant zone) through to Large Lot Residential, Low Density Residential, Village (Luddenham) and Public Recreation.

The DPE is conducting intensive land use planning and planning controls investigations to ensure the expected uses of the Agriculture and Agribusiness Precinct land are appropriate to the planning controls.

It is expected that changes to planning controls will enable a more intensive and industry-targeted use of the land to be able to achieve the stated goals of the IIPH.

While it is premature and not in the scope of this report to conduct feasibility studies into the viability of enterprises to be put to the Agriculture and Agribusiness Precinct land experience tells us that land zoned for residential and village/business uses are a higher and better use than that considered for the agribusiness land uses.

Higher and best use is a term and study which leads to the determination that different planning controls related to a higher value than other controls.

Residential planning controls, and in particular low density controls command a higher land value than rural and as such the purchaser of the land will

struggle to create a financially viable basis for an enterprise. Land identified outside the Agriculture and Agribusiness Precinct is not zoned residential and remains suitable for agricultural and agribusiness uses.

There is a planning proposal to rezone land to the south of the precinct (in Camden Council to the south of Greenland Road but east of the University of Sydney land) to residential in the near future and has not been considered as suitable. Therefore after taking residential land into consideration, there remains enough land identified as being suitable for agricultural and IIPH uses both in the current precinct and outside it.

8.1.8 The land (and potential uses) should be able to meet the various airport safeguarding guidelines

An important consideration is to ensure any of the uses considered to meet the goal can be provided on some portion of the land so as to meet any of the restrictions or guidelines under the Australian Government's Department of Infrastructure and Regional Development National Airports Safeguarding Framework. Guidelines A to I have been considered where appropriate as follows.

1) Airport Noise Impact:

- Most information to inform this advice has been drawn from the Western Sydney Airport – Environmental Impact Statement – Volume 2. At Figures 10-8 and 10-9 – *ANEC contours for Prefer 05 (and Prefer 23) operating strategy (2030)* the contours show ANEC levels over the existing Precinct to be between 25-30 (coloured green) and 20-25 (blue). The types of uses conditionally acceptable for this level of noise are listed at *Table 10-2 – Building Site Acceptability Based on ANEF zone* as Commercial Building, light industrial and other industrial.
- It should be noted that only a small area of land relative to the whole Precinct is affected by these noise levels and aircraft noise is not a factor to significantly reduce the available potential land.
- It is acknowledged that the NSW Government does not endorse the use of Guideline A for land use planning decisions, due to the lack of scientific rigour around N contours. Instead the Department of Planning and Environment uses ANEC/ANEF contours for land use planning decisions.

2) Building Generalised Windshield's Turbulence:

- Not relevant at this stage, will become relevant during business case

3) Manage the risk of wildlife:

- Framework C states many existing airports are surrounded by areas that are attractive to wildlife, especially birds, but appropriate land use planning decisions and the way in which existing land use is managed in the vicinity of airports can significantly reduce the risk of wildlife hazards. Discussions with agricultural specialists in the course of this study reveal that modern glasshouse construction (the dominant use to be put to the land) is such that bird access is very limited and as such may serve to reduce wildlife hazards. Further consideration to these requirements will be required if semi open production techniques are adopted, for example with blueberries.
- Other wildlife would be evident in this area but with more intensive development will reduce in much the same way as it would reduce in any redevelopment scenario.
- The planning consideration will need to be incorporated into the design and management of waste material on site to ensure the risk of wildlife is minimised.

4) Guideline on wind turbines:

- Not relevant

5) Distraction from lighting:

- Agriculture specialists consulted for this report advise this will not be relevant to the IIPH. While glasshouses will generate reflections, the risk can be mitigated through the provision of non-reflective materials and the correct positioning of glasshouses to reduce any other reflection given the preferred flight paths. Subsequent research will need to consider the cost implications of incorporating non-reflective materials in glass house construction and any adjustments in positions of glasshouses on changes in productive (if any) on the selected site.

6) Protected Airspace:

- In discussions with agricultural specialists the potential maximum height of modern glasshouses at eight (8) metres will not impact on aircraft operations. Other buildings such as warehousing can be built to heights over eight metres but there is sufficient room on the current Precinct land and other identified land to ensure the position of any higher warehousing does not impact aircraft.

7) Protected Navigations and Communications:

- Not relevant at this stage, as location of navigation and communication equipment has not been determined. His guideline also includes consideration of Helicopter Landing sites but is not relevant at this stage.

8) Public Safety Areas:

- Depending on location selection this may be relevant and require further analysis.

Key elements 09 of an IIPH



9.1 Products that could be included

9.1.1 World leading, innovative production of food

The current production of agricultural goods across the Aerotropolis region varies, from larger scale operations such as beef, dairy, poultry, egg production and turf nurseries to small, market style gardens and low-tech horticulture. The eastern side of the region is more densely populated with residential and mixed industry, while the western side is associated with these different types of agricultural production.

To provide a more targeted and clear value proposition on the IIPH, insights from the leading work completed in the *PPR*¹⁸, case study exemplar agri-precincts, internal and external stakeholder consultations and industry knowledge helped to determine that the most likely activities to include in the IIPH would be horticultural production (protected and intensive) of certain vegetables, certain berries and potentially aquaculture and floriculture.

The seven activities investigated in detail were:

1. Tomatoes –specifically truss tomatoes and snack tomatoes;
2. Capsicums;
3. Berries –specifically blueberries;
4. Leafy Greens – specifically baby greens such as mixed lettuces, baby spinach and rocket as well as herbs and kale;
5. Mushrooms – fresh;

6. Aquaculture – specifically salmon, trout, abalone and prawns (where possible King Prawns); and
7. Floriculture – specifically cut ornamental flowers.

Of these activities, an assessment was taken to understand their current production in the Aerotropolis. Reflecting the approach taken in the *PPR*, each region within the Aerotropolis was assessed for the current agricultural production by both value, area and volume. The areas examined included the Local Government Areas (LGAs) of Mulgoa, Luddenham, Orchard Hills, Horsley Park, Kemps Creek, Badgerys’s Creek, Greendale, Cobbitty and Leppington. These LGAs are either within the bounds of the Aerotropolis itself or are located nearby. This was coupled with an investigation into national production and value, current export value and destination markets, future demand for the products both domestically and internationally, competition from international markets for the same products, considerations for production, investment and technology and finally market access requirements.

An overview on each of these activities is provided in Table 9-1. While all seven activities are plausible inclusions there is variation in the likely investment required, overall productivity, scale-up and value capture that each could generate based on demand, supply, export considerations and market access. The full assessments on the seven activities can be found in *Appendix 15*.

These activities are considered as examples for the purpose of analysis and do not reflect any form of recommendation in regards to the type of crop or aquaculture activity to consider for the IIPH.

Table 9-1: Overview of activities that could be considered viable in the IIPH

Activity	Activity Overview
Tomatoes	<ul style="list-style-type: none"> • Tomatoes are commonly grown in glasshouse production systems. • Snack tomatoes and truss tomatoes amongst others could be considered for the IIPH. • The snack tomato markets are generally valued higher than the traditional truss tomato domestically and internationally. • There is strong domestic demand for tomatoes, and a high export demand. • It is noted that market access issues and technical barriers to trade can impede export in some instances, particularly relating to the risk of fruit fly.
Capsicums	<ul style="list-style-type: none"> • Capsicums are commonly grown in glasshouse production systems. • Domestic demand outstrips domestic supply, with Australia currently being a net importer of capsicums. • Increased production of capsicums at the IIPH is likely to supply the domestic market in the first instance.

¹⁸ Agrolgy, 2018, Production Possibilities Report

Activity	Activity Overview
Blueberries	<ul style="list-style-type: none"> Blueberries are well suited to intensive production systems, such as tunnels, requiring less energy than a full greenhouse. There is significant demand domestically and internationally for blueberries. The association of blueberries with superfood status has led to an increase in their consumption over recent years. Australian blueberries have market access issues in key high demand countries. Technological improvements in blueberry production are currently increasing their productivity significantly. Blueberries should continue to be considered as a potential inclusion in the IIPH.
Leafy Greens (including rocket, leaves, baby salads, leafy Asian vegetables, micro-herbs and kale)	<ul style="list-style-type: none"> Leafy greens are well suited to intensive production systems. Leafy greens are in high demand domestically and internationally. Leafy greens have a high yield per square metre, they can be grown continuously and consistently at high volumes in small areas. The value of Asian greens in particular must be further analysed to understand their export potential. The co-location of the IIPH with downstream value chain participants such as food processing, freight and logistics (and ultimately direct airside access), may be a key benefit for leafy greens as these products can be highly perishable. Notably there is a distinct benefit of producing leafy greens in combination with aquaculture in a facility such as the IIPH as they both support each other's production in a closed loop or circular system.
Mushrooms	<ul style="list-style-type: none"> Mushrooms are well-adapted to indoor, intensive production systems Mushrooms are highly perishable, and downstream processing prior to export on-site at the IIPH should be considered to preserve quality. Mushroom demand domestically and internationally is the lowest of all products considered in this report Circular economy opportunities may exist for mushrooms, with green waste from the production of other crops being used as manure substrate for mushrooms in an IIPH.
Aquaculture (including king prawns, trout, salmon and abalone, lobster) <i>See additional insights in 16 Appendix: Insights on aquaculture.</i>	<ul style="list-style-type: none"> Aquaculture is well suited to intensive production systems. Australian product is in high demand in export markets due to its "clean" status. On-shore recirculating aquaculture systems (RAS) could be considered at the IIPH. These require significant capital to establish (and in some instances, the production technology is not yet fully commercialised e.g. rock lobster). Developments in this area are underway however, exemplar facilities are being constructed and operationalised internationally that could be mirrored at the IIPH. Further cost benefit analysis should be undertaken to understand the profitability of aquaculture; whilst the end product is high value the capital and operational costs associated with production are significantly higher than for other horticultural products. There may be an opportunity to partner with research and development organisations to develop on-shore production systems at the IIPH to produce high value aquaculture for example king prawns, abalone and lobster. Recirculating aquaculture systems can be co-located with leafy green production systems as described above.
Cut Flowers	<ul style="list-style-type: none"> Cut flowers could be a viable inclusion in the IIPH, however establishing a commercial quantity, leveraging innovative production technology (e.g. from facilities in the Netherlands) and minimising costs will be vital to the success of this activity. There is not a significant amount of unmet demand for Australian product internationally; the Netherlands, South America and Africa all have very large and well-established industries. These may be opportunities to produce 'lesser-known' flowers or even native varieties in bulk quantities that can command high premium prices due to their uniqueness in export market, however more analysis is required. The export of these native flowers may create some biosecurity and quarantine issues, these would need to be better understood to fully consider their inclusion in the IIPH.

Other opportunities

Native Bush Foods

There are emerging opportunities to capture a growing market for native foods (e.g. bush foods). In particular, demand is growing for native fruits and vegetables as niche, high-end and high-value goods. Domestically, consumers associate native food with a sense of pride and identity, while for international consumers native foods are a source of nutrition, flavour and colour that are unique and valued.¹⁹ Horticulture Innovation Australia Limited recently investigated a number of native foods that could be possibly be produced on a large scale, including:

- Kulyu – a similar vegetable to a sweet potato;
- Saltbush – when dried can be used as a seasoning;
- Samphire – a native succulent that is commonly referred to as sea asparagus;
- Warrigal greens – native Australian leafy greens, with a peppery finish unlike normal baby spinach or rocket leaves;
- Youlk – an Australian root vegetable;
- Acacia seed – a seasoning that tastes like nuts, chocolate and coffee;
- Finger lime – tart, zesty pulp typically used as a garnish;
- Bush tomato – a tangy fruit that is often dried and powdered;
- Lemon Myrtle – dried leaves smell like citrus;
- Native Thyme – similar to Italian thyme; and
- Pepperberry – dried and used as a pepper spice which colours dishes.²⁰

Before pursuing the inclusion of native foods in an IIPH, more research would need to be done about their production at a commercial scale, as this has not occurred before. There needs to be a greater understanding of future consumption and better communication and promotion of these foods to ensure their production is viable for an end consumer.

9.1.2 Export potential

Critical to the success of the IIPH and any activities that could feasibly be included in the IIPH (for example those outlined above) will be the products' export potential. It is likely that the inclusion of any product in the IIPH will increase the current volumes of marketable goods significantly. To minimise the impact of these new volumes on the domestic market, and ideally to capture higher value export goods from countries with high food demand and desire for Australian produce, access to export markets will be critical. This is not necessarily physical access, as the WSA itself creates physical connectivity to these markets. For example, the IIPH should be designed to be connected into the freight and logistics hub of the Aerotropolis, and then airside,

creating seamless movement of goods from the IIPH itself to aircraft for movement overseas. Instead, export market access is governed by technical barriers to trade (such as protocol governed markets, import licence requirements, phytosanitary considerations and customs) and through tariffs, quotas or safeguards.

Securing market access is difficult. Levy-paying industry sectors tend to have more sway into generating market access, than those that don't. For example, tomato growers don't pay a levy, and may find the ability to seek market access more difficult, instead they better benefit off inbound buyer trade. While there has been a shift away from trends that the loudest voice is best heard, however the process for seeking market access is still arduous. As an example, for horticultural goods:

- This is coordinated through Horticulture Innovation Australia Limited's Trade Unit (the Unit), which represents the industry to establish new target-market access and improve current market access (e.g. through greater research and development);²¹
- The Unit is advised by an Assessments Panel and an Industry Advisory Panel;
- These panels and the Unit combine to provide advice and guidance on trade to the Department of Agriculture and Water Resources (DAWR); and
- The Unit then works with DAWR and the National Plant Protection Organisation (NPPO) to prioritise and secure market access and improvements based on 'evidence based, export-ready industry sector proposals'.

Applications are assessed based on economic potential, technical market requirements (and capacity to meet these), sustainable market growth opportunities and the export industry's ability to support continued to trade into the future. They are then ranked with high priority assessments progressed 'as soon as resources allow', and low priority assessments either being promoted to the higher priority category, or cancelled within three years.²² The overall process can take more than five years to complete (each time an assessment is evaluated and re-prioritised it doesn't need to be acted upon for an additional three years) and is a risk in planning the IIPH and prioritising options.²³ For example, stakeholders engaged throughout report preparation indicated that the current market access protocol assessments were taking an average of 10.5 years to complete.

For products proposed as feasible inclusions in the IIPH, Table 9-2 outlines the current market access and trade considerations required for each product at a high level (detailed requirements would be country specific). More detailed information on this can be found in *Appendix 15*.

¹⁹ Horticulture Innovation Australia, 2017, Realising the potential of native foods

²⁰ Horticulture Innovation Australia, 2017, Realising the potential of native foods

²¹ Horticulture Innovation Australia, 2018, Trade and market access

²² Horticulture Innovation Australia, 2016 Trade Assessments Panel, Assessment and prioritisation process

²³ Horticulture Innovation Australia, 2016 Trade Assessments Panel, Assessment and prioritisation process

Table 9-2: Market access considerations for products that could be included in the IIPH

Activity	Market Access – import permits, phytosanitary certificates, other declarations etc.	Tariffs
Tomatoes	<p>Import Permits required in most countries, evidence of freedom from fruit fly (generally in a certificate of conformity) and a phytosanitary certificate required.</p> <p>Market access protocols not approved/restricted for China, Japan, South Korea, Thailand and Vietnam</p>	<p>Some trade tariffs are still in place (e.g. Indonesia – four per cent) however in the majority of proximal export markets these are declining or already at zero.</p>
Leafy Greens	<p>Australia is largely supplying free trade markets with simple protocol arrangements (e.g. Malaysia, Singapore and Hong Kong). Thailand and the UAE do require phytosanitary certificates to be issued.</p> <p>Of markets not currently supplied, these typically also require phytosanitary certificates and, in some instances, additional information declaring freedom from certain pests and diseases/viruses.</p>	<p>Tariff barriers are minimal in most Asian countries due to FTAs; some market access restricted countries do have tariffs however these are being phased out (e.g. China).</p>
Capsicums	<p>Phytosanitary certificates and import certificates generally required.</p> <p>It should be noted that production region exclusions are in place in some markets; for example exports to Japan and Malaysia are only being accepted from Tasmania. Some markets are still completely restricted, e.g. Thailand and China.</p>	<p>Tariff barriers are minimal in most Asian countries due to FTAs, some market access restricted countries do have tariffs however these are being phased out (e.g. China).</p>
Mushrooms	<p>Current export markets are all free trade markets, with export requirements typically only import permits, phytosanitary certificates and EXDOC endorsements.</p> <p>Unmet demand markets, these are also largely protocol free markets.</p> <p>Notably, although not a country with high unmet demand, China does have protocol requirements in place; should this market be established then a protocol would need to be arranged.</p>	<p>Tariff barriers are non-existent in most current export markets due to FTAs.</p>
Blueberries	<p>Majority of current export markets are protocol-free markets. Certificates of origin and/or phytosanitary certificates are still generally required. Where protocol markets are established these are generally focussed on fruit fly treatment requirements (this is done with methyl bromide fumigation or cold-treatment typically).</p> <p>High unmet demand markets however (in particular China, Japan) are still protocol markets, with strict access restrictions. Blueberries were added to the protocol access development list in 2017.</p>	<p>Tariff barriers are non-existent in most current export markets due to FTAs.</p>

Activity	Market Access – import permits, phytosanitary certificates, other declarations etc.	Tariffs
Aquaculture	<p>DAWR exporter registration, Health (FX46KR)/Sanitary Certificate, registration with in-country quarantine providers, in some instances an Australian Quarantine Inspection Service certificate may also be required. Food products (e.g. pre-cooked seafood) will require labels to be translated into the market’s language.</p> <p>Typically seafood products entering the Asian markets require proof that produce doesn’t contain heavy metals, anaesthetics, antibiotics etc.</p>	Largely eliminated for most Asian countries under FTAs.
Floriculture	<p>Interestingly cut flowers have the most facilitated path to export market of the products that could be considered in the IIPH. For example, import permits and phytosanitary certificates are not necessarily required for majority of current export market countries (note: they are in the US).</p> <p>Some countries where Australia is not currently exporting, but may in the future e.g. the EU, do require phytosanitary certificates.</p> <p>It should be noted that Australian native flowers are an exception to this, and will always require export permits from the Department of Environment.</p>	Tariffs on cut flowers are in place in Korea, other markets generally have no tariff requirements.
Native Foods	Given the current size and scale of the Native Food market, market access is likely to remain restricted. However, support through the ‘Package Assisting Small Exporters’ program by DAWR has helped move certain products into market, but this program doesn’t necessarily create long-term sustainable market access, nor does it guarantee large supply.	The tariffs on native foods was undiscernible due to current sporadic and low volume export quantities.

Source: AusTrade, DFAT, HIA and MiCORr; see appendix 16 for more information.

9.2 Infrastructure, utilities and waste

9.2.1 Preliminary estimates of resource requirements

The resource requirements in line with the suggested production activities have been estimated for the IIPH. The table below provides a breakdown of the indicative resource requirements estimated at this stage (data are provided per annum at full capacity – year 10).

Table 9 3: Resource requirements for the 250 ha and 500 ha scenario – Average per annum

Resource	Estimated quantity per annum		Comments
	250 ha	500 ha	
Electricity	14,000 MWh	27,500 MWh	Estimation for both productive and non-productive areas
Gas	880,000 GJ	1,721,000 GJ	Estimates are based purely on heating requirements. Gas required may be doubled if gas generators are used to provide electricity to power the precinct.
Water	2,070 ML	4,050 ML	Total water (potable quality) requirement for crop water and humidification and cooling.
Waste water	From 135 ML to 185 ML	From 265 ML to 360 ML	Estimations vary depending on technology application. Waste water would vary based on the crop and technology used (some activities may run waste water in the environment).
Green waste	14,164 tonnes	27,712 tonnes	Wet waste
Other solid waste	16,325 tonnes	31,941 tonnes	Wet waste

Source: KPMG with Agrology input.

9.2.2 Base and innovation cases for utilities

The utilities analysis was based on two potential options for the WSA IIPH: a “base case” option that draws on traditional shared infrastructure solutions, and an “innovative” option that considers alternative, more coordinated and sustainable ways in which the needs of the IIPH can be met.

The innovative solution was further augmented through stakeholder consultations and a workshop where it can be considered to reflect a shared vision and aspiration for the scope, operation and performance of a world-class agribusiness IIPH.

Both scenarios are outlined in the figures below. The rest of this section will detail each key component.

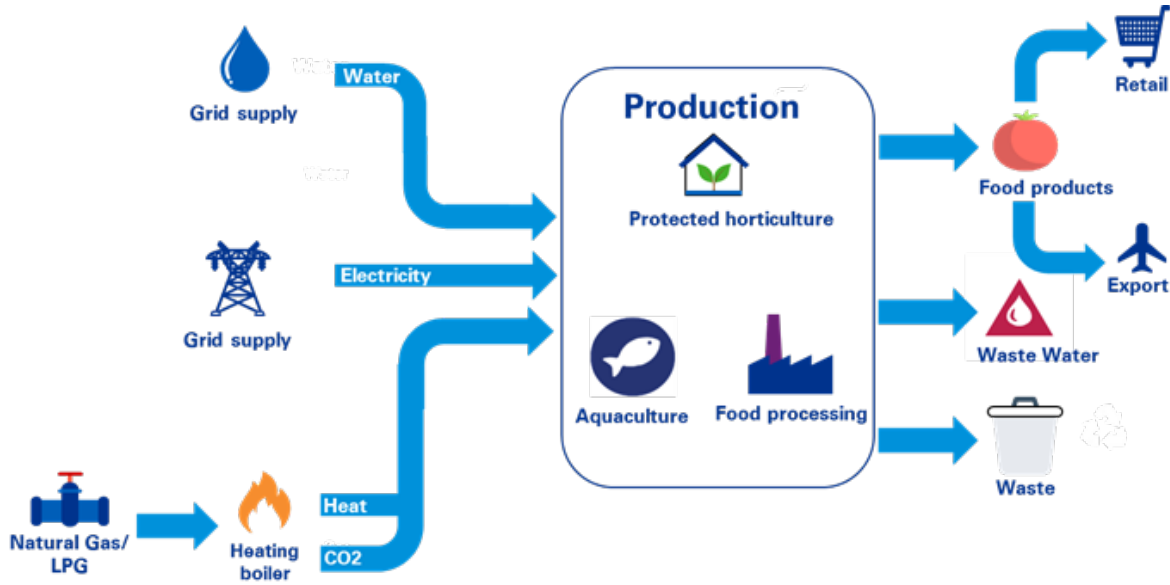


Figure 3: Base Case

Under the base case, there is no onsite optimisation of energy, waste and water usage, whereas the innovation case would seek to integrate across respective utility services to maximise circular economy outcomes.

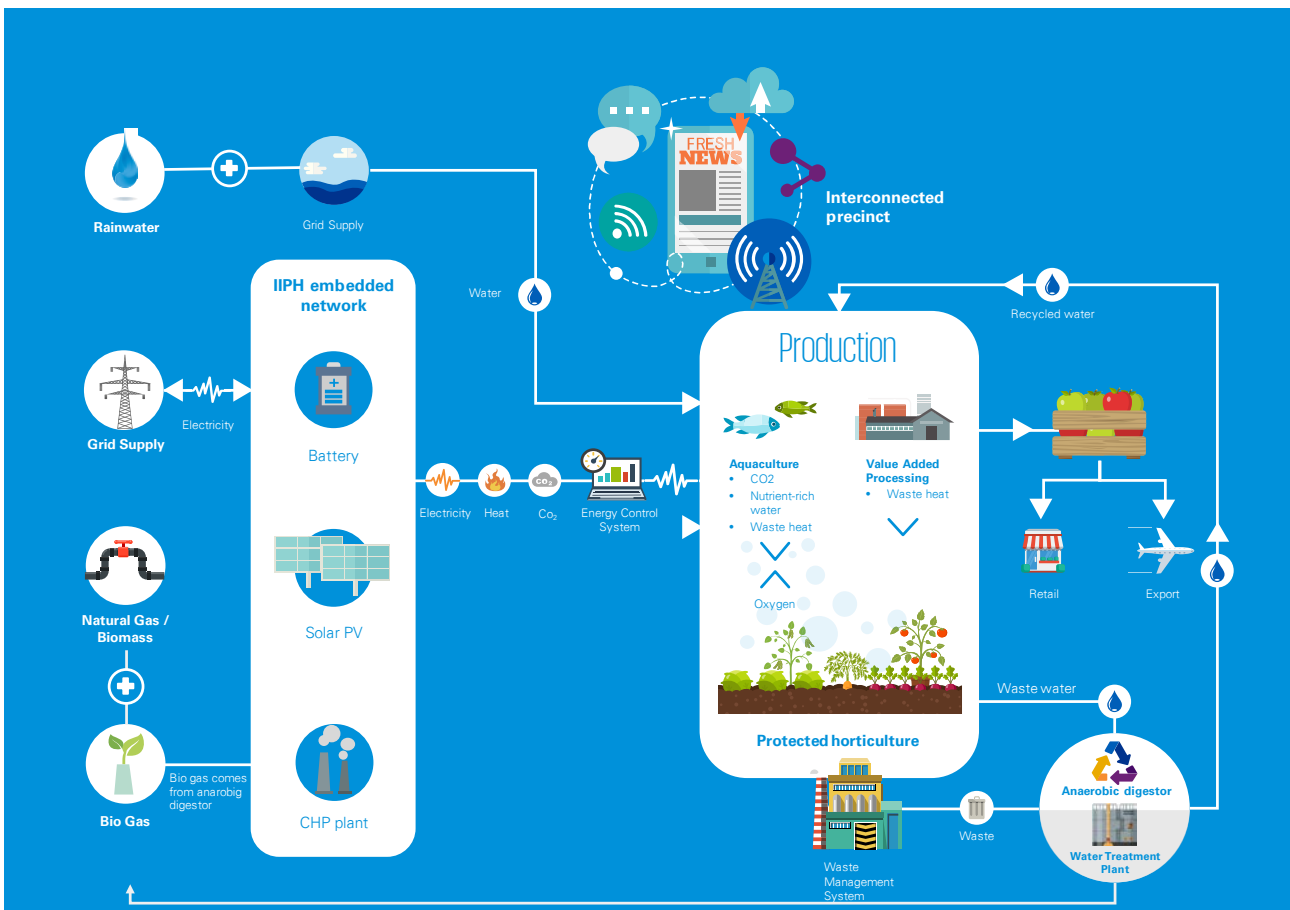


Figure 4: Innovation Case

9.2.3 Electricity

9.2.3.1 Base case

Under the base case, the IIPH would connect to the electricity distribution network. Electricity is distributed across the IIPH via a private local electricity network ("embedded network") from the connection point where Endeavour Energy's infrastructure ends. Tenants in the IIPH could either negotiate their own electricity supply contracts with electricity retailers, or an entity with a retailer authorisation or exemption could negotiate supply with a retailer and on-sell electricity to the tenants.

9.2.3.2 Insights from case studies

In the Netherlands, greenhouses in agri-precincts are commonly powered by CHP plants. CHP plants are either collectively or separately owned by the individual greenhouse operators. The private electricity networks within the precincts are more commonly co-owned by the participating greenhouse operators.

CHP plants provide three key inputs required for greenhouses: electricity, heat and CO². Due to the relatively high heat requirement in the Netherlands, the CHP plants typically run at a level that produces more electricity than required for operating the greenhouses. Any excess electricity is supplied to the national grid, which generates additional income for greenhouse operators. At A7, the greenhouse operators and Microsoft have an agreement for its data centre facilities to be supplied with the electricity from the CHP plants. Microsoft is able to save on their electricity network charges as electricity is sourced behind-the-meter.²⁴

While natural gas from the gas grid remains the most common fuel for CHPs, agri-precincts in the Netherlands have started to explore the harvesting of biogas as an alternative.

9.2.3.3 Innovative case and key considerations

Onsite generation with a combination of centralised CHP plants and rooftop solar is a potential option for the WSA IIPH. This option is likely to still require a connection to the regional electricity distribution network, though the connection size may be much smaller relative to the base case, depending on the expected role of the connection (it could be the case that the connection is only used for backup purposes). A grid connection would allow the IIPH to sell excess electricity back to the grid. Battery is also a potential component to provide redundancy to the electricity system in the IIPH. As CHP plants typically run on natural gas, it is likely that the IIPH would require a connection to the gas grid (refer to the section on gas for more detail). Once the requirements are better defined, regulatory issues will need to be further explored.

Further analysis will be required on the economics of CHP plants in the context of the IIPH given the climate differences between Western Sydney and the Netherlands. Semi-closed greenhouses, which have been identified as a potential protected horticulture system for growing tomatoes in Western Sydney given the warmer climate, use more electricity (for evaporative cooling) but less heating than the conventional greenhouses in the Netherlands.

In addition, there are seasonal variations in the heating and electricity requirements of greenhouses. The use of electricity is expected to peak in summer months, though electricity demand over the year is still relatively flat (around 10 to 15 per cent variation between winter and summer). On the flip side, the heating requirements of greenhouses would peak in winter months. In this context, as part of the energy solution it is important to consider the energy requirements of non-greenhouse tenants in the IIPH to optimise the use of energy generated onsite. Generally, it is more economically efficient for the energy (heat or electricity) produced to be consumed onsite rather than supplied back to the grid, as exhibited in the Microsoft example at A7.

Another factor to consider is that an energy solution with onsite generation would naturally be more complicated relative to the base case where electricity is mainly sourced from the grid. The IIPH is likely to require an energy management system to effectively manage the flow of energy within the IIPH and beyond, as well as the interface between various components of the energy system. As an example, the energy management system would need to be able to adjust the generation levels of the CHP plants to align with the load requirements of the IIPH.

9.2.4 Gas

9.2.4.1 Base case

Under the base case, decentralised heating boiler units accommodated at individual greenhouses would be used to provide heating. These boiler units would run on either natural gas sourced via the regional gas pipeline network or LPG delivered in tankers. A localised gas distribution network would not be required if LPG tankers are delivered directly to individual greenhouses.²⁵

The CO² emission from the boilers would be cleaned and recovered for the use at the greenhouses. No localised CO² pipeline is required if the boilers are operated at the individual greenhouses. Alternative sources of CO² need to be explored as there may be insufficient CO² supply if the boilers are not operated in the warmer seasons.

²⁴ Made in Holland Data Centre, NHH

²⁵ Confirmed in stakeholder engagement.

9.2.4.2 Insights from case studies

Greenhouses in the Netherlands typically use heat from CHP plants. Localised insulated hot water pipelines are installed to distribute heat where CHP plants are centralised (as is the case of Agropark Bergenden).

More recently, some agri-precincts in Netherlands have invested in geothermal plants to reduce their reliance on natural gas and CHP plants. In addition, at Biopark Terneuzen, the greenhouses are supplied with waste heat from the adjacent biomass plant and the fertiliser factory. There are plans to use the waste heat from the Microsoft Data Centre for the greenhouses at A7.²⁶

Alternatives to natural gas for running the CHPs have also been explored. At A7, it was announced recently that a biogas plant would be constructed and produce biogas from green waste. In Australia, CHP plants that are able to run on both biogas and natural gas are commercially available.

The reduced use of CHP plants for heat has led to agri-precincts in the Netherlands seeking alternative source for CO².

9.2.4.3 Innovative case and key considerations

Consistent with the innovative case for the provision of electricity, centralised CHP plants could be adopted to satisfy the heat requirements of greenhouses. Heat would be distributed in the form of hot water via insulated pipelines across the IIPH. Natural gas supply from the gas network would be required to run the CHP plants as LPG tankers are unlikely to be sufficient. As mentioned previously, further analysis will be required to gain a better understanding of the economics of CHP plants in the context of the WSA IIPH given the climate differences between Western Sydney and the Netherlands.

The CO² emission from the centralised CHP plants would be recovered and supplied to greenhouses via a CO² pipeline. There is potential to reuse CO² emission, from the aquaculture operations to the greenhouses (see section below).

9.2.5 Water and waste water

9.2.5.1 Base case

Under the base case, potable water and waste water services would be provided by Sydney Water, although a level of onsite water treatment may be required before waste water is able to be discharged.

Given the IIPH is proposed to be located in a highly sensitive catchment, it is considered unlikely that permission would be granted to discharge waste water directly into waterways.

9.2.5.2 Insights from case studies

In the Netherlands, rainwater is typically harvested and used for irrigation at greenhouses, supplemented with water from the grid. At A7, the sewer system is able to separately discharge rainwater from industrial waste water. Greenhouses at agri-precincts typically co-fund the rainwater harvesting system.

In Europe, increasingly commercial aquaculture farms have been developed in close proximity to greenhouses, a concept commonly known as aquaponic. Nutrient-rich waste water, waste heat and CO² from aquaculture are supplied to the greenhouses, while the aquaculture operations benefit from the oxygen from the greenhouses.

ECF aquaponic system, which has been commercially deployed over a number of sites across Europe, represents an interesting case study.²⁷

9.2.5.3 Innovative case and key considerations

A rainwater harvesting system should be considered as a potential component of the water supply strategy for the WSA IIPH. This does not however eliminate the need for a high-quality and reliable water supply, due to the variability in rainfall.

As noted in the base case, the IIPH may be required to have an onsite water treatment facility. This has potential to be extended into a water recycling facility for reuse onsite.

Sydney Water is planning a new waste water treatment plant to service the Aerotropolis and potentially surrounding precincts. The facility will have a strong focus on resource recovery. It will produce recycled water in line with customer demand and to support the Parkland City vision for a cool and green landscape. It will also incorporate anaerobic digestion and cogeneration to produce renewable energy. There may be an opportunity for the WSA IIPH to partner with Sydney Water, supplying waste water and organic waste to Sydney Water's facility and off-taking recycled water, waste heat and clean CO² for use in the precinct. This approach could offer economies of scale for capital and ongoing operational expense.²⁸

In addition, the WSA IIPH could help to facilitate aquaponic farming by providing the required infrastructure (i.e. CO² and waste water pipeline systems) and being strategic in terms of how different production activities are located onsite.

9.2.6 Green waste and other solid waste

9.2.6.1 Base case

Under the base case, an external service provider would be contracted to collect, transport and dispose waste to landfill or reuse / recycling.

The extent that the IIPH is able to separate and sort waste streams will impact the cost of these services,

²⁶ Judge, P, Microsoft \$2 billion data centre for the Netherlands revealed.
²⁷ <http://www.ecf-farmsystems.com/en/#section-ecf-aquaponics-technology>
²⁸ Stakeholder engagement with Sydney Water

and the ability to capture and utilise waste as a resource. This would require adequate land for this function and waste management facilities onsite.

Consultations identified that existing municipal landfills for the Sydney Metropolitan region are reaching full capacity, presenting challenges and potentially higher costs for the IIPH within development timeframes. This means there is an imperative to reduce the level of waste produced and seek opportunities for reuse and recycling to the extent possible.

9.2.6.2 Insights from case studies

Agri-precincts in the Netherlands are actively exploring the potential of harvesting biogas from green waste and general waste produced within the precincts or sourced externally.

Biopark Terneuzen provides an interesting case study of a unique ecosystem that seeks to maximise the use of waste. In addition to the use of waste heat from the precinct at the greenhouses, its waste strategy also includes:

- Greenhouses supply green waste to the biomass plant, which provides electricity to the greenhouses
- Nedalco, a large-scale producer of bio-ethanol, sources steam, purified water and residual starch from Cargill, a food producer
- Rosendaal, a bio-diesel producer, provides waste water to recycler Hero's.

9.2.6.3 Innovative case and key considerations

The viability of running co-digesters on-site to harvest biogas would depend on securing sustainable sources of high-quality waste from either within the precinct or outside the IIPH. As mentioned previously, there is a potential to partner with Sydney Water in this area. An effective waste management system would help to maximise the use of waste and reduce disposal costs.

Having a deep understanding of how various components within the IIPH could interact with each other (in terms of inputs and outputs) is pivotal for a successful integrated waste strategy. At Biopark Terneuzen, collaboration with research institutions provided the expertise in industrial ecology to drive its waste initiative.

South West councils have identified that their municipal waste contracts expire in 2024. There is an opportunity to explore opportunities for the IIPH to be part of an integrated waste management solution for the region.

Consideration of NASF Guideline C will be critical during design and operation of the facility to help ensure that waste management processing facilities are designed and operated in a manner to minimise wildlife attraction.

9.2.7 Information and communications technology connectivity

Telecommunications connectivity services are not part of the scope, however, during the study's utilities workshop, stakeholders noted its importance for a well-integrated agri-precinct.

Indeed, this has been confirmed in the international case study analysis. Aerofarms, a developer of modern greenhouses in the US, uses remote monitoring and controls to optimise the indoor greenhouse environment, which provides for faster harvest cycles, predictable results, superior food safety and less environmental impact. This reflects a general trend that connectivity has an increasingly pivotal role in protected horticulture production systems. Given so, access to connectivity service may be expected from potential tenants of the WSA IIPH.

Further, as mentioned above, Microsoft has co-located its data centre facility at A7, to utilise the excess electricity from greenhouses. Another key reason for its co-location is A7's close proximity to population centres, which reduces the cost of setting up the cable connections. In this respect, the WSA IIPH site shares some similarities with A7, making it a potentially strategic location for accommodating data centres. This should be considered as part of the design of the IIPH in relation to the types of tenants and participants that the IIPH should accommodate.

9.2.8 Access to public transport

Consideration needs to be made as to how the workforce and any visitors would travel to and from the precinct. To enable the precinct to deliver on the desired the circular economy principles, good public transport access would be a key benefit.

9.3 Supply chain principles

The IIPH and WSA present a unique opportunity for domestic agricultural and food producers to reach both export and domestic consumers, key benefits of WSA include non-curfew limited timetables, direct rail access and critical road infrastructure (including the Old South Road and Northern Road). To help ensure that IIPH produce reaches domestic and export consumers safely and efficiently the following six design principles should be considered in future state design and operation of the IIPH.

9.3.1 Connected, trusted and efficient supply chains

Efficient, effective and a future focussed supply chain is a key principle of the IIPH design and operation. This will enable product differentiation and margin uplift in both domestic and foreign markets.

Key supply chain design principles include:

- **Efficient and streamlined export logistics:** Accreditation to enable pre-customs clearance, biosecurity and quarantine. This will support product flow through, reducing manual handling at domestic and export airports. There are a number of options for phytosanitary treatment of horticulture products in to export markets. Whilst the requirements vary between export markets it is suggested that the IIPH has the capability to perform the following activities:

- Cold treatment;
- Fumigation – Methyl bromide treatment;
- Irradiation; and
- Vapour heat treatment.

There may be opportunities to generate further revenue from the investment in infrastructure and accreditation through offering, freight forwarding, customs clearance, biosecurity and quarantine services to the broader food production market which is seeking to export via WSA on a fee-for-service basis.

- **Access to cold chain infrastructure:** the IIPH will be equipped with temperature controlled infrastructure and cold chain logistics to help ensure product quality and food safety in both domestic and export markets. Through discussion with key stakeholders it is recommended that the design and construction of the cold storage infrastructure takes a modular approach to enable it to scale as the facility grows to capacity.

There may be options to generate additional revenue from the investment in cold storage infrastructure through providing cold chain services to the broader food export market that is seeking to export via WSA.

- **Access to transport infrastructure:** access to road and potentially rail networks will be a key enabler for efficient logistics and has been further considered as part of the location strategy. Access to the planned on and off ramps of the Northern Road has been a key consideration in the location strategy.
- **Innovative traceability solutions:** enabled through digital platforms, IoT data and smart labels. These solutions will enable product differentiation through product provenance, improved food safety compliance and authentication and ultimately improved supply chain operations.
- **Predictive supply chain demand and risk management:** data will be harnessed from across the IIPH and from key customers to create a centralised view of demand and supply and enable just in time picking packing and staging. Seeking to balance and ultimately optimise yield, quality, demand and price.

Design flexibility: to allow for future unknown compliance and security requirements and changing operational technology for example autonomous

vehicles and electrical vehicle charging and smart packaging.

Key benefit of the future focused design include:

An ability to capture product price premiums through:

- Digitally assured product provenance and food safety creating brand differentiation and potentially a price premium
- Improved product quality enabled through reduced lead time, smart labels and a fully temperature controlled supply chain.

Reduced operational costs:

- Reduced lead times and working capital, achieved through proximity to the airport and the growing Western Sydney domestic market
- Improved product flow & reduced double handling. Domestic and export product can be sequenced based on real time flight information and/or customer information
- Ability to optimise freight vehicle movements in and out of the site by delivering to single logistics point and optimising design of truck staging.
- Reduced risk and risk avoidance: Reducing the frequency of handovers and improved cold chain compliance will reduce the risk of food safety and poor quality produce due to lack of compliance with cold chain requirements.

There will be further benefits of locating the IIPH adjacent to the airport freight and logistics precinct including:

- Ability to further reduce operational cost through the use of innovative solutions for transport between the IIPH and WSA. Key considerations may include the use of a conveyor system and/or nonstandard road vehicles such as autonomous vehicles
- Improved security achieved through the ability to develop single landside/airside interface.
- Opportunity to develop other commercialisation opportunities, for example ability to supply retail and retail food handling through the IIPH and direct access to airport retail facilities improving general logistics flow into and out of the airport. At other airports this currently occurs by suppliers delivering many trucks directly into airport buildings and creates operation inefficiency for airport traffic and security management
- Ability to take pressure of future airport expansion and cater for food export growth
- Minimising truck movements on local transport networks

Additional opportunities may exist to provide, storage, transport and export related services to food producers who currently do not have the scale to invest in their own infrastructure. This could include producers within the Western Sydney region and also extend out to producers within the central west regions.

Freight considerations

Analysis during pre-feasibility focussed on high level design and operational principles. One the IIPH concept moves into feasibility stage, it is recommended that

freight and logistics be considered from a more detailed perspective, including consideration of inbound and outbound movements and staff and visitor movements.

📁 **Auckland International Airport** 🔍 **SITUATION**

Future terminal and infrastructure development plans will result in the need to move air cargo terminals. The operator was keen to define the optimal operational design to maximises logistics precinct efficiency and provide commercialisation opportunities to the airport authority. Key issues with existing infrastructure included:

- Legacy facilities inefficient and low modernity potential affecting cold chain compliance and ability to handle growth;
- Inbound freight sharing public roads with passengers - trucks and dolley chains causing congestion;
- Opportunity to improve overall precinct traffic e.g. truck queuing onsite and improve inbound logistics flow; and
- Opportunity to use new air cargo terminal for other purposes for example inbound retail and food.

The strategic objectives for the design included:

- Design most efficient terminal and road network to allow growth to 2044;
- No general limitation on location other than where existing leases prevent, for example Tech Hangars;
- Develop capability for world-class temperature controlled cargo handling;
- Consider opportunities to provide services to other users not necessarily affected by terminal moves for example couriers, post and other forwarders;
- Identify commercialisation opportunities for example multi-user, automation, footprint usage; and
- Identify other benchmark airports, technology, comparative industries e.g. seaports, retail, and pharmaceutical.

📊 **OUTCOME - CONCEPT OF OPERATIONS**

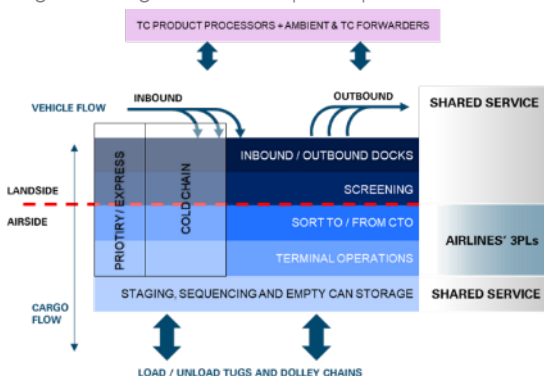
Key strategic goals of the design include:

- Multi-user, single site to optimise logistics and biosecurity processes;
- Facility designed to handle both air cargo and other freight, for example retail thereby simplifying airport-wide logistics flows and improve security;
- Shared services provided which would be out of reach of individual operators;
- Precinct co-located with forwarders and product processors as much as possible;
- Improved facilities offers commercialisation opportunities; and
- Reduce required footprint.

Key enablers required to achieve the above goals included:

- Technology for inbound/outbound vehicle management e.g. public access to Descartes time-slotting;
- Automation for cargo staging and sequencing to take activities off-ramp e.g. Automated Storage & Retrieval System (ASRS);
- Integrated biosecurity and security facilities; and
- Airport funds CAPEX for building and ASRS

Figure 5: High level concept of operations



Financial considerations 10 for a successful IIPH



10.1 Revenue and inputs requirements

10.1.1 Objective

The objective of the financial analysis is to determine, at a high level:

- Revenue potential of assumed farm gate outputs;
- Employment opportunities related to assumed farm gate outputs;
- Input requirements including energy (electricity and gas) and water; and
- Waste generation.

The input requirements have informed the analysis in section 9.2 of this report to ascertain the availability of key utilities within the region (electricity, gas, water, and waste management services).

Revenue and input requirements have been analysed over a 10 year development period, with the assumption that the IIPH will reach capacity within year 10.

Estimation of potential revenue, job creation opportunities and resources requirements have focussed on farm gate outputs only. Additional revenue and job creation opportunities related to shared services such as value adding processing, third party logistics services and research and development

require further specific analysis and are not included in this report.

Estimation of potential input requirements have focussed on utilities required to generate farm gate outputs only. Additional utilities will be required for shared services activities and require further specific analysis.

10.1.2 Assumptions

IIPH size and layout:

Revenue and input requirements are based on two scenarios:

- Scenario 1: 250 ha; and
- Scenario 2: 500 ha.

Within each scenario:

- Shared services account for 10 per cent of land. Shared services may include activities such as value adding processing, logistics services and research and development; and
- Revenue modelling has assumed that land is allocated in 10 ha parcels, 70 per cent of the block is productive (revenue generating) and 30 per cent is non-productive (non-revenue generating) and used for roads, access paths and office space.

Table 10-1: Overview of IIPH scenario assumptions

		Scenario 1	Scenario 2
IIPH	Total Size	250 ha	500 ha
	Number of 10 ha blocks	25	50
Shared Services	Shared services percentage allocation	10 per cent	10 per cent
	Shared services ha allocation	25	50
	Shared Services number of blocks	2	5
Productive Land	Productive land percentage allocation	90 per cent	90 per cent
	Number of 10 ha blocks	23	45
	Non-productive land	Within each 10 ha block it is assumed that 30 per cent of the land will be allocated to non-productive purposes such as roads and office facilities.	

IIPH development

Financial analysis assumes the IIPH will develop progressively over a 10 year period with full capacity being reached within year 10.

It is assumed that development will follow a stair case ramp up approach, similar to that of A7, allowing for both the gradual attraction of tenants and the progressive development of productive land.

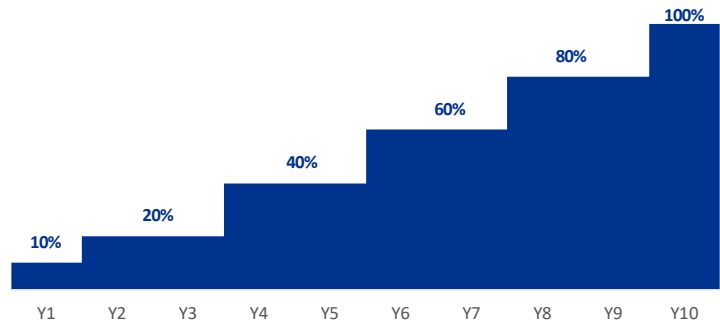


Figure 6: Precinct development rate
 Source: KPMG

Productive land

Revenue, workforce, energy, water and waste estimates have been calculated based on the assumption that four key horticulture products are produced across the IIPH:

- Snack tomatoes;
- Blueberry;
- Capsicum; and
- Truss tomatoes.

Importantly this report does not seek to make recommendations with regards to the type of products that should be produced at the IIPH. Rather the report leverages the analysis conducted in the PPR to inform revenue and input requirements based on the agreed scenarios and development profile.

The farming production land has been evenly split by type of crop.

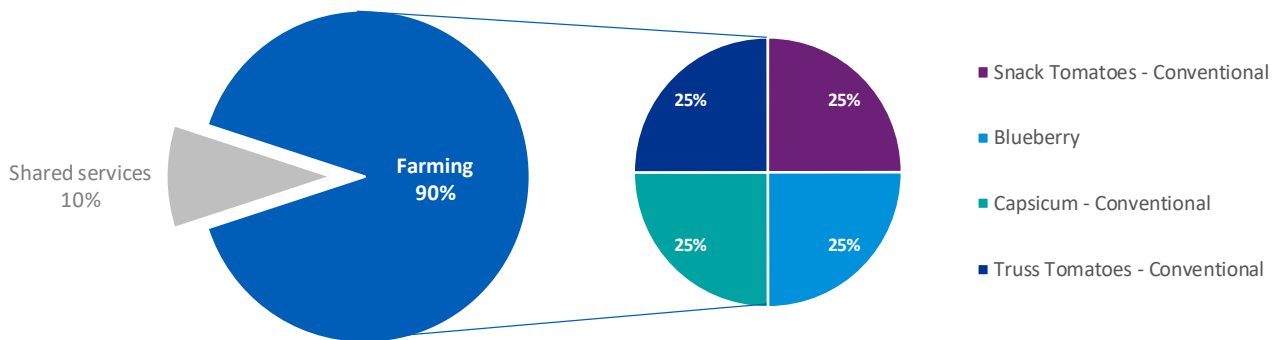


Figure 7: Land use per activity

Table 10-2: Land use per activity, by scenario

	Scenario 1: 250 ha	Scenario 2: 500 ha
Snack tomato	57.5 ha	112.5 ha
Blueberry	57.5 ha	112.5 ha
Capsicum	57.5 ha	112.5 ha
Truss tomato	57.5 ha	112.5 ha

10.1.3 Findings

The following section outlines the key outcomes from the financial analysis including: revenue and employment opportunities and requirements for electricity, gas and water. Opportunities and requirements have been modelled over a 10-year period as per the development phasing approach outlined in 10.1.2 Assumptions.

Revenue estimation

Analysis indicates that the IIPH could generate between:

- \$249 million pa and \$277 million pa in year 10 scenario 1 (250 ha), and
- \$487 million pa and \$541 million pa in year 10 scenario 2 (500 ha).

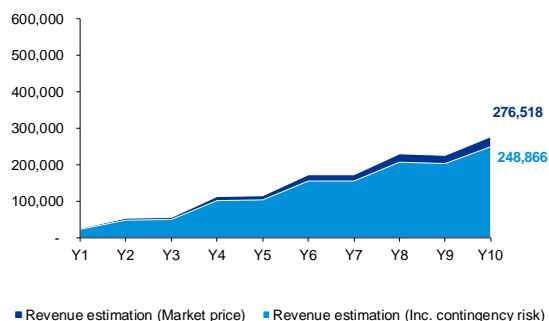
Low side revenue assumes 10 per cent price deflation, based on increase in supply negatively effecting price.

Over ten years of operations, with a progressively increasing capacity, revenue would total:

Table 10-3: Revenue estimation, by scenario

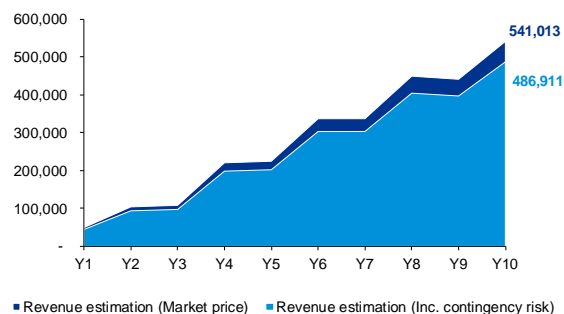
	Scenario 1	Scenario 2
High side revenue	\$1,440 million	\$2,800 million
Low side revenue (inc. 10 per cent deflation)	\$1,290 million	\$2,530 million

Scenario 1 – Evolution of estimated revenue from year 1 to year 10, in \$000



Source: KPMG

Scenario 2 – Evolution of estimated revenue from year 1 to year 10, in \$000



Source: KPMG

Price assumptions include:

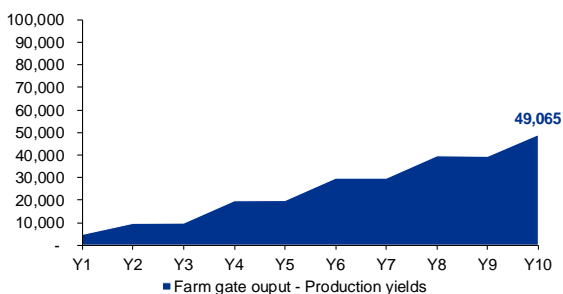
- long-term agreements with customers (retailers or wholesalers);
- exclude export premium; and
- consistent annual pricing due to consistency of supply removing the risk of seasonal price inflation and deflation.

Production of farm gate output

Analysis indicates that the IIPH could generate between:

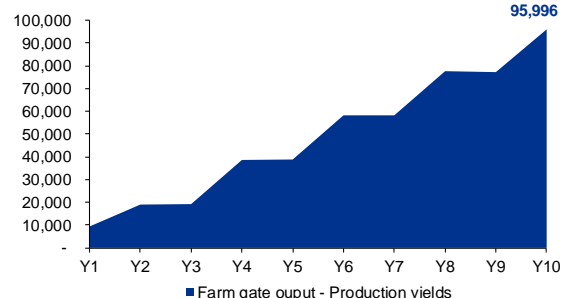
- 95,996 tonnes in year 10 scenario 2 (500 ha); and
- 49,065 tonnes in year 10 scenario 1 (250 ha).

Scenario 1 – Evolution of estimated farm gate output from year 1 to year 10, in tonnes



Source: KPMG

Scenario 2 – Evolution of estimated farm gate output from year 1 to year 10, in tonnes



Source: KPMG

Production of farm gate outputs assume:

- Median production yields of saleable produce from the better operators;
- Average production yields per annum (which allow some waste and some over pack) are applied over the 10-year period, with the exception of blueberry in which the yield is assumed to ramp up progressively to reach full capacity from year 5 to 8; and
- Production yield by type of crop based on conventional Venlo glasshouse production systems and blueberries in poly house production.

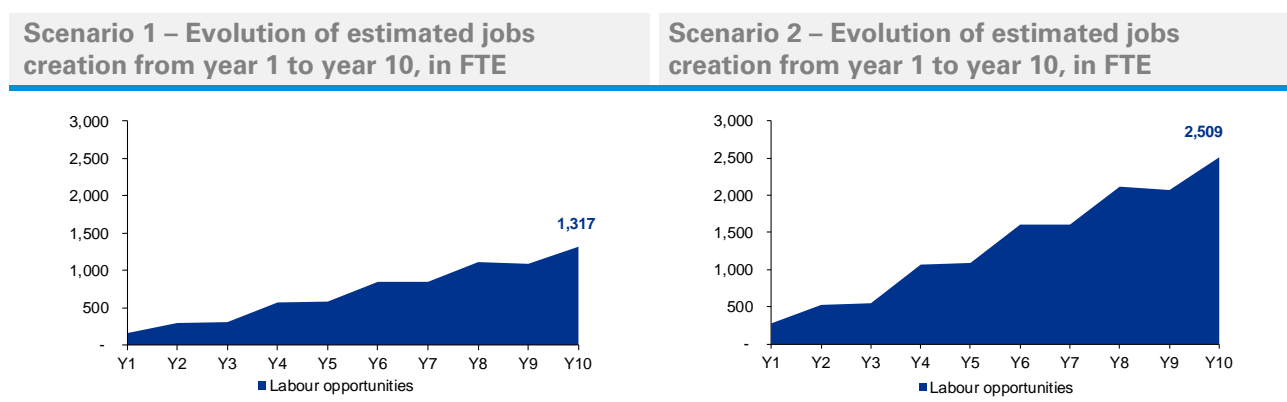
Employment opportunities

Analysis indicates that the IIPH could generate between:

- 2,500 jobs in year 10 scenario 2 (500 ha); and
- 1,317 jobs in year 10 scenario 1 (250 ha).

Further employment opportunities resulting from the IIPH development and operation of the shared services have not been analysed.

Further analysis is required to determine labour requirement during construction.



Source: KPMG

Source: KPMG

Labour requirements assume:

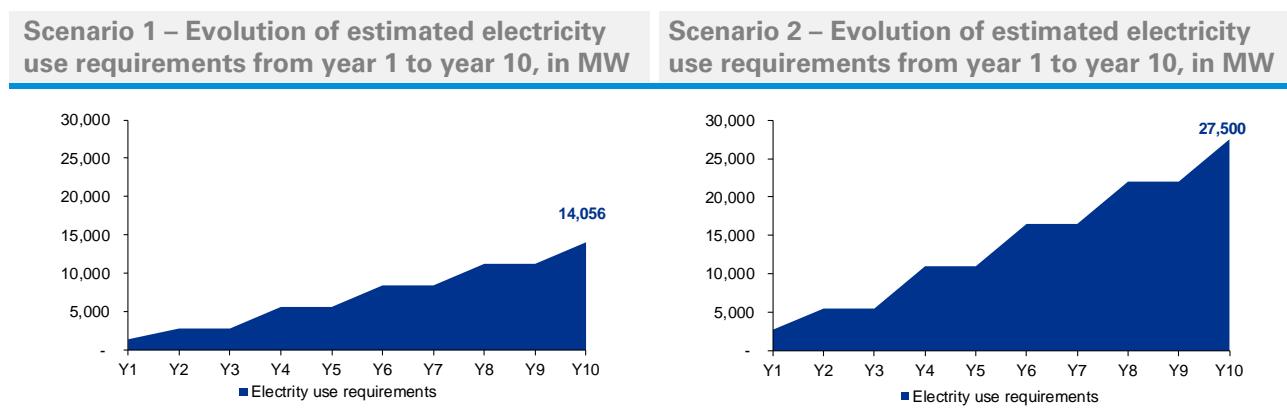
- Estimation of variable FTE is proportional to the production tonnes;
- Variable / fixed FTE – based on a 40-hour week and 48-week year; and
- Each farming activity has a specific profile in terms of FTE and talent needs with some activities being more labour intensive than others (e.g. in this example, production of tomatoes and blueberry are the most labour intensive activities of the sample).

Energy input requirements

Electricity use requirements

Analysis indicates that the IIPH would require between:

- 27,500 MW in year 10 scenario 2 (500 ha); and
- 14,056 MW in year 10 scenario 1 (250 ha).



Source: KPMG

Source: KPMG

Electricity use requirements assume:

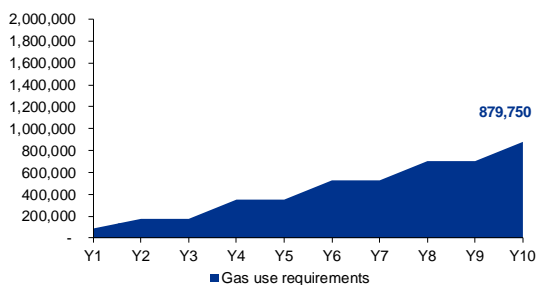
- Requirement by type of crop based on conventional Venlo glasshouse production systems and blueberries in poly tunnel production systems; and
- A median assumption noting that water use can vary depending on selected cooling solution.

Gas use requirements

Analysis indicates that the IIPH would require between:

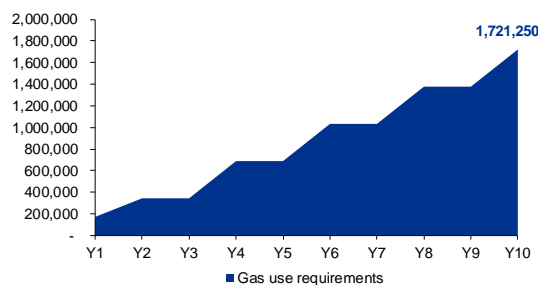
- 1,721,000 GJ in year 10 scenario 2 (500 ha); and
- 880,000 GJ in year 10 scenario 1 (250 ha).

Scenario 1 – Evolution of estimated gas use requirements from year 1 to year 10, in GJ



Source: KPMG

Scenario 2 – Evolution of estimated gas use requirements from year 1 to year 10, in GJ



Source: KPMG

Gas use requirements assume:

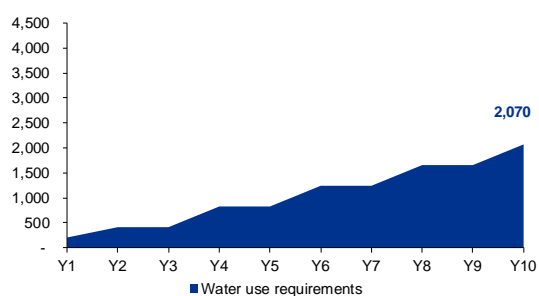
- Requirement is estimated at a crop level and assumes a conventional Venlo glasshouse production systems.

Water use requirements

Based on the analysis of water use requirements for **total growing use** (including crop water use humidification/cooling), analysis indicates that the IIPH would require between:

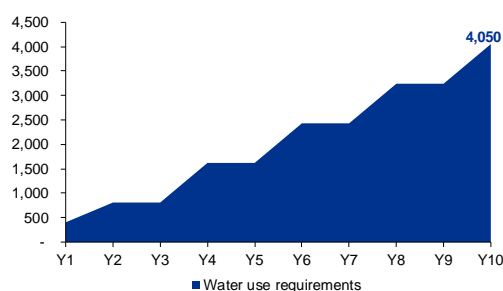
- 4,050 ML in year 10 scenario 2 (500 ha); and
- 2,070 ML in year 10 scenario 1 (250 ha).

Scenario 1 – Evolution of estimated total growing water use requirements from year 1 to year 10, in ML



Source: KPMG

Scenario 2 – Evolution of estimated total growing water use requirements from year 1 to year 10, in ML



Source: KPMG

Total growing water use requirements assume:

- Conservative assumptions for crop water use and cooling / humidification requirements;
- Water required excluding staff amenities;
- Water requirements provided are for potable standard – with higher standard in regard to Salt content (Na and Cl);
- Conservative water use requirements for blueberries including some low pressure misting and noting young crops might actually require less water in the first years; and
- Requirement for semi-closed evaporative losses and humidification via fogging in conventional, noting that there is potential to increase/decrease use requirements depending on the technology and the growing strategy.

Note: There will be additional water requirements to consider for washing if value added processing were done on site.

Through consultations with Agrology, it is understood that capturing rainfall within the region through irrigation systems would reduce the requirement of external water sources to:

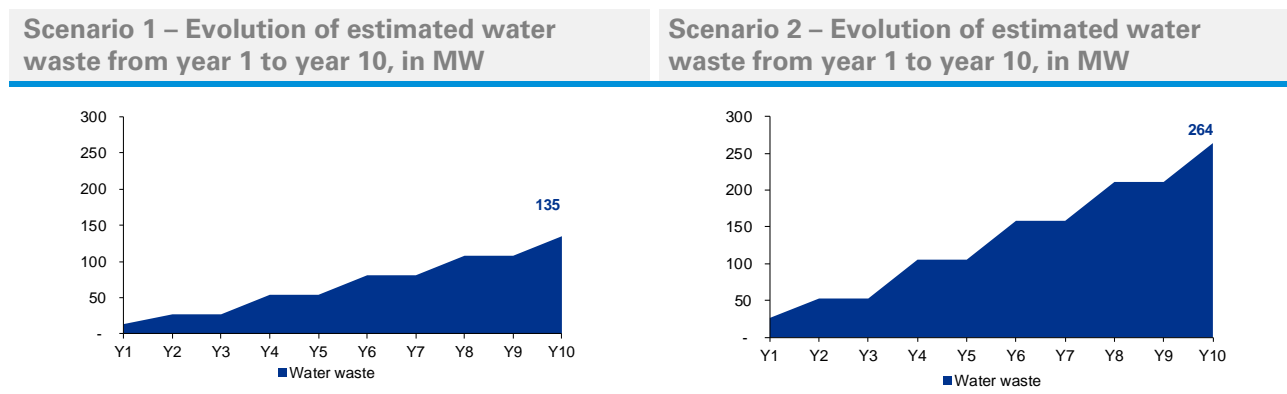
- 2,475 ML in year 10 scenario 2 (500 ha); and
- 1,265 ML in year 10 scenario 1 (250 ha).

Waste

Water waste

Analysis indicates that the IIPH would generate between:

- 264 ML in year 10 scenario 2 (500 ha); and
- 135 ML in year 10 scenario 1 (250 ha).



Source: KPMG

Source: KPMG

Water use requirements assume:

- Water waste is variable depending on operator and technology application.
- Waste water is a general calculation based on a typical commercial recirculating hydroponic system in Australia. In future it is anticipated this figure will reduce as technology and management evolves given the global push towards ‘zero’ discharge.

Solid waste

Analysis indicates that the IIPH would generate between:

- 59,653 tonnes in year 10 scenario 2 (500 ha); and
- 30,489 tonnes in year 10 scenario 1 (250 ha).



Source: KPMG

Source: KPMG

Solid waste requirements assume:

- Green waste (weekly and end of crop clean out) as well as annual solid waste used for the crops (substrate).

Note: these assumptions exclude estimations of solid waste for the capsicum crops (data not available).

10.2 Considering infrastructure costs

10.2.1 Infrastructure costs to consider

The IIPH is at a pre-feasibility stage and, as such there is limited information available on some of the key parameters that will influence utility costs; both the costs associated with constructing the necessary infrastructure and the ongoing costs associated with utility service provision. As a consequence it has proven challenging to obtain even high-level utilities cost estimates for the IIPH at this stage.

There are different types of utility costs to consider for the agricultural IIPH:

- Fixed costs associated with constructing the necessary infrastructure to service the IIPH. This is the infrastructure that will need to be constructed on the IIPH itself. These costs may need to be funded upfront, although some utilities may offer annuity payments over an agreed time period. The required infrastructure will include an embedded electricity distribution network, potentially a gas distribution network, and pipes to provide water and wastewater services.
- Fixed costs associated with connecting the IIPH to the main supply for each utility. In addition to the cost of physically connecting the infrastructure, there may be costs associated with any necessary upgrades to existing infrastructure in order to accommodate the IIPH's needs. The local utility provider would need to undertake this work.
- Fixed and variable costs associated with the ongoing provision of each of the utility services, including transportation and usage costs.

10.2.1.1 Infrastructure provision and connection costs

Through discussions with utility providers it became evident that the IIPH will need to be better defined to develop estimates of the likely costs associated with the infrastructure requirements. Further definition is required around variables such as location, function, size, timing of development and annual demand profiles and how these will change as the IIPH grows. Infrastructure costs will also fundamentally depend on whether and to what extent the IIPH coordinates with the WSA and other developments in the vicinity. There

are large economies of scale associated with infrastructure, and a well-coordinated approach would allow the infrastructure requirements for the area to be optimised and could potentially lead to savings for all parties – provided delivery timeframes line up.

In addition, coordination amongst the utility providers themselves will be important to control costs and disruption and optimise opportunities for circular economy principles to be applied on IIPH.

10.2.1.2 Ongoing utility service provision

Actual costs are likely to vary for a number of reasons.

First, given the potential size of the IIPH, there will be opportunities to negotiate directly with suppliers for energy supply. While estimates have been provided for electricity and gas supply, in practice these rates will need to be commercially negotiated. The grid-based electricity supply could be supplemented with on-site generation such as solar panels, as noted in the base case scenario.

Second, key factors that suppliers will take into account in entering into negotiations include peak demand and the overall demand profile. These factors will be determinative in establishing costs. Consequently the price that the IIPH is able to negotiate requires a demand profile to be established.

Third, market dynamics over the next few years in terms of electricity and gas supply costs are highly uncertain. The supply and demand balance is constantly changing, and energy prices change accordingly. Consequently while the prices identified for electricity and gas may represent a reasonable estimate today, these could change by the time the IIPH is ready to enter into the relevant energy supply arrangements.

Finally, for water and wastewater, the ongoing usage cost is highly dependent on the water solution selected, for example potable versus recycled water. Costs are highly project-specific. Consequently default prices for large customers have been included for the purposes of the modelling.

For waste, an external service provider would be contracted to transport and dispose waste to landfill or reuse / recycling and provide a quote when waste types and volumes have been determined.

11 Developing the IIPH



11.1 IIPH: Concept master plan

The concept master plan seeks to summarise:

- The overall site layout;
- Utilities concept of operations; and
- The supply chain concept of operations.

CONCEPT MAP

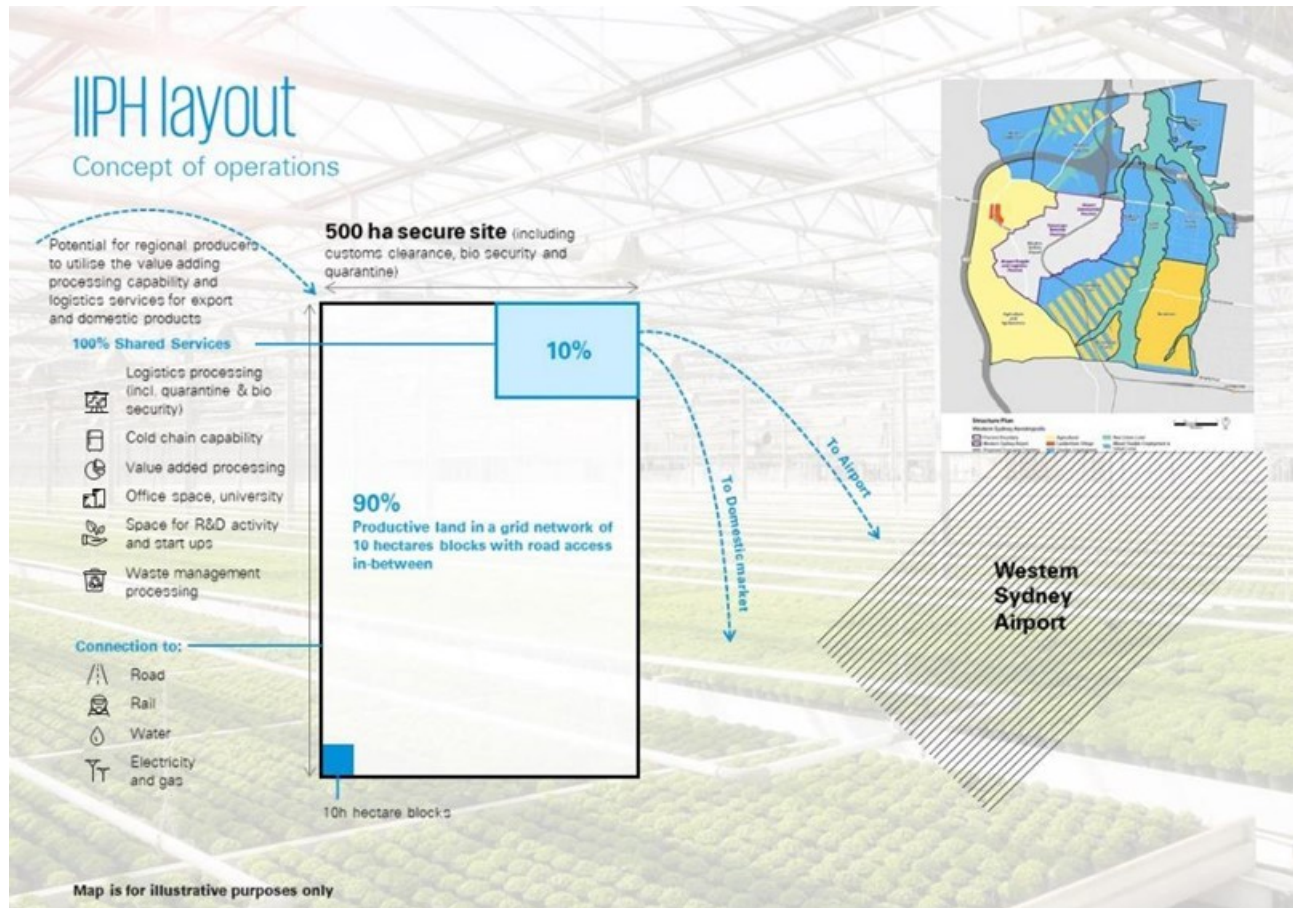


Figure 8: Concept of Operation

UTILITIES: concept of operations

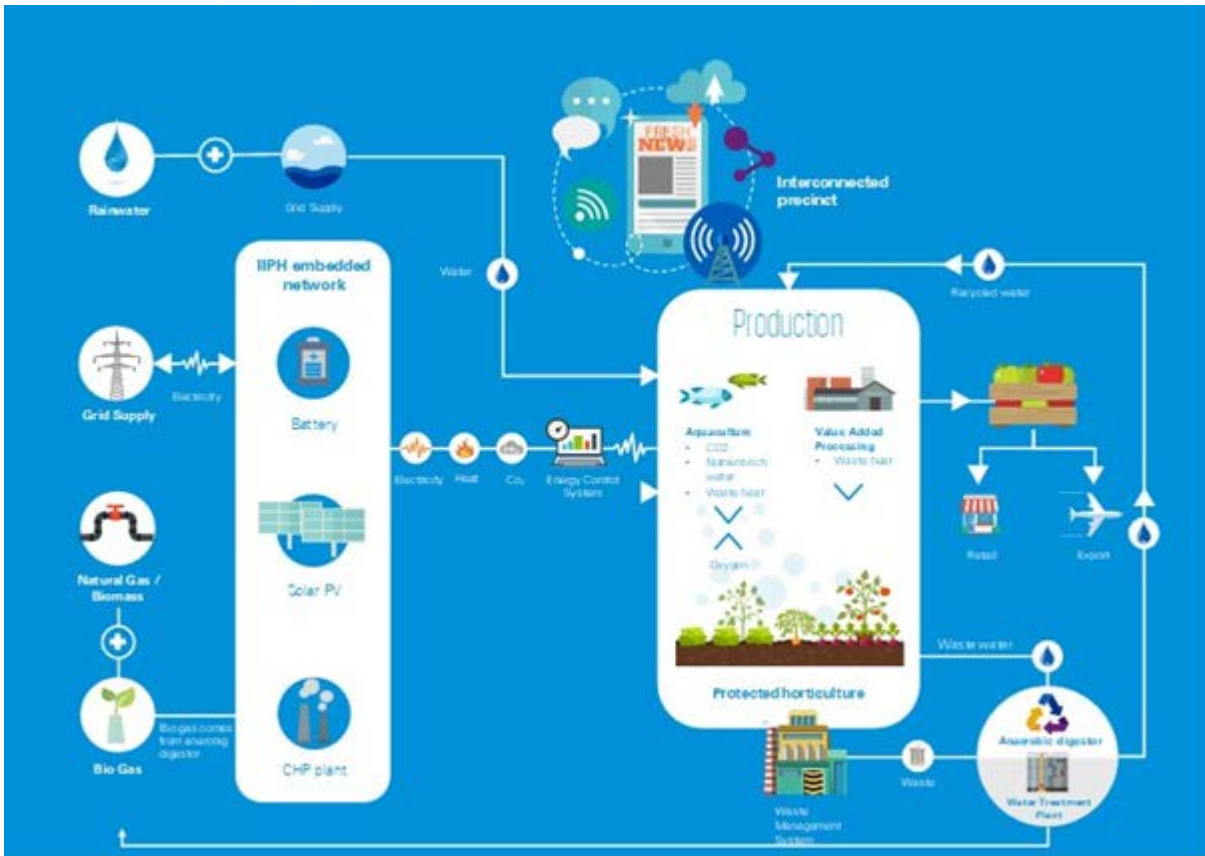


Figure 9: Utilities concept of operations

SUPPLY CHAIN: concept of operations



Figure 10: Supply Chain Concept of Operations

Circular Economy and Technology 12 considerations



A 'Circular Economy' is a unique, future-thinking sustainability concept, which seeks to a shift away from typical 'make, use, dispose' to instead keeping resources in use, valuably, for as long as possible. The concept is best, and most often, applied in relation to resources and energy production, consumption and regeneration. Section 9.2.2. includes consideration of innovative, circular economy principles, in relation to utilities at the IIPH.

Despite the concept of circular economies being typically associated with energy use and reuse, there has been a conscientious shift towards applying the same principles to food production systems and supply chains. In relation to the broader IIPH concept, applying a circular economy principles in will have many benefits including:

- the creation of a mechanisms for **skills exchange**, providing on-the-job tertiary and vocational training;
- enable more efficient supply chains through producing **food close to both domestic and export consumers** due to being positioned near to Sydney and the WSA itself;
- **co-locating food production and food processing** facilities, will shorten food supply chains reducing food miles;

- Digitally **enabling supply chains** though digital platforms and SMART IoT will improve efficiency, trust, transparency and ultimately reduce food waste;
- **data centres** may be leveraged as both an education, job and revenue source, but also as an energy source to support food production;
- **encouraging education and research institutions to support the IIPH** will provide opportunities for high skilled jobs for the local workforce, and will provide a mechanism for innovation and R&D in all aspects of food production, processing and packaging;
- food processors and manufacturers may collaborative identify innovation opportunities in relation to food processing and preparation, **minimising food waste** and creating opportunities to increase the proportion of edible product consumed; and
- a **world-leading, Australian-first IIPH at the WSA may be a tourist attraction**, creating additional revenue and further education opportunities for visitors.

Table 10-4 outlines each of these circular economy factors in detail, providing examples or case studies were possible.

Table 10-4: Opportunities at the IIPH to adopt circular economy principles

Skills Exchanges
<p>The Skills Exchange created at Barangaroo by the Barangaroo Delivery Authority is evidence of how building the workforce of the future could be simultaneously achieved in the construction and operation of the IIPH.</p> <ul style="list-style-type: none"> • The highly successful skills exchange program at Barangaroo generated \$78.5 million in social and economic benefit with 15,000 new, accredited skills qualifications gained; • 85 per cent of workers (nearly 700 people) have completed (or are on track to complete) an apprenticeship, this is double the industry average; • The program saw a return on investment of \$11.76 in net economic and social value for every \$1 invested in the program; and • This was done by essentially creating a 'pop-up college' whilst the site was being built.²⁹ <p>How does this apply to the IIPH?</p> <ul style="list-style-type: none"> • With the nearby University of Sydney, Western Sydney University and local TAFEs, combined with the high demand for education in the greater Western Sydney area, the precinct has the capacity to create a similar skills exchange program; • Benefits range from apprenticeship completions to improved social wellbeing, increased employability and self-confidence and improved productivity and efficiency; • Ultimately, this creates a more competent and competitive workforce with increased skills and qualifications whilst also aiding the construction of the precinct; and • This will help build upon the existing workforce, that already boasts more than 2,000 graduates per annum in Certificate II and III courses in Horticulture and Agriculture.³⁰

²⁹ Barangaroo South, 2018, Barangaroo Skills Exchange Generated \$78.5 Million In Social and Economic Benefit

³⁰ NSW Government, 2017, *Agribusiness – Your Western Sydney Workforce*.

Digital Enablement

Blockchain

Blockchain technology can be used to connect and share data between all parties within a supply chain including producers, processors, certification, storage and logistics providers, regulators, wholesalers and retailers. It provides a comprehensive record of each asset (e.g. base food item, such as a punnet, crate or pallet) that includes data about its origins, composition as well as traceability of the asset across the supply chain. A blockchain-enabled platform would leverage smart contracts throughout the IIPH, critical to delivering supply chain and food assurance of goods produced and processed in the facility. Food assurance (including the ability to demonstrate and ensure quality, safety, environmental management, people and welfare) will create competitive advantages and drive price premiums in both the domestic and international market through demonstrable traceability and transparency of food. Quick reconciliation and reduced error rates will also optimise the operational risk and cost profiles of the whole supply chain.

The IIPH presents a unique opportunity to leverage blockchain solutions to deliver real-time monitoring of food and the supply chain given the IIPH is a greenfield development. In other areas of agribusiness and food production adopting blockchain solutions is more difficult, given the complexity of integrating existing systems and processes that are part of established operations.

How would blockchain work at the IIPH?

Tenants in an IIPH utilise a digital ledger such as blockchain to capitalise off first-mover advantage in the international trade markets. Blockchain would provide veritabily on country of origin, quality and production claims being made by the exporting tenants. Each asset will need to be recorded in a digital format (e.g. sensor recorded, photographic, etc.), captured electronically and loaded into the digital ledger where additional information can be captured by the next relevant user (e.g. the processor). The same process can then occur between each subsequent supply chain player; with the capture, interchange and validation of data occurring instantaneously. Tenants will need to work collaboratively with shared services, downstream and upstream supply chain players (e.g. freight, storage and logistics) as well as customs/quarantine to ensure the assets and blockchain are not disjointed or cost prohibitive (as single users of blockchain will not benefit as much as coordinated, whole-of-sector users).



Figure 11: Blockchain overview

What is the benefit of blockchain at the IIPH?

The benefit of blockchain would be assured supply chain management and food provenance combining to facilitate highly efficient cross-border trade (of standardised foodstuffs) between Australia and export markets in a more responsive manner driving value-capture in the supply chain.

Instead of paper driven value-chain management, data will be the foundation of trade, reducing inconsistencies, tampering or misreporting and reducing working capital built up in the value chain (e.g. customs and quarantine facilities) where manual tasks are still prevalent. Not only can this digitisation of trade facilitate faster transfer of goods, reducing food waste, but it will ensure expedited, dependable delivery of food to market for faster fulfilment. Furthermore, premium customer experiences can be created within the export markets to demonstrate the origin and storytelling around the export produce.

Digital Enablement

Internet of Things - SMART precincts

The Internet of Things (IoT) will allow interconnectivity between the physical (e.g. plants, people and machines) with the digital world. It enables predictability, automation, supports decision making and drives efficiencies. By the time the Aerotropolis is established 5G network connectivity is expected to be effective. At a minimum, establishing an IoT network and utilising a SMART precinct approach at the IIPH will be key enablers to having blockchain and autonomous vehicles at the WSA and IIPH.

SMART Cities

- Already the Federal Government is looking towards supporting the Western Sydney City to be a Smart City by creating a Smart Cities Plan³¹.
- The Smart Cities Plan is **established on the basis of three principles: smart investment, policy and technology**.
 - 1) Smart investment centres on project prioritisation that boost economies through improving city accessibility, affordability, housing, jobs and environments through long-term investment from both public and private capital through innovative financing approaches;
 - 2) Smart policy is better connected all levels of government to drive collaborative reform to better generate policy success; and
 - 3) Embracing smart technology that will better plan and drive functionality in city planning to facilitate economic grow in an efficient and effective way by leveraging real time data driven solutions and commercialisation of innovation.

SMART Precincts

Additionally, a distinct 'smart precinct' capability model has been developed that could be suitably applied here. It has four specific capability layers based on tenant experience, value-add services, operations and ubiquitous connectivity.

1. **Tenant experience** – linking smart capabilities whose primary purpose is to improve the tenant experience (i.e. front-end). Traditional property owners and managers recognise that providing excellent customer experience is essential to their success, but in today's digitally-enabled world, expectations are far higher, particularly in "smart precincts". Accordingly, while some smart capabilities will simply be expected by tenants as standard, advanced capabilities can be provided to truly improve tenant experiences. This layer includes both digital assets (e.g. physical assets at the precinct) as well as web/mobile assets.
2. **Value-add services** - primarily the smart services contained within a Tenancy Platform as well as insights which can be delivered to tenants through data analytics and modelling capability. Value-add services increase the perceived value of the precinct. Many value-add services are low-cost and easy to do but can add significantly to the overall tenant experience and increase the value proposition for tenants. There are various pricing models which can be explored through the provision of value-add services.
3. **Operations** - includes smart capabilities which are both fundamental to the running of operations as well as driving efficiencies related to cost savings, waste reduction, improved sustainability measures etc. The operations layer includes a range of core/expected capabilities which any precinct would need to include, as well as a range of more advanced smart capabilities which can be selected depending on the context of the given precinct and the articulated vision.
4. **Connectivity** - the foundation of the Smart Precinct Capability Model. In order to provide an array of smart technologies in the above three layers, now and into the future, ubiquitous connectivity is critical. None of the software and hardware components of the digital layer can operate effectively without a substrate of network connectivity, power, and ways of deploying hardware at low cost. Getting the connectivity piece right from the outset also limits the need to retro-fit solutions in the future. Connectivity includes wireline fiber-enabled internet (e.g. NBN) as well as a number of current and emerging wireless standards, such as wifi, LTE, Zigbee, LoRa to name a few.

An outline of this model is contained in *Appendix 17: Smart Precinct Model*

³¹ Department of Infrastructure and Regional Development and Cities, 2016, *Smart Cities Plan*

Data Centres

Data can be used as an additional revenue source at the IIPH; data centres have already been developed in other precincts around the world (such as the Microsoft Data Centre at A7).³² Information gathered in the IIPH can be used by producers for advanced manufacturing trials, providing information on the growth, development and storage of produce and be used in digital economy trades. Data centres provide precincts with greater capabilities, jobs and revenue opportunities.

More importantly, data centres generate significant amounts of heat and can be used to preserve, maintain or increase the ambient temperature in greenhouses (as a low-cost and efficient energy source) making the data centre's high electricity use more efficient and effective. At a high level, heat from the data centres is captured and used to heat refrigerant gases that can in turn be used to control the temperature of the greenhouses.³³ Furthermore, the CO₂ produced by the electricity generator powering the data centre (often a CHP) can be used to supplement CO₂ lost in photosynthesis by plants in the greenhouses of an IIPH.

Data centres have already been discussed in this report significantly as they have been effectively incorporated into other international precincts such as Agriport A7. Whilst the benefit of the incorporation is clear more analysis of the appropriateness of the use of data centres at the IIPH will need to be conducted once the location has been defined. Depending on location there may be restrictions due to potential interference with flight paths.

Education, Research and Development

Education represents an opportunity to provide the IIPH with a competitive advantage by driving local skill and scientific development into the local community. Given the market focus on the IIPH a unique opportunity may exist to provide an avenue to close the gap between R&D and commercialisation.

What is the opportunity for the IIPH?

- The IIPH has the potential to provide innovative solutions in food products, processes and supply chain management as well as the ability to deliver education outcomes to ensure the Australian food industry remains competitive in the global marketplace.
- The distinct climate of the Aerotropolis region means there is a unique opportunity for research and development that complements and builds upon other Australian agribusiness research; should the IIPH go ahead this could also create opportunities in the intensive agriculture and greenhouse production systems.
- The University of Sydney's Centre of Excellence for Carbon, Water and Food, located nearby at Bringelly, would also be able to be leveraged in a similar way, and could link in directly with the IIPH's production systems to generate or undertaken research opportunities in partnership with the research being undertaken at the centre; additional research is being conducted at the University's Enginomics facilities - this includes the development of new food ink sensors designed to accurately indicate food conditions and replace expiry dates.³⁴

Western Sydney University hosts the National Vegetable Protected Cropping Centre, a collaborative partnership between Western Sydney University, Horticulture Innovation Australia, industry and research partners to advance Australia's horticultural capabilities. The Centre is based around an 1,800 square metre glasshouse facility, designed with the world's very best glasshouse infrastructure and controller systems, to house research, education and training opportunities in modern protected cropping horticulture.

- CSIRO, as an important national research entity, has been undertaking investigations into indoor and vertical farming, horticulture's unique input requirements as compared to traditional conventional farming systems, produce innovation (e.g. square tomatoes instead of round tomatoes), horticultural biosecurity (e.g. blueberries are not typically grown in the Western Sydney region) and food manufacturing (particularly related to health foods, plant proteins and secondary/by-product food creation). There is a distinct opportunity to partner with an organisation such as CSIRO to ensure that the IIPH adopts a scientifically and technologically up-to-date, whole-of-system production logic (up-to-date production techniques, coupled with innovative manufacturing and value-add, highly connected systems management and finally on-site quarantine and biosecurity for expedited clearance).
- Being proximal to the Sydney Science Park provides an additional opportunity to further explore research opportunities – the IIPH could be a satellite facility for research being undertaken at the Park;
- Sustainably feeding a global population of over 10 billion people by 2050 is considered one of the key challenges of our time, with predictions that more food will be required in the next four decades than all farmers in history have harvested over the past 8,000 years. The IIPH has the capacity to partner with key research organisations to leverage the unique, controlled IIPH environment to conduct innovative research and development to meet ongoing food demand pressures.

³² Datacenter Dynamics, 2018, Microsoft's €2bn Netherlands data center revealed

³³ Reynolds J, 2016, Irish-led green data centre plan.

³⁴ The University of Sydney, 2018, Smart food packaging to reduce Australia's waste problems

Integrating manufacturing for the future

There is a distinct opportunity to ensure that the IIPH involves food production and also manufacturing and processing. This concept is supported by industry stakeholders and the NSW Department of Industry, who recently commissioned studies into the food and beverage manufacturing industry.

Food manufacturing is an inherent part of the food supply chain, and serves to be a critical value-add sector, that facilitates processing and packaging of ready-to-eat foods. As food demand increases – particularly in export markets - the capacity of the IIPH to meet this demand will be improved if food processing is leveraged.

Food manufacturing businesses could be easily co-located at the IIPH, or proximal to it and the WSA more generally. To future-proof these businesses it will be vital that they procure their foods direct from the IIPH as much as possible, utilise modern equipment and processing techniques and up-skill their workforces. Additionally it will be vital that the processed goods being consumed are those in high demand, for example infant meals, ready-to-heat meal packages and convenience style foods.

Finally onsite manufacturing of IIPH produce into value-added food should link in with research, development and education. Food innovations can be tested and trialled at the IIPH at the manufacturing level as well as the production level.

Co-working spaces/Start-up Hubs

Co-working spaces have the ability to encourage additional industry participants to operate within a shared-services facilitated and connectively enabled space. Looking internationally, start-ups and co-working spaces prove integral parts of similar agricultural precincts.

Opened in 2018 and covering 22,000m², the Netherlands' World Horti Centre (WHC) is a leading innovation hub for the international greenhouse horticulture sector. The precinct provides "a platform where business, education and government jointly innovate, connect, create and inspire" with over 40,000 international professionals visiting per year.³⁵

WHC uses co-working spaces to promote collaboration, with paid spots available for short or long term hire, including the option to work in the garden. The centre even boasts its own "HortiHeroes" incubator, identifying entrepreneurs within the industry and running hackathons in their purposefully designed buildings.

Dedicated co-working spaces and accompanying facilities can encourage start-ups and accelerators to operate within the IIPH, and should be considered in future planning. This has the potential to place the IIPH at the forefront of the AgTech, research and innovation community as well as providing tenants with first access to relevant agricultural breakthroughs and advancements.

³⁵ World Horti Center, 2018, <https://www.worldhorticenter.nl/en/home>

Tourism

Similar state of the art agricultural precincts around the world have utilised tourism both to increase their ability to capture visitation, while driving educational opportunities and creating an additional source of income. In 2014, Agriport A7 had over 10,000 tourists from around the world come to learn about modern greenhouse food production methods.³⁶ The DOOR Cooperative is another leading example of thinking beyond agriculture and tying food production, education and tourism together. DOOR runs a program called 'FETfit Youth' this is a health and education program for young school children to visit the DOOR greenhouses and learn how tomatoes are grown before learning how to cook fresh produce.³⁷

In China, more than 22.5 million visits were made to agriculture-related tourist destinations in 2016; that is roughly equivalent to the whole of Beijing's permanent residents' population. An example of this is the COFCO Beijing Agri-Ecological Valley in Fangshan District, Beijing. Tourists can view a multi-layer rotary light planting system in the smart agriculture display hall or be watch how 2,260 cultivated baskets are each individually watered according to computer calculations, ag tech sensors and irrigation delivery systems. In 2016, COFCO hosted a 'Children's Day' where it arranged for parents and children to pick fresh fruits and vegetables, decorate containers and learn about agriculture. One visitor to COFCO Farm stated that the precinct was "*a very good example for agricultural enterprises upgrading their business for high-end tourism. It paves the way for Beijing's new direction for the tourism industry...I will definitely come back again.*"³⁸

Tourism represents an opportunity for the IIPH to gain an additional source of revenue and give back to the wider Western Sydney community. In fact, being located so close to an international airport means that visitors from around the globe will have the opportunity to come and learn from the cutting edge processes occurring in the IIPH.

³⁶ Agriport A7, 2018, <http://agriporta7.nl/agropark/>

³⁷ Cooperative DOOR, 2017, FetFit Youth Education.

³⁸ China Daily, 2017, Two worlds collide in rising agricultural tourism sector

Commercial 13 considerations



13.1 Role of government

13.1.1 Governance model

There are three options that could be considered for advancing the IIPH and what mechanism will pursue the development. The three options for consideration are:

- **Lead** – the lead role would require the establishment of an appropriate vehicle or mechanism to drive the next stage feasibility assessment and commercialisation of the IIPH post this report.
- **Launch** – launch the report as a concept paper for a private and/or alternative public entity to endorse and resume the lead role of the IIPH development.
- **Facilitate** – the government could take a lead role in facilitating the development of the IIPH. The facilitated approach would still require the establishment of an appropriate mechanism or vehicle to deliver against the IIPH and government objectives.

Based on the identified options and the assessment of similar global precincts, the recommended governance model for the continued development of the IIPH is through a facilitated model. In addition, the ongoing involvement of the NSW Government ensures alignment to the broader Aerotropolis development.

13.1.2 Western City and Aerotropolis Authority

On 10 November 2018, the NSW Government passed the WCAA Act 2018 No 53.³⁹ The objective of the Act is to encourage the economic growth and development of the Western Sydney Aerotropolis and the rest of the Western City. A key component of how the Authority will deliver against its objectives is [...] by supporting the creation of precincts that are focused on job intensive land uses and which include knowledge, industrial, educational, commercial, retail and mixed use precincts.⁴⁰

The role of WCAA and supporting legislation provides an appropriate Government facilitated mechanism for the ongoing development of the IIPH. With specific consideration of the IIPH governance, within the wider context of WCAA and the overall development of the Western Sydney Aerotropolis, WCAA legislation provides flexibility in how the government may agree to advance the IIPH.

The functions of WCAA outline its jurisdiction:

- to prepare master plans for development within precincts, including identifying priorities relating to the design and location of that development;
- to carry out development on its own behalf or on behalf of other persons or bodies;

- to participate in the planning, funding, prioritisation and co-ordination of public infrastructure that is provided in association with the carrying out of development within precincts;
- to co-ordinate, secure and attract investment;
- to develop and, if directed by the Minister, implement schemes for funding the provision of public infrastructure, facilities, places and services;
- to promote, organise, manage, provide and conduct cultural, educational, commercial, transport, tourist and recreational activities and facilities;
- to provide consultancy and other services relating to the carrying out of development;
- to enter into joint ventures, project delivery agreements and other arrangements with landowners, developers, State and Commonwealth government agencies and local councils in the Western City; and
- to liaise and work collaboratively with State and Commonwealth government agencies and with local councils in the Western City in exercising its functions.

Additionally, WCAA Act outlines the ability for WCAA [...] to form, or participate in the formation of, private corporations. WCAA, as an agency of the NSW Government, may determine that the establishment of an IIPH private corporation to oversee the ongoing IIPH operations should be considered.⁴¹

As outlined in the report, there are several considerations around land for the IIPH; the required establishment of utilities on a chosen site; and the process of attracting investment and tenants to the IIPH. The WCAA legislation addresses these considerations.

It is recommended that more detailed assessment be conducted as to how WCAA could lead the IIPH development.

13.2 Commercial strategy considerations

In developing a commercial strategy several areas require additional consideration as the IIPH moves from concept to strategy.

The development and delivery of the IIPH should be considered as a commercial activity. As a commercial activity there is still a role for government through the WCAA in steering the IIPH through to implementation to help ensure the opportunity for the State to share in the benefits of this commercial activity are not missed.

The uniqueness of the IIPH and associated value proposition makes it difficult to determine the commercial and financial metrics at this early stage of feasibility assessment. Whilst this study has given regard to the local and domestic market, the ultimate financial outcomes will be primarily determined by the

³⁹ NSW Government, 2018 - Western City and Aerotropolis Authority Act 2018 No 53

⁴⁰ NSW Government, 2018 - Western City and Aerotropolis Authority Act 2018 No 53

⁴¹ NSW Government, 2018 - Western City and Aerotropolis Authority Act 2018 No 53

level of acceptance received from the market. Further due diligence, primarily obtained through engagement with target tenants, must be completed to validate the prospective financial returns.

It is important that the value proposition (i.e. the reason for tenants or investors to participate in the IIPH) is clearly defined and consistently communicated to the market upon formal IIPH launch. To support this, precinct uses, energy proposition, infrastructure services amongst others must be agreed and committed to by the lead agency, recommended as WCAA, prior to a broad tenant attraction process being implemented.

An additional key consideration for the NSW Government is to consider the level of investment required to support the establishment and ongoing operations prior to the IIPH becoming commercially viable in its own right.

While giving consideration to the WCAA governance model, further commercial strategy considerations are examined below as they relate to the relevant components of an IIPH establishment.

13.2.1 Land

As identified earlier in the report, there is sufficient land either within the precinct identified as Agriculture and Agribusiness, or close to it, to warrant further investigations and a preliminary business case.

As advised and captured in the stakeholder considerations, some land owners have formed action groups. Groups will be impatient to see progress on planning controls and reassurance that any development allowable on the land will provide for a higher and better use than current uses (mainly rural). Engagement with these groups in the next phase of the IIPH is advisable.

Another key consideration with respect to land, relates to the control of the land around the entrance to the airport and freight and logistics entrance. It is important to properly plan the entrance considerations to ensure the future of the IIPH. This is where engagement with the relevant other Western Sydney development proponents, such as WSA Co, are important to ensure the holistic nature of the IIPH and the surrounding airport activities.

13.2.2 Infrastructure - utilities

Operational viability will be underpinned by the ability to connect to utility services. The delivery of connection infrastructure requires significant capital investment. Whilst initial costs have been sourced, these should be further refined in the next stage planning based on the evolving costs and structure of the utilities market and the IIPH requirements.

Given the proposed location in the Sydney Metropolitan region and the particular resource requirements of the IIPH, it is recommended that

connection to shared infrastructure services including electricity, gas, water, waste water and waste, augmented by onsite generation and waste management systems are a part of the IIPH commercial strategy. At present, this report has not investigated in detail the barriers to the IIPH connecting to shared services and the potential challenges associated with the delivery timetable of 2024.

Additionally, there is a clear potential for coordinating with WSA and other developments or precincts in the area to optimise utilities planning, sequencing, delivery and operation, and to reduce costs.

There is also the opportunity for lateral co-ordination across utility service providers to increase the environmental performance of the IIPH and implement circular economy principles, particularly on waste and waste water. The study identified a high degree of aspiration and willingness for providers and planners to work together to innovate in service provision and optimise respective capital plans. However, the windows of opportunity for a collaborative approach will narrow over time and needs to be managed effectively through WCAA.

The key commercial consideration in relation to progressing infrastructure and utilities planning - and supporting castings - is defining the location, size, function, demand profile and timing of the IIPH development. This will need to be further defined in order to accurately advise on the costs of connecting and using key utility services.

Finally, a level of infrastructure may be required up front to support tenant investment decisions making but staged where possible to ensure efficient deployment of capital and provide options for the sharing of capital costs with the private sector. The commercial modelling will need to consider infrastructure through the lens of construction, connection and ongoing service delivery to the IIPH.

13.2.3 Development

The commercial development approach will ultimately be determined by the proponents of the IIPH. There are a number of commercial development options for a site of this size that maybe considered including leasing or selling the land to tenants.

13.2.4 Financing and structure

The development and delivery of the IIPH should be seen as a commercial activity. However, the IIPH could require a level of government investment to de-risk the project and support the establishment and ongoing operations prior to the IIPH becoming commercially viable.

This process does not preclude alternative funding and financing including via government or private investment.

To attract finance, the commercial proposition requires further development. To support this, the IIPH concept should have an appropriate governance model, such as WCAA, to facilitate the attraction of capital and execute these arrangements to deliver the IIPH. Similar to the tenant attraction process, the development of an investor prospectus targeted at the core funding participants should be considered post this study to allow the IIPH to be commercialised.

13.2.5 Tenant attraction

The tenant attraction strategy should consider the profile and type of company who will be attracted to the value proposition of the IIPH. Based on stakeholder engagement and insights, it is more likely that these companies will be large domestic or international food and/or primary producers, predominantly fresh food (horticulture) and commercial food preparation companies such as airline caterers.

Tenants should also be identified and targeted based on their alignment with the project vision. Tenants will

need to be of a substantial size to support the preferred scale of development. A proactive approach to tenant identification is critical to achieving the proposed take-up rates of the IIPH components and therefore the required commercial returns.

To commence tenant attraction strategies, further certainty will be required for tenants in relation to location and land access along with the availability and arrangements for access to utilities, transport and waste services. These services will ultimately have a significant impact on the investment proposition for tenants and certainty regarding this should be obtained prior to formal engagement with prospective tenants.

To attract tenants to the IIPH, the development of a clear commercial value proposition and offering will be critical. Confirmation of land and location will be a key enabler of this.

A summary of the key considerations for three potential tenant groups are outlined below.

Table 10-5: Key considerations for three potential anchor tenants

Example Anchor Tenant	Commercial Considerations
Greenhouse Operator	<ul style="list-style-type: none"> • Defined construction approach i.e. acquire land and develop themselves; lease land and build infrastructure; or turn-key operation. • Energy provisions of the IIPH and company capacity to adhere and/or service the cost of operating the greenhouse within the IIPH. • Size of land allocated to greenhouse production – is the space available within their commercial parameters. • Access to the required utilities to operate a greenhouse as required for example water, carbon dioxide. • It is important that production decisions are left to the greenhouse operator as they retain the risk associated with production and market uptake of production.
Food Processor	<ul style="list-style-type: none"> • Capital outlay required to provide processing scale for example, company to supply machinery or lease as part of commercial offering of IIPH. • Size of buildings/infrastructure – requires flexibility to adapt to export market needs or product processing requirements, for example number of packaging lines. • Long-term tenancy, given cost to establish processing facilities, guarantee of tenancy to underwrite investment is crucial. • Access to and capacity of shared infrastructure, for example, cold chain storage, storage (raw ingredient supply and packaged foods) and infrastructure (road/rail/air). These are crucial decision points for the establishment of a processing facility.
Airline Caterer	<ul style="list-style-type: none"> • Proximity to the airport. • Onsite storage and transport integration with the airport for timeliness of product delivery. • Existing sub-contractor arrangements and transition planning for WSA considerations. • Scale of airport operations/flight demand from 2024 and facilities ability to ‘scale’ as required based on estimates of passenger traffic of 86 million by 2060.

Source: KPMG.

The release of the report, along with the Agrolgy report, provide the IIPH concept with further support to engage and attract private sector interest.

13.2.6 Stakeholders

The stakeholder landscape for the IIPH is large and varied. Below is a summary of the key stakeholder groups and areas for consideration for the NSW Government and WCAA.

Table 10-6: Key stakeholder groups for consideration in future planning at the IIPH

Stakeholder Group	Insights	Identified Stakeholders
Utility Providers	Utility providers are crucial to the establishment and ongoing operation of the IIPH. As outlined in this report, engagement with this group of stakeholders requires location/land confirmation for a more targeted and defined estimates on construction and planning.	<ul style="list-style-type: none"> Water supply/waste treatment Electricity provider Gas provider Civil engineers – road/IIPH planning and construction Waste service provider
Community	There are several established community groups who, in future planning, will require ongoing consideration and engagement. Not all community stakeholders are exclusive to the IIPH and this is where coordination with the other Western Sydney parties is crucial i.e. WSA. Key community groups outlined relate to landowners at this point in time. Timing on engagement with these groups should be examined based on desired location of IIPH and timeframes for the NSW Government and WCAA.	<ul style="list-style-type: none"> Aerotropolis Agribusiness Action Group Luddenham Progress Association Western Landholders Group
Amenity Providers	While amenity providers were not directly consulted as part of the study, the engagement of this group will be required as IIPH planning evolves, tenants are confirmed and internal IIPH services are required to support tenants and their employees.	<ul style="list-style-type: none"> Cleaning companies – shared facilities and/or leased buildings Strata or facilities operators Food & beverage retailers – on-site facilities for IIPH tenants
Government	While the NSW Government is a government agency, there are other government related entities engaged in the Western Sydney development process. Engagement and consultation with these groups is crucial in ensuring the overall vision of the Western Sydney Aerotropolis is realised, including the IIPH.	<ul style="list-style-type: none"> Councils i.e. City Deals State Government i.e. Greater Sydney Commission, Department of Planning & Environment, NSW Transport, Roads & Maritime Services Federal Government i.e. Department of Agriculture and Water Resources (regarding federal biosecurity), Department of Infrastructure, Regional Development and Local Government Other Non-Government entities i.e. NSW Chamber of Commerce, Industry Associations e.g. NSW Farmers, NBN Co, Regional Development Australia
Private Sector	While the private sector have been considered in the lens of potential tenants, they are a core user of the proposed IIPH. Users will either be tenants of the IIPH or users of the borderless IIPH/export clearance facilities. There are two clear engagement platforms and both tenants and users of the IIPH remain key success factors in the overall concept.	<ul style="list-style-type: none"> Food processors/manufacturers Primary producers including greenhouse operators Food product importers Airline caterers

Stakeholder Group	Insights	Identified Stakeholders
Research Community	While research and education providers are not the core or primary stakeholder group, there is consideration for their participation in the IIPH as the concept continues to move towards strategy and dependent upon the tenant landscape. Some of these stakeholders were engaged through the study engagement process and should continue to be engaged as part of a wider stakeholder engagement strategy.	<ul style="list-style-type: none"> • CSIRO • Food Innovation Australia Limited • University of Sydney • Western Sydney University • NSW TAFE • Research and Development Corporations, for example, Meat & Livestock Australia • CRC's, for example, Food Agility CRC
Other	Other stakeholders for consideration as outlined.	<ul style="list-style-type: none"> • Property developers • Capital or private investors

Once the next steps for the PH have been determined, especially in respect to the governance model and ideally location, a detailed stakeholder engagement strategy should be developed. The strategy should take into consideration the phasing of the IIPH process moving forward and the priorities of each of the stakeholder groups. Consultation and engagement is crucial especially when community support underpins not only the short-term however longer term objectives of the broader development of Western Sydney. Timeliness is also a key consideration and in most cases, the earlier engagement occurs the more effective as long as there is a clear value proposition and structure for the IIPH (ie governance and location).

13.2.7 Resourcing

A significant amount of action is still required to continue to advance the IIPH concept in time for a

2024 delivery. At a minimum, the engagement and negotiation with land owners and utilities providers requires appropriate planning and further consideration. The NSW Government (and/or WCAA) will be required to review their resourcing capabilities and determine the level of internal and external resources to advance the IIPH concept.

13.3 Risks and mitigation

The risks associated with this concept are many and broader reaching and will evolve as the concept progresses from prefeasibility through to feasibility and development.

The below is not an exhaustive list of risks but seeks to capture key risks and high level mitigation strategies. As the project progresses it is critical that this list is expanded, refined and updated to reflect the development and commercial model of the IIPH.

Table 10-7: Key risks and mitigation strategies

Key Risk	Mitigation Strategy
Identification and acquisition of appropriate land: A number of appropriate locations have been identified for the proposed IIPH within the WSA region. Without defining the precise location and value, commercial analysis and operational design is compromised.	Once land parcels and value have been determined more detailed commercial and operational analysis should be performed.
Governance and commercial structure: High level recommendations with regards to the governance and commercial structure of the IIPH, may require further refinement based on WCAA establishment timing.	NSW Government to continue building on the initial engagement with the newly formed WCAA and establish a pathway to take the study outcomes forward.
Governance and commercial structure: WCAA may not have the capacity or resources to take a lead coordinating role in commercialising the IIPH	Test the level of interest, capacity and availability or resources at WCAA to take a lead role in coordinating the commercialising

Key Risk	Mitigation Strategy
Tenant identification and attraction: The analysis to support this study has assumed a range of commercial tenants will be attracted to the IIPH. Failure to attract commercially profitable tenants to the IIPH will compromise the viability.	Conduct further market sounding to test the level of commercial interest in the IIPH. Develop a tenant attraction strategy based on the outcomes of the market sounding.
Market access: Analysis has assumed that products produced within the IIPH will have market access to key export markets. If market access does not exist demand could be considerably reduced.	Work with State and Federal government to assist acceleration of market access protocols for high priority protocols.
Collaboration: The success of the IIPH will be dependent on collaboration between multiple stakeholders. Whilst a number of successful examples of large scale collaboration in food production and processing have been identified, there is limited evidence of large scale collaboration in food production and processing in the Australian market.	Further explore and define the inhibitors to collaboration in the Australian market and identify potential opportunities to incentivise collaboration
Revenue analysis: Revenue analysis has assumed that current market prices for produce will be maintained despite a significant uplift in supply, this is largely based on the ability to supply global markets through the WSA.	Conduct further financial analysis as the concept progresses to feasibility and business case to refine demand and price expectations.

Source: KPMG

13.4 Summary

In summary:

- **Key elements of the IIPH concept have been identified and defined:** the IIPH has evolved over recent months and continues to be refined as ideas and strategies are conceived and introduced.
- **A clearer appreciation of the IIPH pathway has been established:** to this end, the value proposition and commercial structure has become clearer and this will allow the NSW Government to more fully consider the opportunities and risks associated with the developing the IIPH and the appropriate pathway to take forward.
- **There is commercial merit to the IIPH but there are significant risks to manage:** analysis of industry trends, best practices and the IIPH feasibility outcomes indicate that the IIPH concept has commercial merit and the potential to yield positive outcomes – albeit with risks to be managed and explored.
- **Adopting a structured approach to delivery:** The project will ultimately benefit from adopting a structured approach that comprehensively incorporates the vision and proposed attributes of the IIPH whilst integrating future ideas and improvements.

13.5 Next Steps for consideration

1. Conduct a full feasibility study:
 - Further refine the value proposition and key elements of the IIPH;
 - Define the role(s) of the Federal Government and NSW Government (including WCAA) in leading the concept through feasibility to commercial proposition;
 - Develop a land acquisition strategy and land owners engagement plan;
 - Develop the innovation and circular economy model, including guidance for suppliers, operations, access arrangement for providers, equipment requirements and details of the CHP plant; and
 - Develop a tenant attraction strategy
 - Identify high potential products and work with State and Federal government to accelerate market access protocols for high potential products
2. Liaise with NSW DPE and Planning Partnership to finalize the WSA LUIIP Stage 2 to help safeguard the preferred locations for the IIPH.
3. Consider and explore partnership arrangements with key utility providers.
4. Confer with Transport for NSW on the timing of work on the Northern Road, OSO and the M5 extension to ensure corridor preservation and access arrangements to service the preferred location of the IIPH.

Appendix: Western Sydney Aerotropolis planning maps

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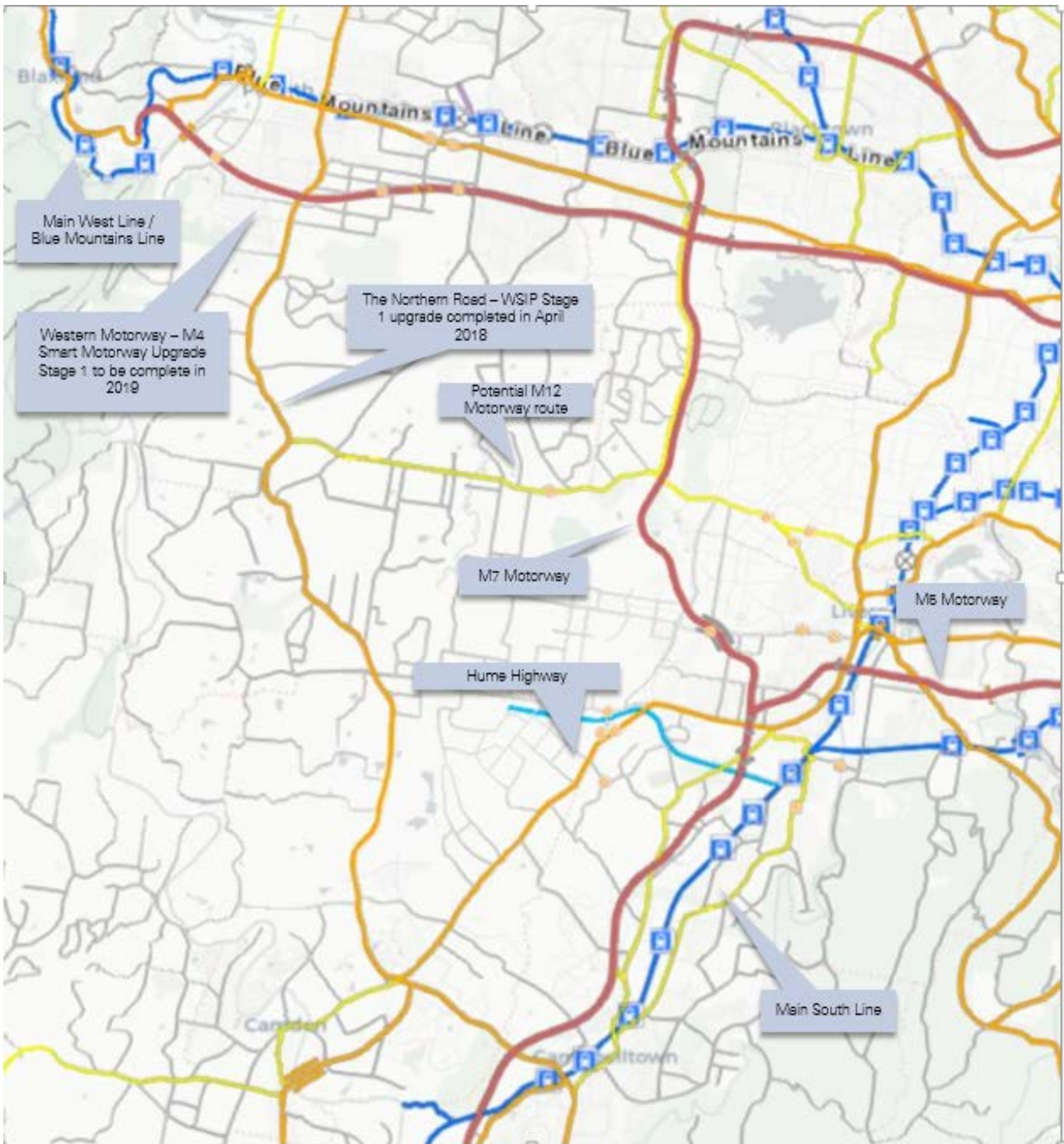


Figure 12: Current planned road and rail infrastructure for the Aerotropolis

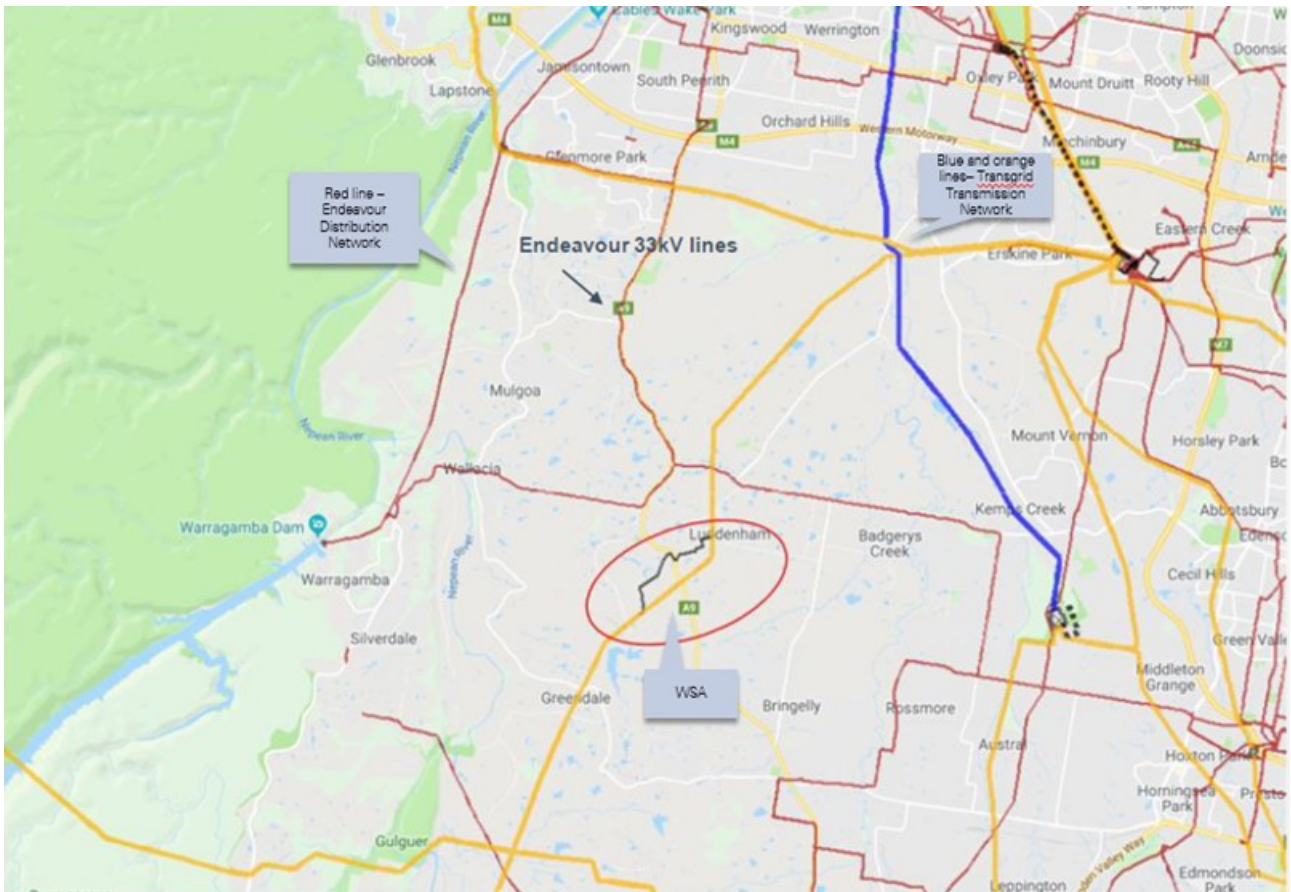


Figure 13: Current planned TransGrid Network and Endeavour connections at the Aerotropolis

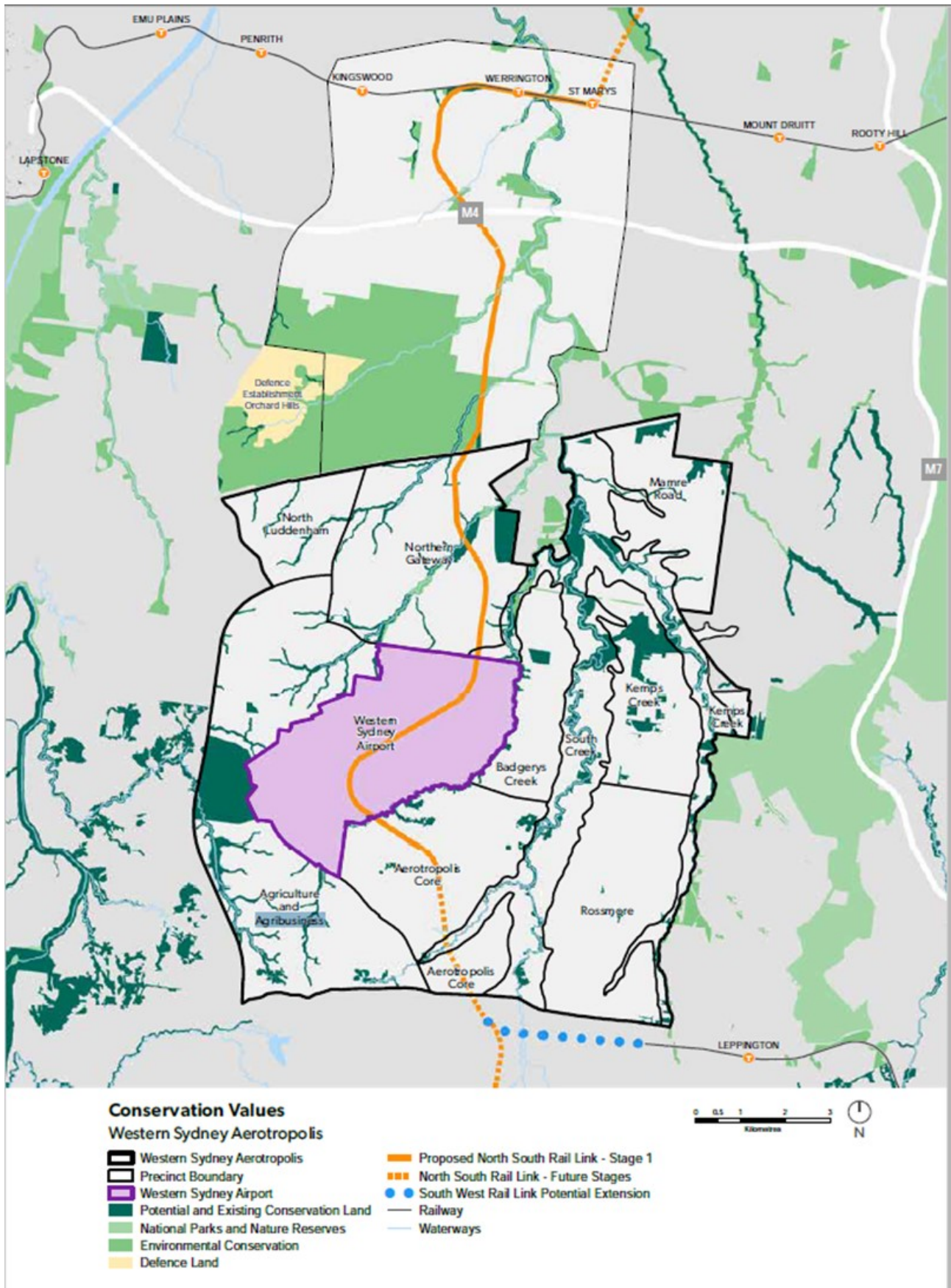


Figure 14: Western Sydney Aerotropolis Land Use and Infrastructure Implementation Plan - Conservation Values Plan

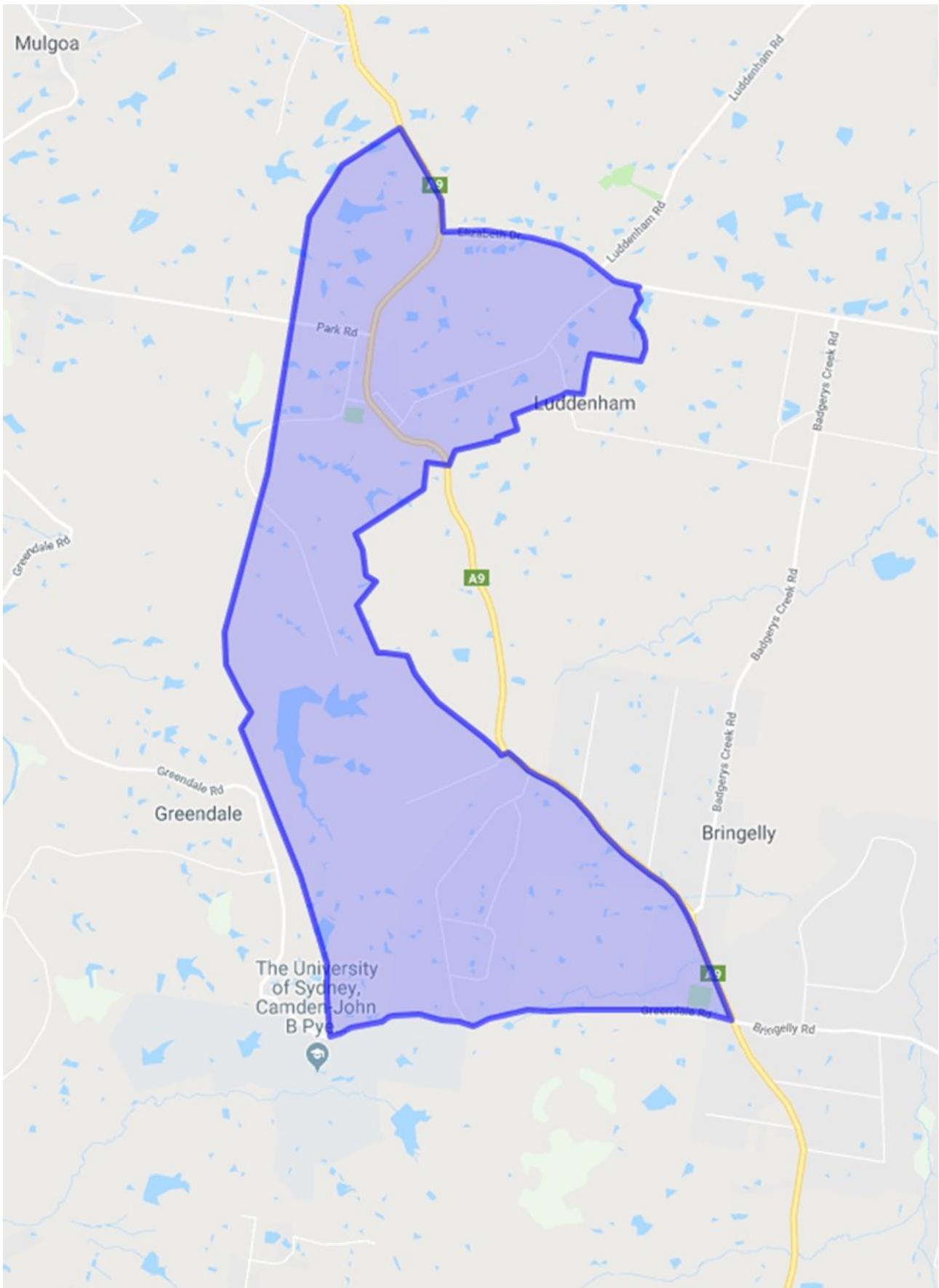


Figure 15: NearMap Pty Ltd street map showing location of Precinct and major water bodies

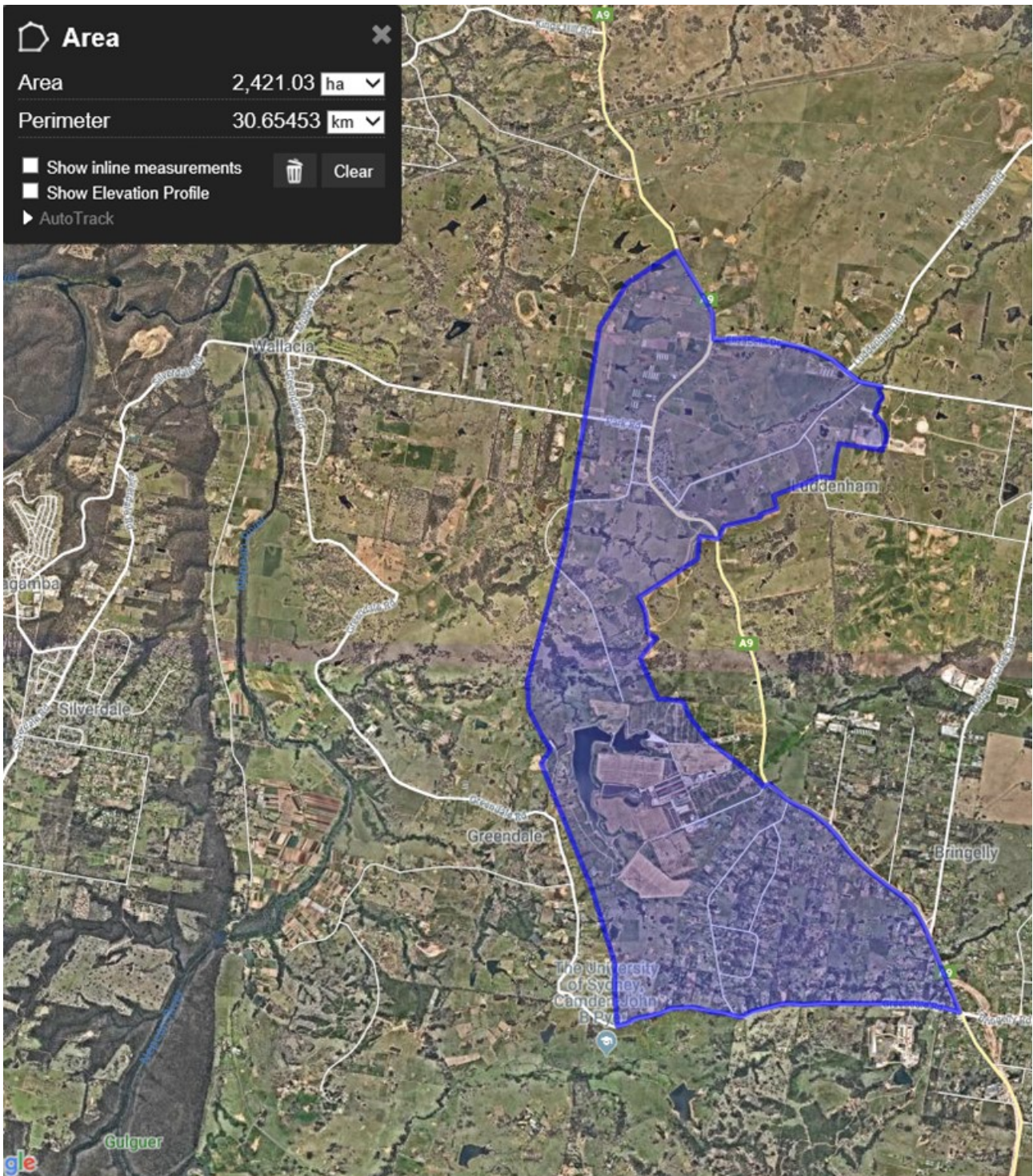


Figure 16: Nearmap Pty Ltd aerial photo of precinct and surrounding areas including approximate area.

Appendix: Precinct and education cluster case studies

15

15.1 International precincts



Agriport A7 - Noord Holland, Netherlands



HIGHLIGHTS

What is it?

Agriport A7 (Noord Holland) is a modern project hosting 850ha of Greenhouse park including large scale glasshouses and open field areas for the production of fresh vegetables as well as processing and logistics entities. The facility is the Netherlands' largest Greenhouse Horticulture Region and houses 100 ha of business park. The industrial park was officially opened in November 2008.

Key industry focus?

- Greenhouse park
- Business park
- Logistics and transport

Innovation type/s?

- Data centre
- Self-sufficient energy generation, including geothermal energy
- Participant-owned shared services



OVERVIEW

Vision/Purpose

To produce intensive horticultural crops at scale leveraging shared investment in energy and logistics. Reducing impact on environment and creating energy self-sufficiency.

Achievements

- The first hyper-scale data centre has been operational at Agriport since 2015.
- Two more plots of 70 ha and 55 ha are now available for data centres in the Agriport area.
- Energy Combination Wieringermeer (ECW) has completed a geothermal energy project in combination with horticulturalists in Agriport. The geothermal energy project has been operational at Agriport since 2015 providing stable heat for heating the greenhouses.

Companies

- Hiemstra BV
- Agriport A7 BV
- Barendse-DC
- Gam Bakker BV
- Ruigewaard BV
- Peter Appel Transport
- De Palletcentrale
- Poeliersbedrijf Van der Laan
- Peter Mul boomverzorging
- Lunchroom De Tafel van Agriport
- Shell
- AcconAVM accountants en adviseurs
- Bakker Personeelsdiensten
- Crown of Holland
- Microsoft
- B&S Watering systems
- Van der Bel



Agriport A7 - Noord Holland, Netherlands

How does it work?

Europe’s largest high tech greenhouses are based at A7. In large scale greenhouses, like in data centres, management of energy costs is the key to success. The 150kV underground power lines bring down the power costs and the 450MW of wind power at A7 makes it easier to meet the company’s environmental goals.

A7 is located just 30 car minutes north of Amsterdam, where 60 per cent of all Forbes 2000 companies active in ICT have already established an office. Yet, A7 is located in a low density populated area and has therefore had less impact on the way people live and recreate. And compared to the urban Amsterdam area, the land prices are competitive.

The companies at A7 are interconnected in an ecosystem of industries that benefit most from world class infrastructure. The A7 location therefore offers many advantages for large scale data centre operations.

Expansion of data centres in the business park

Companies such as Microsoft, Alphabet, Amazon and CyrusOne are planning to establish data centres in the park as A7 is located near AMS-IX and Amsterdam Airport Schiphol. A7 is focused on applying circular economy principles at these data centres. A7 is located approximately 60km from the closest airport

- *Power generation:* The park utilises energy produced by the greenhouses to generate electricity for the data centres, whereas, heat and carbon dioxide produced from the servers of the data centres are used by the nearby greenhouses
- *The business park* also offers large plots and enables quick and smooth construction of data centres due to cooperation between the government and the project developer (the Regional Development Agency NHN, the Netherlands Foreign Investment Agency (NFIA), and the A7;
 - Microsoft has established two data centres in A7, whereas, Amazon announced plans to build a data centre located on a purchased plot of land of 24 ha at the facility;
 - In October 2018, CyrusOne announced plans to develop hyper-scale data centres in A7 and as per the agreement will have the option to purchase up to 33 ha of land to build a 270MW master-planned multi-data centre campus;
 - In 2018, Alphabet purchased 70 ha of land at the A7 and plans to use the land for the expansion of its data centres. According to Jack Kranenburg, commercial director of A7, the building permit has been issued in the name of Nimble, and estimates a data centre of around 3 ha on a plot of 24 ha.



CREATING AND MEASURING IMPACT

Measuring impact

- Commercial productivity – high yielding production
- High skilled jobs
- Creating new economies
- Circular economy – recycling of CO² and heat

Brands

- Microsoft
- Shell
- Crown of Holland
- Hiemstra
- Gam Bakker
- Accon avm



KEY INSIGHTS FOR WSA – IIPH

- ✓ Business park tenancy model
- ✓ Led by private sector
- ✓ World leading example for food production, logistics, energy and circular economy
- ✓ Co-operative geothermal heat source, leading to reduced energy cost for tenants
- ✓ Hosts Microsoft and Amazon data centres



AeroFarms - Newark, New Jersey, USA



HIGHLIGHTS

What is it?

Newark is home to AeroFarms, 0.64 ha flagship production facility. It is the world's largest indoor vertical farm with a core focus on sustaining a thriving circular economy.

Key industry focus?

- Horticulture (leafy greens), biology, engineering, automation, building systems, food safety, nutrition

Innovation type/s?

- Smart aeroponics - a closed loop aeroponics system
- Smart lighting
- Smart nutrition
- Smart data / analytics
- Smart substrate
- Smart pest management
- Smart scaling



OVERVIEW

Vision/Purpose

"AeroFarms is on a mission to transform agriculture by building and operating environmentally responsible farms throughout the world to enable local production at scale and nourish our communities with safe, nutritious, and delicious food."

Achievements

- AeroFarms was the first and only agriculture company to date to be honoured by the Ellen MacArthur Foundation as one of the Circular Economy 100, a select group of global companies focused on eliminating waste and improving our positive impact on the environment and sustainability
- AeroFarms received a US\$1 million Seeding Solutions grant from the Foundation for Food and Agriculture Research to work with universities on research to improve global crop production and plant nutrition
- In 2017, AeroFarms was awarded US\$11.14 million in tax incentives for over 10 years to build the US' largest indoor farm in Camden, New Jersey.

Financial partners

- Meraas
- Wheatsheaf
- Mission Point
- Ikea
- ADM Capital
- EB Bernstein
- GSR Ventures
- Middleland Capital
- Prudential
- Goldman Sachs



AeroFarms - Newark, New Jersey, USA

How does it work?

AeroFarms is a vertical aeroponic farming (a technique for crop growth using limited water and no soil) company growing green-leafy vegetables at its facility.

The plants are all grown without pesticides, because they're protected from pests inside the warehouse.

Aerofarms implements vertical aeroponic farming and uses military-grade technology to monitor the plants and maintain optimum conditions for high yields. The company offers three mixed greens and three standalone greens including baby greens, microgreens and herbs such as kale and arugula.

Funding model

- In May 2017, AeroFarms closed a US\$40 million Series D round, adding IKEA Group and David Chang, chef and founder of the Momofuku Group, and retired US Army General David Petraeus to a previously released list of international investors
- The round takes AeroFarms' total fundraising efforts to over US\$130 million since 2014, including a US\$40 million debt facility from Goldman Sachs and Prudential

AeroFarms will use the latest round of funds for continued investment in leading R&D and technology and additional farm expansion around the world.



CREATING AND MEASURING IMPACT

Measuring impact

- 0.65 ha facility
- AeroFarms uses 95 per cent less water than field farming and has developed a closed loop water circulation system that recirculates water to our plants
- Every year, AeroFarms produces up to 30 harvests and yields 907.2 tonnes of greens
- AeroFarms uses less than 1 per cent of the land required by conventional growing. That means we are over 390 times more productive per square foot vs. traditional agriculture, while also ensuring that our plants get all of the macro and micro nutrients they need all year round
- Resource efficiencies
- Circular economy
- Optimise for taste, texture, colour, nutrition, and yield



KEY INSIGHTS FOR WSA – IIPH

- ✓ Most successful agricultural circular economy
- ✓ Example of benefits and capabilities of vertical farming
- ✓ Combination of digital, scientific, automation and engineering innovation
- ✓ Environmentally responsible farms



Rothamsted Centre for Research & Enterprise (RoCRE)

Harpenden, United Kingdom



HIGHLIGHTS

What is it?

The Rothamsted Centre for Research and Enterprise (RoCRE) is a research hub focused on promoting collaboration and innovation by partnering with commercial, agricultural and technology businesses.

The site is located on a 400 ha Rothamsted site in Harpenden.

Key industry focus?

- Agri-food
- Bioscience
- Horticulture

Innovation type/s?

- Co-working space for research (not production)



OVERVIEW

Vision/Purpose

“Aim to deliver know-how, data, better practices and new technologies to improve the performance, resilience and value of crop and livestock systems in the UK and worldwide.”

RoCRE offers a range of facilities including conference facilities, flexible laboratory space and informal meeting hubs.

Achievements

- Rothamsted houses a unique experimental system and an archive of soil and plant samples which has been running continuously since 1844
- Close collaboration between R&D and companies - Enterprises operating in the building benefit from working alongside scientists from Rothamsted Research

Companies

(18 tenants at the Daniel Hall Innovation Centre and Lawes Open Innovation Hub)

- AgriMetrics
- BioNemaX
- Gowan
- Plant Impact
- Timac Agro

Facilities

- Soil and Seed Analytical services
- Controlled growing environments
- Glass house facilities
- Farm platforms
- Insectary
- Metabolomics
- Field Trials
- Bio-imaging



Rothamsted Centre for Research & Enterprise (RoCRE) Harpenden, United Kingdom

How does it work?

The site consists of large field trial systems (primarily wheat research) and a series of facilities for plant bioscience including modern lab space and facilities for bio-imaging, microscopy, molecular analysis, metabolomics, proteomics, over 1,000km² ha of glasshouse space, an environment-controlled building with 16 cabinets and 8 growth rooms, containment facilities and an insectary unit.

Incubation and collaboration spaces are the key facilities available at the campus;

- The combined office and lab incubation space accommodates SMEs
- The collaboration hub offers expert business and technical support and space to promote information exchange, collaboration and growth with labs and meeting spaces
- Provide a shared laboratory space for research scientists and allow use of a project office. Support is available from the Rothamsted Knowledge Exchange and Commercialisation team.

RoCRE manages the Daniel Hall Innovation Centre, the Rothamsted Conference Centre and the Lawes Open Innovation Hub alongside Rothamsted Research;

- Current research engagements at RoCRE include designing new wheat germplasm, improving yield in Brassica crops, and increasing photosynthetic efficiency in wheat plants
- The Daniel Hall Innovation Centre provides incubation facility for start-ups, small and medium sized agribusiness companies.

Funding model

- Research funding is provided by the Biotechnology and Biological Sciences Research Council (BBSRC), Lawes Agricultural Trust and Rothamsted Research. Grants from partnerships with research institutions, universities and companies also support RoCRE's "Science Portfolios" (research projects) in crops productivity and future agri-food systems
- The Hertfordshire Local Enterprise Partnership invested £500,000 from the Growth Deal and the Growing Places Fund into this project in 2015-16
- Use of facilities is on a monthly fee basis

Participation/ Engagement model

- Agri-related start-ups have access to office and lab incubation modules, cold rooms, meeting suites, and agile working environments
- Access to collaborative events, conferences and workshops and subsequent opportunities to connect with a global network of corporate partners

Partners

- Rothamsted Research
- Lawes Agricultural Trust
- BBSRC
- Agritech East
- Green Triangle
- Cambridge Cleantech Network
- Hertfordshire Growth Hub



Rothamsted Centre for Research & Enterprise (RoCRE)

Harpenden, United Kingdom



CREATING AND MEASURING IMPACT

R&D focus

- The Agri-Tech Research Innovation Accelerator (AgRIA) program is designed for accelerating agricultural innovation by providing business mentors and encouraging technology patents in agriculture
- Research collaboration centre at the Lawes Open Innovation Hub encourages innovation and research engagement between commercial companies and academia

Measuring impact

- Located on the renowned Rothamsted Research Campus, which is the longest running agricultural research station in the world
- Over 170 years of agricultural expertise
- 300 onsite scientists for research assistance
- 16,000 field trial plots

Commercialisation pathways

- The Rothamsted Centre for Research and Enterprise (RoCRE) provides incubation space for agricultural technology businesses. RoCRE currently houses R&D divisions for 18 businesses
- The RoCRE Lawes Open Innovation Hub was opened in 2015 to enhance relationships between businesses and researchers to deliver new agricultural technology
- The Daniel Hall Innovation Centre provides Agritech SMEs with the laboratory and office space for agri-tech SME's.⁴²



KEY INSIGHTS FOR WSA – IIPH

- ✓ State of the art facilities designed for scientific innovation
- ✓ Collaborative environment for start-ups, dedicated to the development of businesses
- ✓ Research support for onsite tenants
- ✓ No production capability

"RoCRE welcomes another agricultural innovator", [Link](#); "Opening up innovation in plant science", [Link](#); "AGRIA", [Link](#); "Dedicated To AgriTech Business Growth", [Link](#); ROCRE-Rothamsted, [Link](#); "Information Exchange, Collaboration And Growth", [Link](#)



National Agri-Food Innovation Campus York (NAFIC) York, United Kingdom



HIGHLIGHTS

What is it?

What is it?

NAFIC is located in the countryside of North Yorkshire and is placed approximately 8 miles from the historic city of York. The NFAIC at Sand Hutton offers 2.78 ha of office and laboratory accommodation.

Key industry focus?

- Agribusiness
- Education
- Life Sciences
- Pharmaceutical
- Healthcare
- Biotech

Innovation type/s?

- Labs and innovation centres
- Networking and open innovation space
- Sustainable farming



OVERVIEW

Vision/Purpose

NFAIC offers a range of options for organisations to grow within a scientific environment.

The organisation aims at providing science accommodation, support services, accessible location and opportunities to interact with scientists and businesses, working at the interface of government, academia and industry.

Achievements

- Taiwan based agritech company, YesHealth Biotechnology, announced its plan to establish its European base facility at NFAIC by 2020
- In 2017, two businesses expanded into NFAIC; Symbiosis IP Ltd and FPCR, and both the businesses are using their offices as northern headquarters
- Covance Drug, drug development business, expanded its biopharmaceutical chemistry, manufacturing and control (BioPharmCMC) capabilities into leased space at NFAIC in 2017
- In 2016, as part of the UK Government's Agri-Tech strategy, two centres for Agricultural Innovation have been established at NFAIC: The Centre for Crop Health and Protection (CHAP) and The Centre for Innovation Excellence in Livestock (CIEL)

How does it work?

- NAFIC focuses on development of the regional agri-tech agenda and works with local partners including the Universities of York, York St John, Bio-renewable Development Centre (BDC), and the agricultural colleges of Askham Bryan and Bishop Burton
- The site can accommodate large or small occupiers with a range of options including fully-fitted wet and dry labs, offices, and write-up space suited to research and specialist manufacturing
- NFAIC has eight major facility blocs, with each bloc including a mix of laboratory and office space with labs available up to 0.04 ha and adjoining offices up to 0.3 ha
- Laboratories are designed to support the research, diagnostics and laboratory need based on the production methods
- NFAIC provides a platform for all types of research including living skin cultures research, field work on beehives, proto-type testing of a diagnostic kit, and development of a pre-manufacturing pilot plant
- Participation/ Engagement model

Public-private partnerships

- Partners range from government agencies, NGO's, civil society organisations, health agencies such as Animal Plant Health Agency (APHA), Fera Science Ltd, Public Health England, Crop Health and Protection Limited
- NAFIC has a well-established relationship with Science City York (SCY) and is a core member of the Bioscience Director's forum that enables the tenants on the campus to engage within the bioscience sector across industry players and academia

Seminars/Programs

- In 2016, NAFIC hosted UKTI Agri-Tech sector specialists from markets across the globe including India, Brazil, China, Canada, USA, New Zealand and Europe. The event focused on highlighting the knowledge and research capacity that existed within Fera Science Ltd, CHAP and CIEL and its assistance in addressing both global and country specific agriculture challenges



CREATING AND MEASURING IMPACT

Measuring impact

- NFAIC offers an 80 acre parkland setting with 2.3 ha of office and lab space
- The campus offers a 250-seater lecture theatre
- Provides laboratory space equipped with HVAC, laboratory gases, utilities, fume extract and benching
- NAFIC receives investment from the York, North Yorkshire and East Riding Local Enterprise Partnership (LEP), aimed to assist businesses in accessing agri-food applied research expertise



Partners

- Animal & Plant Health Agency
- Department for Environment Food & Rural Affairs
- Public Health England
- Abingdon Health

Fera Science

R&D focus

The organisation has partnered with Make it York and Science City York (SCY), to support the companies and agencies with funding and grant development

Commercialisation pathways

- NFAIC aims to have 1,600 people employed onsite by 2021 from the current total staff of 850
- Provides business services and office space to research organisations that work together with companies, government authorities and other knowledge institutes
- Cooperate within bilateral projects as well as public-private partnerships⁴³



KEY INSIGHTS FOR WSA – IIPH

- ✓ Provides space and infrastructure access to tenants
- ✓ Government supported
- ✓ Focus on research, providing research support for partners onsite

NFAIC company website: Home page, [Link](#); NFAIC Accommodation, [Link](#); "Two new centres for Agricultural Innovation", [Link](#); "NAFIC hosts UKTI Agri-Tech sector specialists from across the globe", [Link](#); "The Campus welcomes new tenants", [Link](#); "Taiwan to invest £18m in UK to build new vertical farm", [Link](#)



Techno Farm Keihanna - Kizugawa, Kyoto, Japan



HIGHLIGHTS

What is it?

Techno Farm Keihanna employs an automated cultivation system with the largest output of any indoor vertical lettuce farm in the world at 30,000 heads (3 tons) daily.

Key industry focus?

Lettuce

Innovation type/s?

Innovation at Techno Farm centres around three themes: reduced cost, limited environmental impact, and global adaptability.

Technology includes:

- Automated cultivation system
- Water recycling rate of up to 98 per cent
- Environmental control technology (temperature, humidity, wind velocity, lighting intensity)
- Specialised LED lighting
- IoT/AI technologies to optimise cultivation through analysis.



OVERVIEW

Vision/Purpose

“World’s First and Largest Automated Vertical Farm for Lettuce”

Purpose: Representing the next generation of vertical farming, Techno Farm builds on Spread’s original indoor vertical farming technology to provide a further improved model for stable production in any climate.

Mission: Continually work towards the realisation of a sustainable society while protecting the environment through the use of food technology for the comfort and safety of our children and of future generations.

Achievements

- SPREAD has operated its current indoor vertical farm, Kameoka Plant (Kameoka, Kyoto) since 2007, which produces 21,000 heads (2 tonnes) of lettuce every day
- By March 2013, SPREAD achieved profitability
- In 2014, SPREAD started developing its next-generation vertical farming system, Techno Farm, based on its accumulated know-how with the aim of global expansion
- In 2016, Techno Farm received a gold award at the Edison Awards
- Pesticide-free lettuces contain more beta-carotene - an antioxidant - than other farm grown lettuce

How does it work?

- Techno Farm Keihanna is owned and operated by Spread Co. It is a vertical farming production company that directly sells to 2,400 supermarkets and retail stores all over Japan using their own sales force and in store promotion
- Spread collaborates with a range of innovative business partners from a variety of backgrounds as it works to produce ever greater technological innovation and make sustainable agriculture reality
- For the development of cultivation technology and new products, Spread conducts research on topics related to cultivation technology, product quality and global environment
- Spread has collaborated with Japanese equipment manufacturers to develop innovative technologies for water recycling, environmental controls, automated cultivation and LED lighting
- Spread provides knowledge on construction design, cultivation, and operations, while the local partner operates the Techno Farm, and manages sales and logistic
- Partnership models include license model, JV model and JV + SPV.

“Techno Farm Keihanna, World’s First and Largest Automated Vertical Farm to Break Ground”, [Link](#); “Largest automated farm to open in Japan”, [Link](#); “Techno Farm Keihanna”, the Largest Automated Vertical Farm in the World, to Start Shipping its Products”, [Link](#); “Skyscraper farms are about to go global”, Finance and Commerce, [Link](#)



Techno Farm Keihanna - Kizugawa, Kyoto, Japan



CREATING AND MEASURING IMPACT

Measuring impact

- Reduction in cost, environmental impact, and global adaptability
- Eco friendly – recycles 98 per cent of water used for cultivation
- Low cost – 50 per cent labour cost reduction, 30 per cent energy cost reduction
- IoT – remotely collects and analyses big data production
- According to Japanese researcher Innoplex, the cost to make one head of lettuce at the existing Kameoka building is about 80 yen



Commercialisation models / IP arrangements

- Spread plans to apply franchise/ownership model in the domestic market, to acquire 10 per cent share of the Japanese lettuce market and aims at achieving a daily production capacity of 500,000 lettuce heads (50 tonnes)
- Globally, Spread will cooperate with local companies and provide technology and support for distribution and sales. Spread will develop and propose business schemes applicable to each area.
- Spread has collaborated with technology companies such as NTT West to implement an artificial intelligence program to analyse production data



KEY INSIGHTS FOR WSA – IIPH

- ✓ Provides a model for stable production in any climate
- ✓ Focus on innovation to provide better outcomes
- ✓ Global reach
- ✓ Water recycling rate up to 98 per cent
- ✓ Using food technology to work towards a sustainable society



World Horti Centre - Naaldwijk, Netherlands



HIGHLIGHTS

What is it?

World Horti Center provides educational, research and presentation services for international greenhouse Horticulture sector

Provides solutions to social issues relating to water quality, food supply, food safety and sustainability

Key industry focus?

- Agriculture
- Horticulture (tomato and cucumber)

Innovation type/s?

- Knowledge and innovation centre of international greenhouse Horticulture
- Co-working space
- "HortiHeroes" incubator



OVERVIEW

Vision/Purpose

World Horti Centre's primary vision is to "play a leading role in providing solutions to relevant social themes such as water, food supply, food safety, well-being and sustainability."

The global greenhouse horticulture sector can make a major contribution to the health and well-being of people globally. The precinct is a platform where business, education and government jointly innovate, connect, create and inspire.

Companies

670 horticulture companies

- AAB nl
- BOAL systems
- Rabobank
- Westland partners
- MEERdeur
- Valk systemen
- Priva

"Techno Farm Keihanna, World's First and Largest Automated Vertical Farm to Break Ground", [Link](#); "Largest automated farm to open in Japan", [Link](#); "Techno Farm Keihanna", the Largest Automated Vertical Farm in the World, to Start Shipping its Products", [Link](#); "Skyscraper farms are about to go global", Finance and Commerce, [Link](#)



World Horti Centre - Naaldwijk, Netherlands

How does it work?

- The World Horti Centre provides short and long term co-working spaces along with a permanent exhibition hall for innovative companies in the greenhouse industry
- The precinct is home to the Dutch Greenhouse Demo Centre, a research greenhouse, and school & universities specialised in horticulture
- The center provides about 22,000 sqm of total area including:
 - 4,000 sqm with 40 classrooms for 1,300 students
 - 6,500 sqm state of the art research facilities
 - 10,000 sqm business to business area
- There are different docks for different vegetables like tomato and cucumber which can be climate controlled according to conditions of any country in the world from a central control room
- The ground level centre features 6,500 sqm of research facility, whereas, the second level provides space for 1,300 students to take part in academics and internships provided by horticulture companies
- Demokwekerij Westland research centre, co-initiator of the World Horti Center, undertakes various studies within the time frame of 2 weeks to 3 years, including:
 - Crop protection on behalf of crop committees and various manufacturers of both chemical and biological pesticides
 - Climate research on orchids on behalf of orchid crop committee
 - Fertilisers study, developing new fertilisers and feeding methods
 - Studies of new detection methods using drone and fluorescent technology
 - Climate research and bio-stimulant research on tomatoes

Partnerships with companies and education centres

- MBO Westland is a part of Lentiz Educational group and is a co-initiator of World Horti Center. MBO Westland provides more than 20 courses in trade, business services, engineering, care and food. MBO Westland address the need of regional business community
- InHolland provides a two year associate degree at World Horti Center educating junior professionals on running a horticulture business

Participation/ Engagement model

- Participants pay to use the co-working space and facility
- Participation in the trade fair gives year round exposure to potential investors and other interested parties



CREATING AND MEASURING IMPACT

Measuring impact

- Annual visitors to the centre
- Over 80 companies exhibiting in the year round international greenhouse horticulture sector show
- 38 departments in the research centre
- Over 1,300 students and 25,000 professional visitors every year



KEY INSIGHTS FOR WSA – IIPH

- ✓ 270 co-working spaces, hackathons and purposefully designed buildings create start-up friendly environment
- ✓ HortiHeroes incubator helps identify and develop entrepreneurs
- ✓ Connection to education to drive talent growth
- ✓ Strong focus on collaboration between private and public sector
- ✓ Sustainable energy features
- ✓ International engagement attracts 25,000 professional visitors each year



Fresh Park Venlo - Venlo, Netherlands



HIGHLIGHTS

What is it?

- Fresh Park Venlo (FPV) develops and maintains functional and profitable housing for Fresh & Food companies at a dedicated food park in Venlo. The business park includes 130-ha of Private Food Park and more than 25 ha Business space.⁴⁶

Key industry focus?

- Food
- Fresh produce
- Processing and distribution of fresh food

Innovation type/s?

- SMART Logistics Centre Venlo
- Cameras and vision system sorting



OVERVIEW

Vision/Purpose

Fertile breeding ground for cooperation and development of new food products and services.

Recent development

- In October 2018, Hines Europe acquired the business park from Royal ZON through perpetual leasehold right.

Companies – 100+ food companies and suppliers

- | | |
|------------------------------|---------------------------------|
| • Frankort and Koning | • DEMIR |
| • Toyota | • Hendrix fruits and vegetables |
| • Port International | • Landgard |
| • Berry Packing Services | • EuroPoolSystem |
| • Zon Fruits and Vegetables | • Berden |
| • Wetron | • GEA |
| • Gial | • Hagens |
| • Recycold Cool Solutions BV | Nedalpac |

How does it work?

- The FPV business area includes logistics companies, suppliers and producers in the field of the food industry on the ground, as well as companies in the field of storage and packaging industry
- FPV facilitates more than 100 companies in the food business through a dedicated Facility Management Services team and manages the public spaces on the park. However, lessee, owners and tenants are responsible for managing areas within the allocated plot boundaries
- The business park is a logistic hotspot linking the import and export ports of Rotterdam and Antwerp and the German and European market
- Suppliers procure locally / import vegetables from overseas for processing at the park facilities, conduct packaging procedures and transport to retail stores and wholesalers
- FPV offers business space to small-sized businesses and established food companies, along with investment and development of commercial spaces.

Fresh Park Venlo website, [Link](#); Fresh Park Venlo Occupants, [Link](#); About Fresh Park Venlo, [Link](#); Logistics Hotspot, Fresh Park Venlo, [Link](#)



Fresh Park Venlo - Venlo, Netherlands



CREATING AND MEASURING IMPACT

Measuring impact

- Accessible 152 million European consumers within a 9-hour drive. 2 train terminals within 1 km, 2 airports within 100 km and 2 ports within 200 km business area
- Sustainable supply and distribution channels as it provides tri-modal road, waterway and rail transport network
- 70 per cent of the growers are located within 100 km of Fresh Park

Every year 80,000 containers are handled by ECT Venlo

- Includes a 5,400 ha Food And Logistics Centre Greenport Venlo zone
- Supports more than 50 per cent of the road and rail freight trade between Netherlands and Germany
- Some of the practice-oriented education and research institutions specialising in food and logistics are located in the Venlo

Brands

- Zon Fruit & Vegetables
- Landgard
- GEA Refrigeration
- Hendrix Fruit & Vegetables
- Securitas BV



KEY INSIGHTS FOR WSA – IIPH

- ✓ Offers space to small-sized businesses and established food companies
- ✓ Education and research institutions specialise in food and logistics
- ✓ Ideal location linking the Netherlands with the rest of Europe



Atlantic Sapphire - Miami, United States



HIGHLIGHTS

What is it?

The company Atlantic Sapphire is a bluehouse (land-based farm) that does organic farming of salmons for selling and distribution purpose⁴⁷

Key industry focus?

- Fish breeding and production

Innovation type/s?

- Onshore bluehouse



OVERVIEW

Vision/Purpose

The main objective of Atlantic Sapphire is to sustainably produce Atlantic Sapphire salmons in bluehouses which eliminates the need to use net pens and chances of adulteration and infections providing clean and healthy salmon products for consumption.

How does it work?

- Atlantic Sapphire came up with an idea of creating a commercial pilot of a bluehouse for organic farming of salmon and the main reason was to eliminate the need to transport the fish from sea to distribution houses and from there to retail and wholesale stores
- The company is constructing and plans to complete a \$130 million, 3.5 ha facility in Miami to hatch, grow and process salmon by 2019;
 - Miami Bluehouse first phase is constructed near Homestead General Aviation Airport
 - Fresh and salt water wells and an injection well for treated wastewater have been drilled in 20 acres space
 - The company has begun phase 2 construction on the 20 acres purchased in 2016 and plans to buy the contiguous 40 acres to grow papayas
 - Miami Blueshouse water source is purified through limestone rock in a sustainable ancient artesian aquifer
- Atlantic Sapphire established the Denmark Bluehouse in collaboration with Danish recirculation aquaculture expert, Thue Holm, to eliminate the need to use net pens in remote areas for catching salmon
- Atlantic Sapphire salmon has been rated "Best Choice" by the Monterey Bay Aquarium's Seafood Watch, SeaChoice and OceanWise
- The land-based farm or bluehouse uses modern technologies and circular economy principles including:
 - Advanced filtration systems or RAS's purifying water continuously and preventing salmons from being exposed to sea lice and wild fish diseases
 - Creation of renewable energy (biogas) using the waste generated.

Atlantic Sapphire homepage, [Link](#); "Florida, the Salmon State? It could happen soon", [Link](#); "In our Oregon and Washington stores, we carry sustainably farmed Atlantic Sapphire salmon", [New Seasons Market](#), [Link](#); Atlantic Sapphire – our-product, [Link](#); Atlantic Sapphire – about us, [Link](#); Atlantic Sapphire – American sapphire, [Link](#); Atlantic Sapphire – investor presentation, [Link](#)



Atlantic Sapphire - Miami, United States



CREATING AND MEASURING IMPACT

Measuring impact

- Outlook for US project Capex is estimated to increase by US\$15 million, impacting total required funding by US\$11 million
- According to Washington Economics Group, the Miami Bluehouse first phase is estimated to create 2,745 direct and indirect jobs. Also, the construction and development of phase 3 plus operations of the entire project is estimated to create 21,000 jobs
- The Bluehouse in Denmark is operational since 2011 and has produced over 25 generations of Atlantic salmon
- Biological performance: mortality since release in grow out phase less than 2 per cent (in the Denmark facility)
- Outlook for 2018 Capex has increased by US\$2 million since April 2018 due to risk reduction and operational improvements such as increased cooling capacity and feeding system in the Denmark facility
- Commencement of fresh water operations with first eggs scheduled for Q4 2018 for the US facility.



KEY INSIGHTS FOR WSA – IIPH

- ✓ Use modern technologies and circular economy principles
- ✓ Create renewable energy (biogas) using the waste generated
- ✓ Aiming to sustainably produce Salmon to provide cleaner and healthier option

15.2 Education clusters



University of Arizona - Arizona, United States



HIGHLIGHTS

What is it?

The University of Arizona (UA) is a research and innovation institute with expertise in advanced energy, bioscience, agriculture and water, and intelligent transportation systems.

UA has established Tech Launch Arizona that integrates Tech Parks Arizona with campus activities at the University of Arizona⁴⁸.

Key industry focus?

- Bioscience
- Agriculture (mushroom)
- Power generation
- Pharmacy
- Engineering

Innovation type/s?

- Multi-tier vertical farm (VF) based research, education, and outreach facility (UAgFarm)
- Implementation of Agrivoltaics projects
- Advanced sensing & climate control lab
- Aquaponics research



OVERVIEW

Vision/Purpose

“The University of Arizona is committed to providing access to quality education, encouraging research, and using its discoveries to improve lives.”

The Research, Discovery and Innovation (RDI) office of UA focuses on providing researchers with the infrastructure to impact local and state communities. The research centres and facilities contributes to the agribusiness by collaborating with researchers, government and corporates and offer an opportunity for research to drive development of public policy and economic growth.

Achievements

- Times Higher Education has recognized the UA in the top 100 higher-education institutions in the world in the 2017 edition of its annual World Reputation Rankings

Tech Parks Arizona, The University of Arizona, Link; Research, Discovery and Innovation, The University of Arizona, Link; Tech Parks Arizona, Link; Solar Zone, Tech Parks Arizona, Link; Governance - Tech Parks Arizona, Link; Awards and recognitions, Tech Parks Arizona, Link; For Researchers, Research, Discovery and Innovation, Link; Facilities, RDI, Link; Experience BIO5, Link; “What is Agrivoltaics”, Link; Biosphere 2, Link; Institute of the Environment, Link; “West Center - Water & Energy Sustainable Technology”, Link; FEW Nexus, RDI, Link; Controlled Environment Agriculture Center, Link; University of Arizona, Link



University of Arizona - Arizona, United States

How does it work?

The University of Arizona conducts agri-business related research, and provides facilities to support government agencies, corporates, industry partners and other academic institutions to manage and develop crop production applications. The UA operates Research, Discovery and Innovation (RDI) office, Tech Parks Arizona and the Controlled Environment Agriculture Center (CEAC)

- *Tech Parks Arizona*: The UA Tech Park, 544.3 ha site in Tucson, accommodates more than 40 companies. The park includes a 70 ha Solar Zone with 10 companies that have power purchase agreements with Tucson Electric Power. The Tech Parks Arizona also includes an Arizona Center for Innovation that focuses on accelerating technology commercialisation and provides platform for start-ups. Some of the tenants are: Eurest Dining Services, Arizona Technology Council, Arzon Solar, DRS Technologies, IBM, Oracle, Facilities and Plant Services.
- *Research, Discovery and Innovation (RDI)*: The RDI office supports the research enterprise of the university. RDI offers Research Advancement Grants.
- The RDI includes facilities for faculty, students, and scientists in government and industry for experimental research, product research and development, and expert consultations.
- *BIO5 Institute* focuses on collaborating five core research areas – agriculture, engineering, medicine, science, and pharmacy to develop and commercialise new technologies, diagnostics, and treatments.
- *Biosphere 2*: laboratory for controlled scientific studies, and public educational tours. Biosphere 2 is utilised to perform experiments aimed at understanding energy, water, and the environment.
- *Institute of the Environment*: UA established this Institute to identify and implement innovative solutions to manage environmental challenges in Arizona and around the world
- *WEST Centre*: In partnership with government agencies and industry partners, UA established WEST Centre in 2015 with the focus on wastewater treatment and alternative energy.
- UA researchers are working with the government officials in Yuma to enhance agriculture in the region by studying the intersection of Food, Energy, and Water (FEW) and collaborating FEW nexus-related research projects for practical applications.
- *Controlled Environment Agriculture Center (CEAC)*: CEAC facilities are located at the Campus Agricultural Center in Tucson and includes advanced technology greenhouses and growth chambers. The Campus Agriculture Center has greenhouse space of 1,400km² available for UA faculty's research.
- In collaboration with the Plant Science Department, CEAC conducts research on optimising environmental conditions for mushroom growth
- The CEAC launched a multi-tier vertical farm based research, education, and outreach facility (UAgFarm)
- UAqua Farm at CEAC enables engineering and science based research for advancing technology and crop production applications that combine aquaculture with hydroponics.

Partnership model

- Industrial partnerships – solar energy companies
- Academic partnerships
- Partnership with government departments such as Pima County, Tucson Water, along with industry partners to establish WEST Centre



University of Arizona - Arizona, United States



CREATING AND MEASURING IMPACT

Measuring impact

- UA receives more than US\$625 million annually in research funding
- More than US\$20 million funding comes from agencies focused on advancing solar energy such as Department of Energy and the National Science Foundation
- Tech Park Arizona houses 52 tenant companies which employ 5,870 of people
- UA Tech Park at Rita Road encompasses 513.1 ha and 18.6 ha of space for high-tech offices, R&D and laboratory facilities
- RDI office has collaborated with 270 R&D companies

R&D focus

- UA's Tech Park Arizona has announced plans to expand Solar Zone Phase Two, focused on energy storage, grid optimization, and microgrids
- UA is focused on establishing advanced sensing & climate control lab for sustainable CEA
- Focused on wastewater treatment and alternative energy

Commercialisation pathways

- UA Tech Parks provide office, laboratory, warehouse, prototyping, assembling, light manufacturing, data storage centre space to corporates on rent
- Biosphere 2 hosts daily tours for industry experts, government officials and the public with the focus on Earth systems planning and management
- Contract research organisation which works together with companies, government authorities and other knowledge institutes.



KEY INSIGHTS FOR WSA – IIPH

- ✓ Providers researchers with infrastructure and resources to impact local and state communities
- ✓ Academic, industrial and government partnerships
- ✓ Contribute to agribusiness research to drive development of public policy and economic growth



Wageningen University (WUR) - Wageningen, Netherlands



HIGHLIGHTS

What is it?

Wageningen University and Research is a collaboration between Wageningen University and the Wageningen Research foundation, with a focus on:

- Food and food production
- Living environment
- Health, lifestyle and livelihood

Key industry focus?

- Agribusiness
- Education
- Horticulture

Innovation type/s?

- Technologies and patents
- Shared Research Facilities
- Labs and innovation centres
- Simulation models and software
- Collaboration, tech transfer, co-creation with partners



OVERVIEW

Vision/Purpose

The mission of Wageningen University & Research (WUR) is “To explore the potential of nature to improve the quality of life”.

WUR aims to achieve food security and improved nutrition and promote sustainable agriculture to further develop their position in the domain “health food and living environment”.

Focuses on the total system: careful production and processing of healthy food, sustainable use of soil, water and atmosphere, reduction of inputs of nutrients, auxiliary chemicals and pesticides, and reduction of Greenhouse gas emissions, focusing on sustainability and animal welfare.

Achievements

- WUR researchers were bestowed with the highest scientific award in Netherlands, Spinoza Prize in 2009
- Global position as supplier of application-oriented and field-based research
- Fosters entrepreneurship in Food and Agtech through StartLife
- In 2017, WUR got the first place in SustainaBul after being named the most sustainable university in Netherlands by students
- In 2017, WUR was ranked the highest worldwide in the UI GreenMetric ranking



Wageningen University (WUR) - Wageningen, Netherlands

How does it work?

- WUR comprises of one faculty of 5 departments including Agrotechnology and Food Sciences, Animal Sciences, Environmental Sciences, Plant Sciences and Social Sciences.
- The research at Wageningen University is conducted through chair groups
- The research can be grouped into the following categories:
 - Knowledge base research (KB) (within the WUR themes like Sustainable food and non-food production, Global food and nutrition security)
 - Policy support research (BO) (Nature, landscape and rural areas and Agro)
 - Legal research (WOT) (Infectious Animal Diseases, Food Safety, Genetic Resources, Nature and Environment, Fisheries, Economic Information)
 - Top sector research (Agri and Food and Horticulture and Propagation Materials).
- WUR conducts scientific research in the healthy food and living environment domain;
 - Fundamental Research – Usually practical research
 - Field-based research – Aimed at collecting primary data, using methods such as measurements and surveys
 - Application Oriented research – Development of expertise for practical applications. It is often conducted in partnerships with governments, other research institutes, and Dutch and international companies
- Some examples of their research work include:
 - EU project researchers of WUR and international colleagues have developed a prototype of a harvesting robot for peppers that searches for the fruits, takes 3D pictures of them, assesses their colour and shape and only harvests those that fit the requirements
 - WUR have been running a pilot with Dutch entrepreneurs and a Kenyan horticulturist to come up with ways to conserve water while harvesting crops

Global Food Innovation Centre on Wageningen Campus

In 2016, Unilever announced housing its Global Food Innovation Centre on Wageningen Campus, strengthening the agri-food innovation eco-system in Wageningen. Wageningen Campus was selected as an ideal location owing to the concentration of leading research centres, both private and public;

- The Foods Innovation Centre will focus on healthy and sustainable food innovation. It is expected to help Wageningen's ambition to become the Dutch knowledge centre in the area of agri-food and Life Sciences within the Food Valley region, boosting knowledge and innovation networks
- Construction of Unilever's Global Foods Innovation Centre officially started on November 2017. The premises (1.8 ha floor area) consists of a pilot plant, a food and customer experience centre and two floors with offices and laboratories

Partnership model

- Public-private partnerships
- Confidential contract research
- Partners range from scientific governmental agencies, academic and business partners, NGO's, Civil Society Organisations (CSO's) and citizens



Wageningen University (WUR) - Wageningen, Netherlands



CREATING AND MEASURING IMPACT

Measuring impact

- Research at Wageningen University funded by direct & indirect government funding and contract funding. The amount of direct government funding for education and research was €227.3 million in 2017
- Attracting EU funds to finance EU research programmes and partner in various EU cooperation programmes
- Turnover of Wageningen Research from EU funding programmes was €21.7 million in 2017
- Annual growth of 5 per cent of the research turnover from the public-private and private markets
- 3 chairs specialised in Agribusiness including Agrotechnology and food sciences, Animal sciences and Plant sciences
- 9 research institutes, including Wageningen plant research
- Prominent position in international rankings and citation indexes
- Work with over 80 countries
- 'WOT statue', an agreement with the Government that supports them in the implementation of laws and regulations that are needed for safe food and healthy animals

R&D focus

- Wageningen Data Competence Centre is established to support developments in the field of big data and data science at WUR
- Experimental facilities and laboratories like Microspectroscopy Research Facility
- WUR has adopted 'smart farming' project, that uses technologies like GPS, sensor technology, ICT and robotics
- WUR has launched the Photosynthesis 2.0 Programme, that focuses on re-designing the engine of biological productivity
- Data Intensive Smart Agrifood Chains (DISAC) project is developing sensors, data infrastructures, data analysis methods and knowledge to optimise cultivation systems and production chains

Commercialisation pathways

- Offers technologies and patents to organisations
- Various intellectual property right formats, licences and spin-offs
- Contract research organisation which works together with companies, government authorities and other knowledge institutes
- WUR is a supplier of application-oriented and field-based research to Government and companies
- Cooperate within bilateral projects as well as public-private partnerships
- In 2017, WUR established the RAM teams (Relation Account Management) for thirteen large accounts to serve partners domestically and abroad
- Involved in JPI FACCE, which focuses on agriculture, food security, and climate change, along with the Ministry of Agriculture, Nature and Food Quality (LNV)
- WUR plans to expand the China office



KEY INSIGHTS FOR WSA – IIPH

- ✓ Research focused on sustainability and animal welfare
- ✓ Ideal location owing to concentration of leading research centres, both private and public
- ✓ Conducts scientific research in health food and living environment domain
- ✓ Offers technologies and patents to organisations



Research Triangle Park (RTP) - North Carolina, United States



HIGHLIGHTS

What is it?

The Research Triangle Park (RTP or the Triangle) is the largest research park in the US, and is located between three major universities: Duke University, North Carolina State University, and the University of North Carolina. The Triangle is bordered by the NC State University that has aided in the public research for ag-biotech.⁴⁹

Key industry focus?

- Agricultural Biotechnology
- Chemicals
- Pharmaceuticals

Innovation type/s?

- Laboratory and office space for research
- Co-working space for research (not production)



OVERVIEW

Vision/Purpose

RTP aims to facilitate research collaboration among the universities in the region, attract top talent, and promote cooperation among companies and universities, along with creating a sustainable economic impact for North Carolina.

Achievements

- Major ag-biotech companies including Bayer CropScience, BASF, Syngenta and Novozymes have set up their research facilities in RTP
- About 60 per cent of North Carolina's ag-biotech companies are located in the Triangle
- Houses the North Carolina Biotechnology Center which comprises the AgBiotech Group that works with ag-biotech businesses to facilitate research and innovation

⁴⁹"Agricultural Biotechnology in North Carolina", Link; "The Transformative Impact of The Research Triangle Park – A Case Study", Link; "Raleigh and Research Triangle Park – NC State University", Link; "Agricultural-focused startups are blossoming in the Triangle", Link; "Clusters of Innovation Initiative", Link; Research Triangle Park, Link



Research Triangle Park (RTP) - North Carolina, United States

How does it work?

Collaboration and co-working spaces along with laboratory facilities support the establishment of a number of R&D units in the Triangle, especially the biotechnology cluster.

- The park operates two main buildings: the Frontier and the Lab. The Frontier is a collaboration space while the Lab is a full-service lab and office space for R&D operations for multiple companies
- The Triangle has special zoning for Research Applications and Scientific Research Park

Partnership model

Public funding: The Triangle was created with funding from state and local governments, nearby universities, and local businesses



CREATING AND MEASURING IMPACT

Measuring impact

- Facility comprises 264 companies
- Houses more than 50,000 people with expertise in biotechnology, chemicals, and pharmaceuticals
- 7,000 acres (2,833 ha)
- 209 ha of built space

R&D focus

- Companies invest more than US\$300 million per year in R&D at RTP's universities
- RTP's pharma and biotech cluster is focused on research, comprising one of the strongest cluster for R&D and clinical testing institutions in the US

Commercialisation pathways

The presence of large ag-biotech firms along with the easy accessibility to collaborate with nearby research universities has enabled the growth of smaller ag-biotech firms in the Triangle:

- The ag-biotech start-up companies complement major biotechnology companies such as BASF, Bayer CropScience and Syngenta. For example, in 2009, Bayer CropScience acquired Athenix, a RTP-based company
- "I would say that RTP has an ecosystem that is friendly, certainly, for any start-up, but more and more so for ag-related start-ups," said Joy Parr Drach, CEO of Advanced Animal Diagnostics, a RTP-based start-up for agri-tech products.



KEY INSIGHTS FOR WSA – IIPH

- ✓ Friendly ecosystem for ag-related start-ups
- ✓ Facilitates research collaboration and promotes cooperation
- ✓ Accessibility to nearby research universities has led to growth of ag-biotech firms



New Zealand Food Innovation Network - Auckland, New Zealand



HIGHLIGHTS

What is it?

The New Zealand Food Innovation Network is a national network of facilities established to assist the food and beverage industry of New Zealand and provides the following services:⁵⁰

- Process optimisation
- Export
- Funding
- Business innovation
- New product development
- Commercial production
- Business development

Key industry focus?

- Food and beverage

Innovation type/s?

- Innovation Jigsaw - The NPD roadmap



OVERVIEW

Vision/Purpose

The main objective of the Food Innovation Network is to provide a platform for organisations operating in the food and beverage industry. They provide product development and various other services such as process optimisation and business innovation depending on the needs, strengths, maturity and capabilities of local business.

Companies

- Food Inc New Zealand
- McFoodie
- Sustainable business network
- iFab
- James & Well
- COFCO
- University of Otago
- New Zealand trade and Enterprise
- The University Of Auckland
- Massey University
- Food HQ
- Plant & Food Research
- Callaghan Innovation
- Auckland University of Technology
- Ministry for Primary Industries

Food Innovation networks – About, [Link](#); Food Innovation networks – special expertise, [Link](#); Food Innovation networks – FOODBOWL, [Link](#); Food Innovation networks – FOODWAKAITO, [Link](#); Food Innovation networks – HAWKES BAY, [Link](#); Food Innovation networks – FOODPILOT, [Link](#); Food Innovation networks – FOODSOUTH, [Link](#); Food Innovation networks – FOODSOUTH OTAGO, [Link](#)



New Zealand Food Innovation Network - Auckland, New Zealand

How does it work?

The Food Innovation Network has six different facilities across New Zealand providing different services given below:

- **FOODBOWL** – specialist expertise: process optimisation, commercial production, export and funding. Processing capabilities: high pressure processing, general processing, packaging, liquids/beverages, freeze drying, dry processing and other equipment
- **FOODWAKAITO** – specialist expertise: Commercial production, export, business development. Processing capabilities: Unique milk and Non-dairy products
- **HAWKES BAY** – specialist expertise: business development and new product development
- **FOODPILOT** – specialist expertise: process optimisation and new product development. Process capabilities: beverages, evaporating and drying, chopping and mincing, cooking and process control and extrusion and puffing
- **FOODSOUTH** – specialist expertise: process optimisation, business development, new product development. Processing capabilities: consulting services, extrusion, risk management programme, enrobing, product development kitchen, drying, general processing and UHT liquid processing
- **FOODSOUTH OTAGO** – specialist expertise: process optimisation and new product development. Processing capabilities: non thermal processing, drying, liquids/beverages, sensory panel, thermal processing

The Food Innovation Network solves problems for entrepreneurs by guiding them in the right direction from formulation to contract manufacturers and funding support. Assists exporters and manufacturers in the field of export contracting and alternative manufacturing techniques to improve efficiency.

Partnerships model

- Partnerships with government agencies and educational institutions such as Ministry for Primary Industries and Massey University
- Legal company partnerships such as James & Well to support intellectual property such as patents and trademarks



CREATING AND MEASURING IMPACT

Measuring impact

- The **FOODWAKAITO** facility can produce 65,000 litres of milk in a day. It has a 10.5m high stainless steel dryer weighing 7.5 tonnes. This facility is certified by NZ Food Safety Authority
- The **FOODBOWL** and **FOODWAKAITO** has the capacity to commercially produce 1 - 5 tonnes of products
- The **FOODPILOT** helps companies develop new products and assists the companies with proof of concept
- The facilities use equipment like Multivac Thermoformer, Unique flow wrapper and continuous band sealer for packaging purpose and uses equipment like UHT Pasteuriser, Asptic Line and Jacketed blending vessels for beverage and liquids

R&D Focus

- Food research and dairy products
- New product development

Commercialisation pathways

- Provides services such as process optimisation and new product development to entrepreneurs, exporters, manufacturers and small and medium enterprises
- Assists organisations with funding process and acts as middlemen between investors and organisations



KEY INSIGHTS FOR WSA – IIPH

- ✓ Provide product development and process optimisation services
- ✓ Solves problems for entrepreneurs
- ✓ Assists exporters and manufactures
- ✓ Middlemen between investors and organisations



Washington State University - Washington, United States



HIGHLIGHTS

What is it?

Washington State University is focused on research for sustainable resources and health. They provide various online and offline courses and with research and extension centres to sustain crop health and growers productivity.

Key industry focus?

- Agriculture
- Food production
- National security

Innovation type/s?

- Technologies and patents
- Laboratories and innovation centres



OVERVIEW

Vision/Purpose

Vision:

“Washington State University will be one of the nation’s leading land-grant universities, preminent in research and discovery, teaching, and engagement.”

Mission:

“To advance knowledge through creative research, innovation, and creativity across a wide range of academic disciplines.

To extend knowledge through innovation educational programs in which students and emerging scholars are mentored to realise their highest potential and assume roles of leadership, responsibility and service to society.

To apply knowledge through local and global engagement that will improve quality of life and enhance the economy of the state, nation and world.”

Achievements

- The Washington State University was singled out for its highest research activity in the Carnegie Classification out of about 4,500 public and private universities



Washington State University - Washington, United States

How does it work?

The research conducted at the university can be grouped into the following categories:

- Solving health challenges and collaborating across disciplines to prevent and treat diseases
- Sustainable food production research is done in the areas of optimising agricultural practises, available and affordable food and nutritious and safe foods
- Research on smart and sustainable systems for enhancing performance in cities via digital technologies
- Research on national security such as preserving strategic stability, strengthening America's infrastructure, reducing hunger but sustaining agriculture and natural resources and addressing biological threats.

Partnership model

- Funding and resources from various government and local institutions. In FY2017, the Washington State University also attracted US\$145.1 million in private support.
- Universities and research institution partnerships
- Government and national institutions partnerships – e.g. Department of Justice, National Institute of Health, US Department of Defence, and Office of Rural Healthcare.



CREATING AND MEASURING IMPACT

Measuring impact

- 352.9 million expenditure on research and development in FY2017
- More than 600 study abroad programs in over 48 countries
- 4 research and extension centres to sustain crop health and growers productivity
- More than 20 small business development centres to help small businesses grow



Commercialisation pathways

- The Washington State University assists the researcher with patents, trademarks, copyrights, software and plant varieties
- Provides start-up support
- Assists with digital marketing, eliminating the need for third party vendor intervention
- Provides space for a start up to function and operate
- Provides commercialisation gap fund up to US\$50,000 to those who are able to demonstrate that their innovations have an ability to make economic impact on the society

R&D focus

- Sustainable health addressing challenges of chronic health problems and health care cost
- Sustainable resources including food production, water and energy
- Smart systems to increase efficiency in power infrastructure



KEY INSIGHTS FOR WSA – IIPH

- ✓ Focused on research for sustainable resources and health
- ✓ Provide online and offline courses
- ✓ Assists researchers with patents
- ✓ Provides space for start-ups to function and operate



The Roslin Institute - Scotland, United Kingdom



HIGHLIGHTS

What is it?

Research at the Roslin Institute, which is part of University of Edinburgh, is focused on animal biology and animal science research. The institute receives funding from Biotechnology and Biological Sciences Research Council. The main objective of research conducted is to enhance human and animal lives.

Key industry focus?

- Animal research
- Genetics and genomics

Innovation type/s?

- A collaborative research centre focusing on human and animal disease mechanism



OVERVIEW

Vision/Purpose

“To enhance the lives of animals and humans through world class research in animal biology. Knowledge exchange and commercialisation (KEC) is a key contributor towards this aim of producing research with applications and impact outside of the research community.”

The principle purpose is to:

- Enhance knowledge of genetic factors
- Understand basic mechanism of health and disease and comparative biology of animal species

Achievements

- The University of Edinburgh received the silver Athena SWAN award in 2014, and The Roslin Institute received the Athena SWAN gold award for supporting the career of women in science
- Scientists at The Roslin Institute are among the 260 international researchers who won the Eureka16 prize for the Fantom5 project in 2016



The Roslin Institute - Scotland, United Kingdom

How does it work?

The research conducted at the university can be grouped into the following categories:

- Developmental Biology that investigates mechanism and control of animal growth and development from molecular to whole organism level
- Research in genetics and genomics in studying complex animal systems and developing improved predictive models
- Research in infection and immunity studies between the host and pathogen and trying to prevent and treat endemic and zoonotic bacterial, parasitic and viral diseases
- Research in clinical sciences help improve the lifelong health and welfare of veterinary and human patients
- Research in blueprints of healthy animals, control of infectious diseases and improving animal production and welfare
- The Roslin Institute has a National Avian Research Facility in partnership with Pirbright Institute and is supported by the University of Edinburgh, BBSRC, Roslin foundation and Wellcome trust providing resources for study of avian biology

Partnership model

- Academic partnerships
- Industrial partnerships – Agriculture, pharmaceuticals and genetics
- Local community partnerships – Easter Bush Research Consortium and Midlothian science zone and council



CREATING AND MEASURING IMPACT

Measuring impact

- There are a total of 37 active chairs in the institute
- Development plans for Easter Bush Campus is expected to generate wealth and additional employment
- Each year the Roslin Institute generates a total economic benefit of £320 million and supports 1,321 jobs
- The Roslin institute works with breeding companies to improve agricultural productivity and welfare of farmed animals
- The Biotechnology and Biological Sciences Research Council has awarded £29.3 million strategic funding to support research and facilities at The Roslin Institute between 2017 to 2022
- The Roslin Institute received £11.3 million from the CIEL.

R&D focus

- R&D focus is on animal sciences such as diseases in animals, improving animal welfare and production traits
- Another focus area is human and animal lifelong health and welfare. Involves validation of the disease model and developing diagnostics and therapeutical approaches for animal and human welfare.

Commercialisation pathways

- The institute gets into commercial strategic partnerships with both animal health and animal breeding industry players including Zoetis, Cobb Vantress, Genus and Hendrix genetics
- The University of Edinburgh has partnered with private equity advisor JB Equity to raise £15 million to support the venture, and in return, Roslin Technologies will offer opportunities to capitalise on the growing demand for food and agricultural products.



KEY INSIGHTS FOR WSA – IIPH

- ✓ Study complex animal systems to enhance human and animal lives
- ✓ Works with breeding companies to improve agricultural productivity and welfare of animals

15.3 Deep diving into energy, utilities and infrastructure at international precincts

The objective of this deep dive was to identify potential solutions on utility services as well as circular economy concepts that may be applicable to the WSA IIPH. The findings have been summarised below

15.3.1 Agri-precincts across the Netherlands

The Netherlands provides an interesting case study of how intensification in agriculture can drive productivity. The Netherlands has a land mass of 41,543 km², and a population of 17 million people. Despite being a relatively small country, the Netherlands is the world's number two exporter of food produce by value. The Netherlands' strong culture of collaboration and cooperation is exhibited in its large number of established agri-precincts across the nation.

In this section, we present three agri-precincts in the Netherlands.

15.3.1.1 Agriport A7 – Middenmeer, Netherlands

Located 30-minute drive from Amsterdam, A7 is a development site with two key components: a 100-ha business park and a high-tech greenhouse park of 850 ha. One of the key objectives of the precinct is to reduce environmental footprint through the collaboration of companies from different sectors, and raise economies of scale by bundling non-core business of growers such as central processing, logistics, energy, etc. Key features include:

- Greenhouse operators run their own CHP units to generate electricity, heat and CO² required for operating the greenhouses. Due to the relatively high heat requirement in the Netherlands, the CHP

plants typically run at a level that produces more electricity than required for operating the greenhouses.

- Participating entities (including the greenhouse operators) jointly own ECW Network, which operates the private electricity and gas networks within A7. The precinct is connected to the external electricity and gas grid networks. Excess electricity from greenhouse CHPs is supplied back to the national grid.
- Since 2014, ECW has begun operating four geothermal wells, drilled to a depth of 2,300 metres, providing about 20 per cent of the heat demand of greenhouses via insulated pipelines. Given the use of geothermal energy and resulting decline in the reliance on CHPs for heating, ECW has developed an on-site CO² distribution network and sources CO² externally for the greenhouses.
- ECW also operates a central water management system, harvesting rain water from the roofs of industrial buildings for irrigation in the greenhouses. The sewer system at A7 has the ability to discharge rainwater separately from domestic and industrial waste water.
- Microsoft is developing a €2 billion data centre facility at the business park. The facility will use excess electricity from CHPs behind-the-meter (hence savings network charges). Microsoft also signed an offtake agreement with the closely located 450MW wind farm project currently under construction. There are plans to harvest the waste heat from the data centre facility for heating the greenhouses.
- In 2018, it is reported Vidras Technology planned to build two bi-fermenters with gasifier to use waste from the precinct to produce biogas; the biogas would be used by ECW to provide electricity



15.3.1.2 Agropark Bergenden – Bergenden, Netherlands

Agropark Bergenden is located in the east of the Netherlands, and was implemented from 2002 onwards as a cluster of greenhouse companies. The push factor for its development was the expansion of nearby urban areas that needed space that was occupied by scattered greenhouses. The total site area is 180 ha.

The industrial ecology of Agropark Bergenden comprises two key components:

- A collective rainwater harvesting system, capturing rainwater from the roofs of the greenhouses and stores it to be used as irrigation water

- A collective CHP installation that delivers power to the greenhouses and to the national grid; CHP also produces heat and CO² for greenhouses.

Both components are jointly owned by the participating greenhouses. The centralised approach to CHP-investments helped to provide energy for the greenhouses at a substantially lower cost until 2008. Subsequent to that, several greenhouse operators faced bankruptcy, which raised the energy costs of the other companies.

The CHPs at Agropark Bergenden run on natural gas, but there have been plans to invest in a co-digester to produce biogas to run the CHPs.



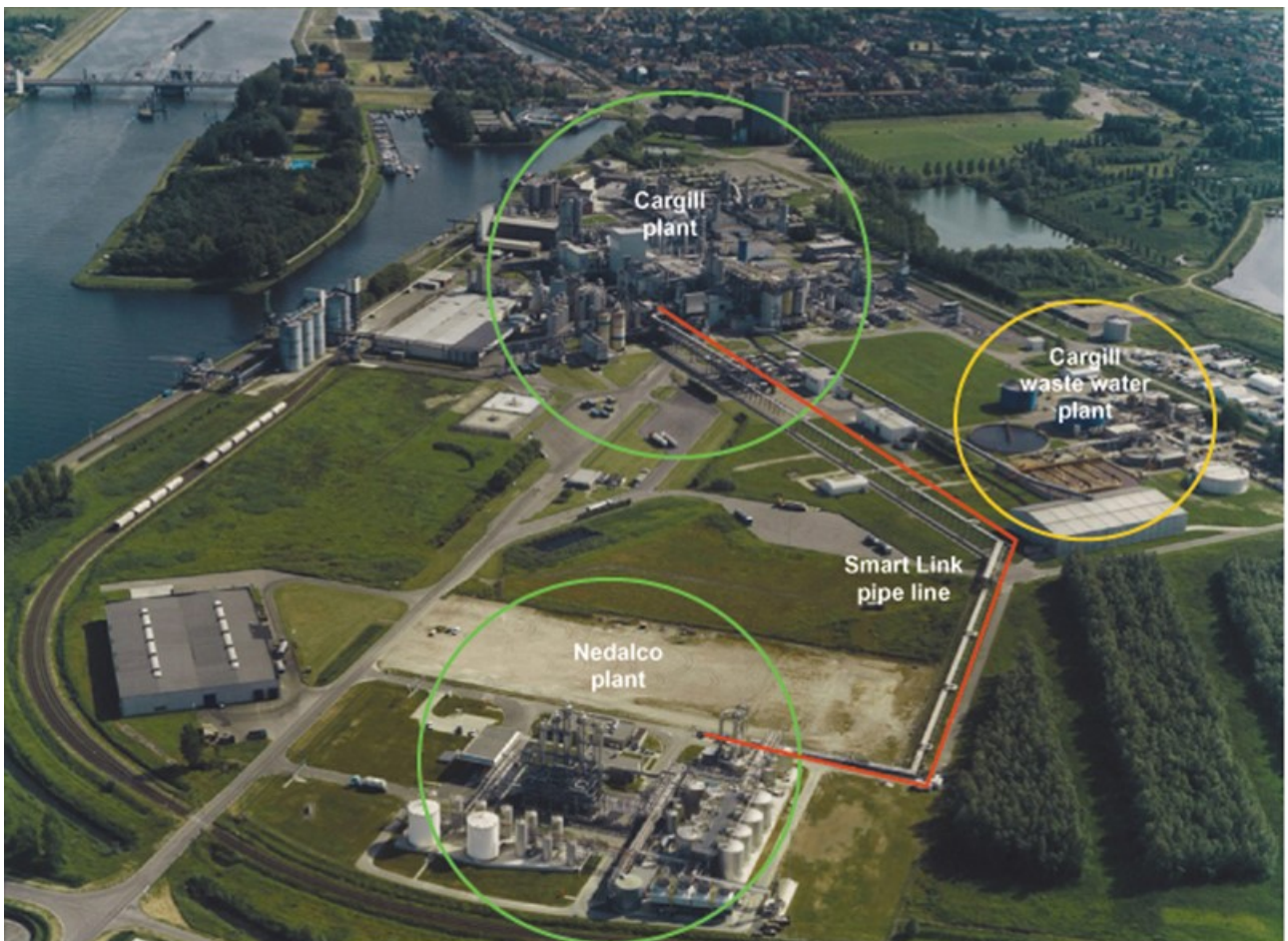
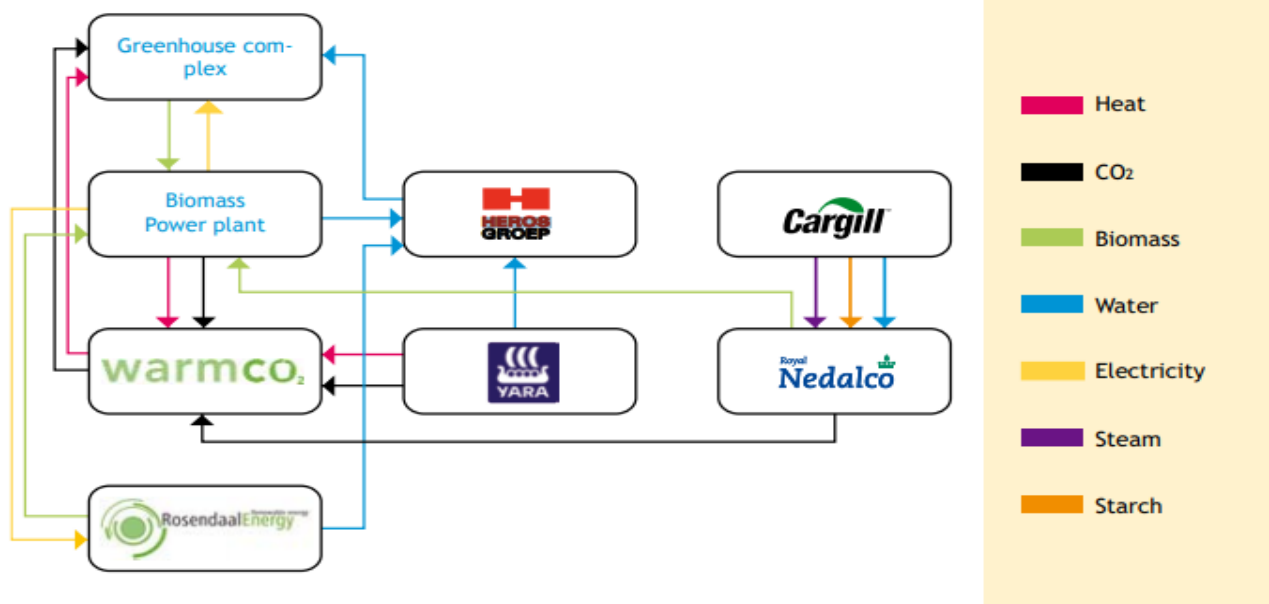
15.3.1.3 Biopark Terneuze – Zeeland, Netherlands

Biopark Terneuze was formed in 2007 as a result of a partnership scheme amongst the existing firms in the area and the planned development of a 240 ha protected horticulture area. At that time, it was concluded that co-location of greenhouses could improve resource use amongst agro- and other industrial companies, that the geographical proximity of various organisations represented an opportunity to create an ecosystem where by-products of various participants could be better used within the precinct.

The exchanges between participants at Biopark Terneuze are summarised below:

- The local biomass power plant and Yara, a mineral fertiliser producer, generate large amounts of CO² and waste heat from their operations, which are supplied to the nearby greenhouses. The biomass plant also provides electricity to the greenhouses at a competitive cost.

- Cargill, a food producer, supplies its starch, steam and water by-products to Nedalco, a large-scale producer of alcohol and bio-ethanol. The processed water from Nedalco is fed back to Cargill's water recycling plant for purification and re-use.
- Rosendaal Energy, a biodiesel producer, supplies waste water to the recycling company Heros, as well as biomass to the power plant.
- These exchanges provide economies of scale and resources to operate more efficiently and more cost effectively, as well as reducing the environmental footprint of both companies. A unique component of Biopark Terneuze is the two-kilometre pipeline, which transports CO² and hot water (harvested from waste heat) within the precinct. The pipeline, which is operated by a co-operative between the existing firms.



15.3.2 Aquaponic farms across Europe

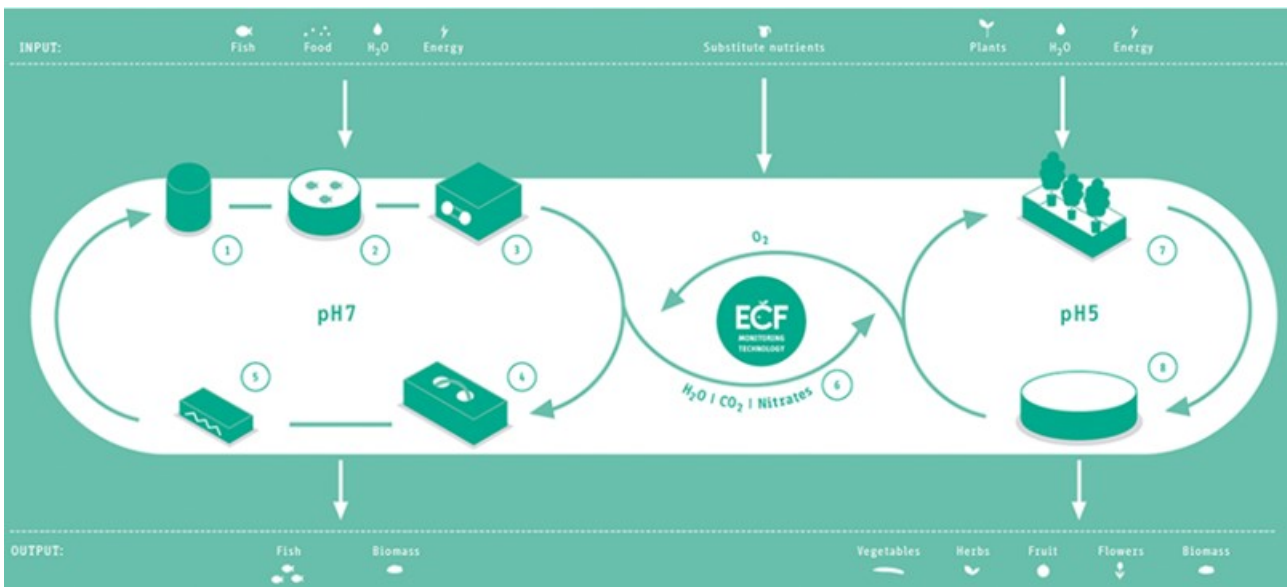
An aquaponic farm combines aquaculture (fish farming) and hydroponics (growing produce out of water, commonly done in greenhouses). The concept of aquaponic has been applied commercially across Europe.

A Berlin-based company, ECF develops aquaponic farms across Europe. ECF leverages two circuits and operate them jointly: the aquaculture circuit for fish and the hydroponics circuit for plants. In the aquaculture circuit, ECF uses rain water and fresh water (from water grid), in which 3 to 5 per cent of the existing water is replaced daily. This nutrient-rich waste water is then reused for irrigation at the greenhouse. Further, the CO² emission from the aquaculture circulatory system is also channelled to the greenhouse. On the other hand, oxygen produced

by the plants at the greenhouse is pumped back into the water in the aquaculture circuit.

In Kruishoutem, Belgium, Aqua4C (an aquaculture company) entered into a partnership with Tomato Masters to operate fish-breeding tanks adjacent to Tomato Masters' greenhouses. This partnership applies similar concepts as ECF aquaponic farms. Aqua4C has sought to make its operations more sustainable through its choice of fish. It raises jade perch, an Australian species, which has a plant-based diet, does not require antibiotics, and requires less water to survive than other species.

ECF estimates that their aquaponics farms enable food to be produced using up to 90 per cent less water compared to conventional agriculture, and save up to 7 per cent of operating costs compared to stand-alone aquaculture and hydroponics system.



Appendix: Products considered viable for an IIPH

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Table 16-1: Components required for a successful IIPH adjacent to the WSA

01 Protected horticulture Tomatoes (including truss tomatoes and snack tomatoes)

This activity can be broken down into snack tomatoes and truss tomatoes. In Australia, snacking tomatoes are increasing in popularity and are sold at a premium price. However, conventional tomatoes still dominate production (42 per cent field, compared to 33 per cent truss).⁵³ For the purposes of economic analysis later in this report, the two activities have been reported separately, for the purposes of assessing the activity as a whole tomatoes have been reported as one activity.

Current National Market Supply:

	Mulgoa – Luddenham -Orchard Hills	Horsley Park – Kemps Creek	Cobbitty- Leppington	Badgerys’s Creek - Greendale	Australia
Tonnes	125	340.87	52.92	1065.08	405,167
Area under production (ha)	3.52	31.59	0.29	13.43	5430
Proportion of production within Aerotropolis	0.06 per cent	0.58 per cent	0.01 per cent	0.25 per cent	0.9 per cent
Value of production (AUD)	\$189,504	\$516,787	\$80,235	\$1,576,065	\$304,841,279
Proportion of value within Aerotropolis	0.06 per cent	0.17 per cent	0.03 per cent	0.52 per cent	0.78 per cent

Exports

2016/17 tonnes	530 tonnes (approximately 0.1 per cent of total national production) For target Asian markets, this includes Singapore, China, India and Indonesia, however total volumes are relatively low compared to other horticultural goods and commodities traded.
2016/17 value	\$2.5 million (approximately 0.4 per cent of total national value). The highest value export destination in 2016/17 was Singapore with 26 per cent of exports.

Source: Horticulture Innovation Australia Handbook 2016/17; ABS cat. No 7503 (2015/16) and ABS cat. No 7121 (2015/16); UN ComTrade.

Current International Market Supply:

Global producers (by ha)		Global producers (by tonnes)	
China	1,003,992	China	56,423,811
India	760,000	India	18,399,000
Nigeria	574,441	United States	13,038,410
Egypt	199,712	Turkey	12600,000
Turkey	188,270	Egypt	7,943,285

Source: FAO Stat, reporting year 2016.

Future Demand

National

Generally, tomato consumption in Australia has been steady, with per capita p.a. consumption averaging 10 kg. In the last two years, this has decreased 2 per cent year-on-year, however remains high generally.⁵⁴

⁵³ Horticulture Innovation Australia Statistics Handbook, 2017

⁵⁴ Horticulture Innovation Australia Statistics Handbook, 2017

01 Protected horticulture Tomatoes (including truss tomatoes and snack tomatoes)

International

Current Australian-supplied export destinations (top five)		Unmet demand for Australian tomatoes in global markets		Demand from consumers for tomatoes from global competitors (representative of the existence of demand in the global market for other producers' products; possible demand that Australia could capture).	
Singapore	United States	\$151,000	Netherlands	\$1.8 billion	
New Zealand	Russia	\$51,000	Mexico	\$1 billion	
Hong Kong	UAE	\$43,800	Spain	\$483 million	
Papua New Guinea	Canada	\$43,200	Morocco	\$295.4 million	
Nauru	UK	\$34,500	Turkey	\$336.2 million	

Source: UN Comtrade, Intracen Trade Map.

The supply data above shows, that domestic production is largely consumed locally, supplemented with some additional import. The unmet demand for Australian tomatoes is relatively small compared to international competitors, particularly in the Netherlands and Spain.

Sector Activity Considerations

Production in Australia has typically been in outdoor systems, across the eastern coast. More recently, there has been a shift to more intensive glasshouse systems. The common field tomato is still the most produced, however with the shift to greenhouse production truss and cherry/grape tomatoes have increased in production. Domestically, year round demand for 'easy-to-consume' tomatoes, i.e. the grape/cherry varieties, is being met with an increase in glasshouse production, allowing climate variability to be overcome.

The supply data above shows, that domestic production is largely consumed locally, supplemented with some additional import. The unmet demand for Australian tomatoes is relatively small compared to international competitors, particularly in the Netherlands and Spain.

Investment Requirements:

There are a two main types of intensive production that can be considered for the IIPH, these range from conventional systems to modernised glasshouse production systems. Farm systems in Australia are starting to shift towards larger operations that are producing in intensive, climate controlled facilities. Significant capital for infrastructure and technology is required to invest in either of these systems.

Market Needs and Requirements:

Domestically

Australian consumer preferences indicate that consumption of smaller cherry and grape varieties is likely to increase, while larger varieties drop off. Overall consumption did decline slightly in 2017, however tomatoes remain the most popular fruit or vegetable (by dollar share) in Australia.⁵⁵

Internationally (as per unmet demand above)⁵⁶

Securing better market access to countries with higher unmet demand will be critical to securing better value from the production to tomatoes. For example, current unmet demand for Australian tomatoes is highest in the USA, Russia, UAE and Canada (as stated above).⁵⁷ These countries do have some market access requirements, for example:

- USA – import permit required, phytosanitary certificate required to prove free-from red-legged earth mite, and to prevent fruit fly contamination packaging must be shrink-wrapped or netted. Tomatoes must be packed within 24 hours of harvest. Greenhouses must be declared fruit fly free from an appropriate entity.
- Russia – certificate of conformity required (hygiene certificate necessary from the DAWR and independent laboratory accreditation), additional phytosanitary certificates

⁵⁵ Nielsen, 2018, *Fresh Is Best: Top 20 Ranking of Australia's Favourite Fruit and Veg*

⁵⁶ AusTrade, 2017, *Guidance for exporters*.

⁵⁷ Australian Government Department of Agriculture and Water Resources, 2017, *Manual of Importing Country Requirements*

01 Protected horticulture Tomatoes (*including truss tomatoes and snack tomatoes*)

- UAE – strict market access requirements are in place, including import readiness certificates, country of origin labelling for food safety and phytosanitary certificates.
- Canada – tomatoes are not controlled agricultural goods
- UK – no import permit required, phytosanitary certificate required, non-protocol market.

Critical to capitalising on higher global unmet demand for tomatoes though will be securing market access into proximal Oceanic and Asian countries with increasing populations and high food demand. For example China, Japan, South Korea, Thailand and Vietnam all have restricted access arrangements, only Malaysia, Singapore, Hong Kong and Indonesia have improved market access.

Some countries do charge a tariff for imported goods, for example Indonesia has a tariff of four per cent on imported tomatoes from Australia. Tariff markets are less favourable than non-tariff markets, however in the instance of tomatoes, tariffs are not exorbitant for unmet demand markets.

Technology:

Aside from production technological developments (which have already significantly increased yields) technology in intensive production hubs is already being integrated in other production systems in Australia. For example, Sundrop Farms are using solar to desalinate water for use in their glasshouse facilities.

The growth of tomatoes in protected systems (either in glasshouses or semi-closed systems) requires other technology too such as heating, high-pressure water movement, evaporative cooling, positive pressurisation, supplementary lighting, pollination and harvesting.

During crop growth consideration needs to be given to the ability to deliver water to plants as automatically as possible, with irrigation frequency and water borne nutrient delivery designed to support appropriate plant cycle stress for production. Technology to monitor and feedback information (for example through soil sensors and IoT communicating devices) helps to ensure that growth conditions can always be optimised. Once flowering, autonomous pollination and harvesting are robotically feasible.

ACTIVITY OVERVIEW

Tomatoes are known to grow well in greenhouse, intensive production systems. Tomatoes are already being grown in these conditions in other parts of the country. There are two key types of tomatoes that would be viable to consider including in an IIPH, the snack tomato and the truss tomato. Generally, the snack tomatoes is valued slightly higher than the traditional truss tomato domestically and internationally.

There is strong domestic demand for tomatoes, and a high export demand internationally for tomatoes (however it should be noted that market access issues and technical barriers to trade does impede export in some instances). Producing a large enough volume of product will be key to this activity's inclusion in an IIPH.

02 Capsicums

Current National Market Supply:

	Mulgoa – Luddenham -Orchard Hills	Horsley Park – Kemps Creek	Cobbitty- Leppington	Badgerys’s Creek - Greendale	NATIONAL
Tonnes	35.02	15.36	0	2.9	36,793
Area under production (ha)	0.87	2.71	0	1.06	1,178
Proportion of production within Aerotropolis	0.007 per cent	0.2 per cent	0	0.008 per cent	0.215 per cent
Value of production (AUD)	\$118,202	\$51,862	\$0	\$10,092	\$109,610,20 7
Proportion of value within Aerotropolis	0.1 per cent	0.004 per cent	0	0.0009 per cent	0.1049 per cent

National Exports

2016/17 tonnes	346 tonnes (approximately 0.4 per cent of national production) For target Asian markets, this includes to Singapore and China, however total volumes are relatively low compared to other horticultural goods and commodities traded. Overall, the highest volume export market was New Zealand with 201 tonnes.
2016/17 value (AUD)	\$172.4 million (approximately 0.075 per cent of national value). The highest value export destination in 2016/17 was New Zealand with 57 per cent of export value.

Source: Horticulture Innovation Australia Handbook 2016/17; ABS cat. No 7503 (2015/16) and ABS cat. No 7121 (2015/16); UN ComTrade.

Current International Market Supply:

Production (ha)		Production (tonnes)	
China	753,040	China	17,458,282
Indonesia	260,222	Mexico	2,737,028
Mexico	170,135	Turkey	2,457,822
Nigeria	96,965	Indonesia	1,961,598
Turkey	89,032	Spain	1,082,690

Source: FAO Stat, reporting year 2016.

Future Demand

National

Future national demand for capsicums is expected to increase only steadily. In the last three seasons average year-on-year production to meet demand has only increased one per cent,⁵⁸ and this has coupled with a decline in export volumes (where it assumed that non-exported produce is thus consumed domestically). Imported

⁵⁸ Horticulture Innovation Australia Statistics Handbook, 2017

02 Capsicums

produce is still supplementing domestic production anyway, with capsicums largely being sourced from New Zealand.

International

Current Australian-supplied export destinations (top five)		Unmet demand for Australian capsicums in global markets	Demand from consumers for capsicums from global competitors (representative of the existence of demand in the global market for other producers' products; possible demand that Australia could capture).	
New Zealand	Japan	\$29,000	Netherlands	\$956.1 million
Papua New Guinea	USA	\$23,000	Mexico	\$782.1 million
Fiji	Thailand	\$14,000	Spain	\$496.4 million
New Caledonia	Malaysia	\$11,500	Canada	\$169.7 million
Singapore	Canada	\$3,000	Turkey	\$91.4 million

Source: UN Comtrade, Intracen Trade Map.

Internationally, Australia's largest export market is New Zealand with more than half of exported produce going to this market. It should be noted however, that overall supply volumes to the international market are relatively low. There is enormous unmet demand from other international suppliers of capsicums though, this indicates that there is scope for increasing Australia's share of international consumption if market access, trade barriers and favourable pricing can be secured.

Sector Activity Considerations

Majority of capsicum production in Australia is outdoor (northern state focussed), however southern markets are starting to introduce high-tech greenhouse production systems. Capsicums require warm temperatures for good fruit set, colour and yield – important factors to ensure they meet the quality demands of both domestic and international consumers. The *Production Possibilities Report* does already indicate that some greenhouse production is occurring in the Aerotropolis region, however this is largely not of the high-tech variety and introducing more modernised systems will increase production volumes and value. Currently those that are producing capsicums in protected environments are using low tech poly-tunnels, but improved systems can in some instances double field or low-tech production and ensure more consistent quality with reductions in pests and diseases too.⁵⁹

Domestically, consumption peaked in 2016/2017, and is expected to continue to increase steadily over the next year or so. The ongoing demand for Australian produce has consistently lead to a supply import deficit however this has been decreasing slightly in recent years. Consumers like capsicums due to their high vitamin and mineral content and as a source of fibre, the different colours are indicative of their sweetness with red capsicums sweeter than green and yellow varieties⁶⁰ (and often the more popular). Capsicums are typically quite hardy fruits, however should be stored in the fridge; they are often sold in ready-to-refrigerate packaging or loose. Consideration of harvest to packing and storage will need to be made when planning the IIPH facility as once picked, capsicums should be consumed within five days. Additionally, understanding the consumer demand preferences will be important to obtaining good prices, generally red fruit is favoured over green fruit, however red fruit takes longer to ripen on plant or must be treated with ethylene gas.⁶¹

⁵⁹ Protected Cropping Australia, 2016, Overview of the Australian Protected Cropping Industry

⁶⁰ Victorian State Government Better Health Channel, 2015, Capsicum

⁶¹ Government of Western Australia Department of Agriculture and Food, 2008, Growing capsicums and chillies

02 Capsicums

Investment Requirements:

Investing in modern glasshouse or greenhouse systems that allow greater climate control (e.g. temperature and humidity) and water/nutrient management through technological enhancements will improve yields and allow for year-round growth of capsicums. Glasshouses will need to be constructed and operated, and have access to sufficient energy and water to support optimum growth. As will be the case with other activities under examination, the processing and packing of capsicums will likely happen onsite and investment in relevant machinery and equipment will be required.

Market Needs and Requirements:

Domestically:

Consumer preferences for capsicums are for bright 'traffic light' colours⁶², with firm flesh and shiny skins (and free of pest damage or imperfections). Specific packaging of capsicums generally only occurs when produce is 'grouped' (e.g. one of each colour), individual packaging doesn't occur. Bulk packaging for sale into retail markets is in vegetable pallets or trays, generally capsicums travel 'well' when kept in optimum conditions (5-12 degrees Celsius). Seasonality of supply does impact price in some instances however this is reducing as more consistent year-round production is being achieved. To minimise the impact of price fluctuations, ethylene gas exposure or reduction is used to prevent or increase ripening of fruits.

Some niche markets are emerging, for example longer capsicum fruits (where appearance is more like a large chilli) or colour variations (e.g. yellow/white skins, purple/black skins). Demand for these products is lower than other 'traditional' varieties, however they do command a slightly higher price.

Internationally: ⁶³

Current Australian trade markets for capsicums are proximal free trade markets. These markets have similar product specifications to domestic requirements. Of those markets with unmet demand, import market access considerations include:

- *Japan* – produce must be from Tasmania only, consignments are to be free from pests, soil, weeds and extraneous matter, a phytosanitary certificate is required. Produce from outside of Tasmania is not permitted to be imported.
- *USA* – import permits are encouraged but not compulsory, phytosanitary certificates are required and inspection of produce at the port of entry may be conducted (particularly for presence of noxious weeds and pests).⁶⁴ There is no specific protocol requirements in place.
- *Thailand* – market access prohibited, not a protocol market.⁶⁵
- *Malaysia* – produce must be from Tasmania only, and a phytosanitary certificate and import permit are required.⁶⁶
- *Canada* – must be free of pests and soil, subject to inspection by the Canadian Food Import Authority (CFIA) (including requiring a Confirmation of Sale and Import Declaration), confirmation of eligibility with legislation and regulations at the time of export should be confirmed with the CFIA.⁶⁷

The other markets to consider in Asia that do consume capsicums are largely those markets that are proximal to Australia, for example Indonesia and China; these markets have high food demand and lower food security and are good target locations. However both these markets have restricted access, China is prohibited in entirety and Indonesia is also in the category of accepting only Tasmanian (and some Riverland) fruits.⁶⁸ Additionally China and Indonesia have two of the largest production areas of capsicums globally.

Technology:

Generally, there is no specifically unique considerations for capsicum high-tech protected cropping; increasing production through hydroponics will increase yields significantly while simultaneously reducing water and fertiliser demand through controlled irrigation.⁶⁹ Additional genetic technological improvements are also going to improve yields in the greenhouse. Greenhouse production of capsicums has also encouraged genetic improvements to be made in cultivars of capsicum to further optimise yields. These considerations are not particularly unique however and would apply to most protected cropping activities.

62 Woolworths, 2015, Produce Specifications: Capsicum

63 AusTrade, 2017, Guidance for exporters.

64 Australian Government Department of Agriculture and Water Resources, 2017, Manual of Importing Country Requirements: Capsicum Annuum Seed

65 Aus Veg Hort Innovation, 2018, Market Access Matrix.

66 Aus Veg Hort Innovation, 2018, Market Access Matrix

67 Australian Trade and Investment Commission, 2018, Export Markets - Canada

68 Aus Veg Hort Innovation, 2018, Market Access Matrix

69 Government of Western Australian Department of Agriculture and Food, Burt J, 2005, Growing capsicums and chillies

02 Capsicums

ACTIVITY OVERVIEW

Like tomatoes, capsicums are technically adapted to greenhouse production already, with numerous varieties to meet consumer needs already cultivated in other parts of Australia. The shift towards intensive cultivation has allowed increases in production volumes and reduced input requirements.

Production of capsicums is unlikely to deliver a large export premium, as already Australia is a net importer of capsicums with production not meeting domestic needs to date. It is likely that the inclusion of capsicums in an IIPH would thus be able to supply both the domestic market (reducing imports) and a premium product or the export market (or a value-add, processed product, to at least claim some degree of differentiation and thus price premium).

03 Blueberries

Current National Market Supply:

	Mulgoa – Luddenham -Orchard Hills	Horsley Park – Kemps Creek	Cobbitty- Leppington	Badgerys’s Creek - Greendale	NATIONAL
Tonnes	Nil.	Nil	Nil	Nil.	9,553
Area under production (ha)	11.31	Nil	Nil	Nil	Approx. 1300 ha.
Proportion of production within Aerotropolis	0.008 per cent	0	0	0	0.008 per cent
Value of production (AUD)	\$1,226,279	\$Nil	\$Nil	\$Nil	\$193.6 million
Proportion of value within Aerotropolis	0.6 per cent	0	0	0	0.6 per cent

National Exports

2016/17 tonnes	356 tonnes (approximately 3.7 per cent of national production) For target Asian markets, this includes to Singapore, China and Indonesia, however total volumes are relatively low compared to other horticultural goods and commodities traded. Overall, the highest volume export market was Hong Kong with 169 tonnes.
2016/17 value (AUD)	\$8.5 million (approximately 4.4 per cent of national value). The highest value export destination in 2016/17 was Hong Kong with 47 per cent of export value.

Source: Horticulture Innovation Australia Handbook 2016/17; ABS cat. No 7503 (2015/16) and ABS cat. No 7121 (2015/16); UN ComTrade.

Current International Market Supply:

Production (ha)		Production (tonnes)	
Canada	54,535	United States	269,257
United States	37,555	Canada	178,745
Poland	5,039	Mexico	29,067
Mexico	2,946	Poland	14,721
Germany	2,714	Germany	10,710

Source: FAO Stat, reporting year 2016.

Future Demand

National

Blueberries have become one of the most popular fruits domestically in recent years, in the last twelve months their relative consumption increased the most of all reported fruits and vegetables.⁷⁰ Per capita consumption averages just over 300 grams per person, with prices fluctuating seasonally with shifts in supply. Currently production is increasing in line with future demand, however demand still significantly outweighs total production (trade deficit in 2016/17 was still more than 800 tonnes).⁷¹

⁷⁰ Nielsen, 2018, Fresh Is Best: Top 20 Ranking of Australia’s Favourite Fruit and Veg

⁷¹ Horticulture Innovation Australia Statistics Handbook, 2017

03 Blueberries

It should be noted that some investment has already been underway in growing the supply of domestic blueberries, and as these supplies come into availability it is critical that domestic consumption does continue to increase, and the export markets are capitalised.

International

Current Australian-supplied export destinations (top five)	Unmet demand for Australian blueberries in global markets	Demand from consumers for blueberries from global competitors (representative of the existence of demand in the global market for other producers' products; possible demand that Australia could capture).
Hong Kong	China	\$595,300
Singapore	Vietnam	\$190,000
Indonesia	United States	\$169,100
Malaysia	Netherlands	\$122,000
Kuwait	Germany	\$76,000

Source: UN Comtrade, Intracen Trade Map. Note: blueberries is included in the category 'fruit not elsewhere included' thus these figures are likely to be over-inflated.

Supply data shows that domestic production is almost entirely consumed locally with supplementary imports, and that the unmet demand for Australian blueberries is relatively low (the top five countries total less than \$100,000) in the international market compared to other international suppliers. Australian supply to the international market is likely to increase in the future as more production volumes enter the market, however South American competition and Dutch production is likely to make competition difficult without improved market access support.

Sector Target Considerations/Requirements:

Blueberry production in Australia is spread geographically across the south eastern region of the country, with isolated production in WA. The majority of production occurs in the Coffs Harbour region, and when production is in-season in this area supply swells causing a fall in price throughout the late spring and summer. There are five cultivars of blueberry grown in Australia with the three most popular ones being the Southern Highbush (warmer climate), Rabbiteye (low chill) and Northern Highbush (high chill). The chill requirement for blueberries is important to their ability to flower and fruit productively.⁷² Given the WSA region is located in a region where the climate drops below 7 degrees regularly it is feasible to consider producing the Southern Highbush in typical growing systems (e.g. outdoor) however if warmer varieties were considered, tunnel protection or retractable roofing systems would be required, supported by hydroponic substrates.

Managing fruit size and quality is important in the blueberry market domestically, with preferences for larger and sweeter fruits. Given the perishability of berries, and particularly blueberries, access to rapid freight and specialise post-harvest handling facilities will be critical. Including blueberries in the IIPH allows for these two considerations to be taken into account. It should be noted that the PPR acknowledged the possibility of berries attracting birds, and this would need to be factored into planning considerations for the IIPH and safeguarding the airport.

Investment Requirements:

As outlined, there are two distinct growing systems that could be invested into at the IIPH. The most plausible of those being poly-tunnel production. There poly-tunnels still demand quite a high area for production, however they allow more controlled atmosphere growing conditions and weather protection without the same capital requirements as glasshouses. Water requirements tend to be higher in poly-tunnel systems compared to outdoor blueberry production, and a full irrigation system will be required.

⁷² Agrology, 2018, Production Possibilities Report

03 Blueberries

For the facility to be able to produce and pack berries on site, processing and packaging will need to be accommodated in situ too. This will require specific investment in machinery and equipment by the producer.

Market Needs and Requirements:

Domestically

Consumer preferences for blueberries has increased due to the demand for more functional foods (blueberries are high in natural antioxidants) This is largely due to an upward shift in demographics, including the desire for convenient snacks (e.g. grab and go sized foods). The result of this domestic consumer preference is a typically higher premium price for blueberries compared to other berries (or processed fruits), as supplies increase however a more stabilised average retail price is expected to emerge.⁷³

Internationally (as per unmet demand above) – market access requirements⁷⁴

Current export markets for blueberries are largely free trade markets (e.g. Hong Kong, Singapore, Malaysia), with more recent export destinations added (Thailand, Indonesia and the Middle East). Of the markets with unmet demand, China is the most important in terms of value however; despite having its own well-established industry, demand is sufficient to require import but there is limited market access for Australian berries. Given the Australian season is counter seasonal this is important to factor into decisions to include blueberries into the IIPH. Australian blueberries are competing against Peruvian and Chilean producers in the southern hemisphere however, and these countries have significantly lower costs of production compared to Australia.⁷⁵ Australia does not currently have protocol access to the Chinese market (it was included in the Australian Government Chinese protocol list in October 2017, however negotiations have not been completed), but research by the Australian Blueberry Growers Association found that there is distinct, growing demand for Australian berries.⁷⁶

Of the remaining countries with unmet demand, access considerations include:

- *Vietnam* – there is no tariff on blueberries into Vietnam. Requires a certificate of origin.
- *US* – there is no tariff on blueberries into the US. Requires a certificate of origin.
- *Netherlands & Germany (EU)* - no import certificate is required, however a phytosanitary certificate is.

Australia also doesn't have technical protocol access to the Japanese market where demand is also high, however has had this in the past. Re-establishing this access would benefit export trade.⁷⁷

Where protocol market access is facilitated it is generally required that blueberries are declared fruit fly free, are methyl bromide fumigated and are cold treated while on-shore or in transit.⁷⁸

Technology

Production of blueberries in poly-tunnels in either raised beds or in hydroponics allows for more specific irrigation and fertigation and coupled with in-ground soil sensors this is helping to produce higher quality and quantity crops of blueberries. Additional technology supporting the pollination of flowering plants is also being used to increase production, as well as selective plant breeding to increase fruit size, sweetness and overall flavour profile.

Machine harvesting technologies will stand to greatly increase production volumes and reduce costs, as labour throughout harvest is significant in current production systems (particularly in relation to Highbush varieties).⁷⁹ This may require detailed breeding to improve plant structure (e.g. canopy shaping) and new orchard layouts to accommodate machinery. Other innovations, such as the BIRD device⁸⁰ (Berry Impact Recording Device) which monitors quality of berries throughout harvest, packing and transportation, will help to detect anomalies in the supply chain and ensure high quality, valuable produce.

73 Australian Blueberry Growers' Association, 2018, Australian Blueberry Industry Strategic Investment Plan

74 AusTrade, 2017, Guidance for exporters.

75 Fresh Plaza, 2018, We decided to import blueberries from Chile this year

76 Australian Blueberry Growers' Association, 2018, Australian Blueberry Industry Strategic Investment Plan

77 Tasmanian Government Department of Primary Industries, Parks, Water and Environment, 2014, Blueberry Market Profile

78 Australian Government Department of Agriculture and Water Resources, 2015, Horticulture Exports Program – Blueberry exports to India permitted

79 Takeda F et al., 2017, Applying New Technologies To Transform Blueberry Harvesting

80 Growing Produce, 2015, New Technology Helps To Solve The Berry Mechanization Challenge

03 Blueberries

ACTIVITY CONSIDERATIONS

Blueberries stand to be one of the most viable inclusions of all the products considered in this study for the IIPH. Blueberries are well adapted genetically to intensive production systems, can be grown in tunnels, requiring less energy than a full greenhouse, and establish quickly, thus producing fruiting crops much earlier than other horticultural crops.

Additionally, there is significant demand domestically and internationally for blueberries. The association of blueberries with superfood status has led to an increase in their consumption over recent years, and this trend does not look to be declining. Production of blueberries at the IIPH for export markets will need to be supported by improved market access and removal trade barriers however, as some markets with large unmet demand don't receive Australian fruits such as blueberries.

Finally, technological improvements in blueberry production is currently increasing their productivity significantly. Research and development into fertigation, controlled application systems and automatic harvesting is only going to continue to provide supporting reasons for including this activity in the IIPH.

04 Leafy Greens

This activity can be broken down into leafy greens, leafy Asian greens, kale and herbs all of which can be produced in an intensive protected cropping environment. For the purposes of analysis in this report, the activity is reported as leafy greens, leafy lettuce used as an indication of the activity as a whole as finite data on all categories was not available.

Current National Market Supply:

	Mulgoa – Luddenham- Orchard Hills	Horsley Park – Kemps Creek	Cobbitty- Leppington	Badgerys’s Creek - Greendale	NATIONAL
Tonnes	6.67	466.87	2.778	734.2.	139,900
Area under production (ha)	0.85	12.69	0.26	9.76	8,679
Proportion of production within Aerotropolis	0.01 per cent	0.14 per cent	0.002 per cent	0.11 per cent	0.26 per cent
Value of production (AUD)	\$8,110	\$567,658	\$3,378	\$892,692	\$187.2 million
Proportion of value within Aerotropolis	0.004 per cent	0.3 per cent	0.002 per cent	0.48 per cent	0.786 per cent

National Exports

2016/17 tonnes	1313 tonnes (approximately 1.6 per cent of national production) For target Asian markets, this includes to Singapore and Indonesia, total volumes were highest of all the plant based activities considered. Overall, the highest volume export market was Singapore with 471 tonnes.
2016/17 value (AUD)	\$8.4 million (approximately 2.3 per cent of national value). The highest value export destination in 2016/17 was Singapore with 36 per cent of export value.

Source: Horticulture Innovation Australia Handbook 2016/17; ABS cat. No 7503 (2015/16) and ABS cat. No 7121 (2015/16); UN ComTrade.

Current International Market Supply:

Production (ha)		Production (tonnes)	
China	625,341	China	14,933,121
India	171,618	United States	4,073,530
United States	113,980	India	1,089,025
Spain	34,962	Spain	930,081
Italy	34,343	Italy	735,967

Source: FAO Stat, reporting year 2016; note these figures are for the full category ‘lettuce’.

Future Demand

National

More than half of Australian households purchase leafy greens (including rocket, lettuces and baby spinach). Future demand trends are unpredictable though; based on past data, production has been steady over the last three years, however this has included both a decline in production in 2016, and a significant increase in 2017.

04 Leafy Greens

Domestic demand is not likely to drastically increase, and international supply is instead going to be the main source of future demand.⁸¹

Another common “leafy green” vegetable that is increasing in demand domestically is kale, kale (along with other more established spinach varieties as opposed to salad size) is consumed on average at a rate of 270 grams per capita,⁸² however as the purported health benefits of kale continue to be advocated for and its status as a ‘super food’ mean that future demand is trending upwards.

Finally, possibly inclusion in the IIPH of herbs (e.g. basil) would be beneficial in terms of capturing value from future domestic demand. The increase in domestic consumption is largely being spiked by the interest being generated in cooking shows, healthy eating and fine dining. These have seen an increase in not only true fresh herb demand but also processed herbs (such as pastes and sauces). Demand is expected to increase over the next five years by 2.5 per cent per annum.⁸³

International

Current Australian-supplied export destinations (top five)		Demand from consumers for leafy greens from global competitors (representative of the existence of demand in the global market for other producers’ products; possible demand that Australia could capture).		
	Unmet demand for Australian leafy greens in global markets			
Singapore	United States	\$325,000	United States	\$270.2 million
Hong Kong	Germany	\$137,700	Spain	\$119.6 million
United Arab Emirates	United Kingdom	\$123,000	Netherlands	\$104.2 million
Thailand	Canada	\$102,700	Italy	\$84.4 million
Malaysia	Netherlands	\$71,600	Mexico	\$66.5 million

Source: UN ComTrade, Intracen Trade Map.

Australia is a net exporter of leafy vegetables, with the majority of exports going to Singapore and Hong Kong (both free trade markets). Supply to international markets has increased by 58 per cent since 2015.⁸⁴ Year-on-year, exports increased 42 per cent between 2015/16 and 2016/17 alone. However, data shows that unmet demand is not high in current export markets, nor is it high relatively in any other global markets with unmet demand for Australian produce. Competitors (such as the US and Spain) have much higher unmet demand, evidencing that there is capacity to sell into markets should Australia be able to produce significantly more quantities or demonstrate a superior product.

In regards to international demand for herbs, this is still expected to be prevalent however not to the same extent as domestic demand and is likely to be in the processed herbs and spices category instead of the fresh supply. In 2018/19 only 15.6 per cent of produced herbs and spices are expected to be exported overseas, and this is increasing at approximately 7 per cent per annum.⁸⁵

Sector Target Considerations/Requirements:

Leafy greens are mainly grown in Australia in low-tech systems such as poly-tunnels and greenhouses, however some higher-tech facilities are starting to emerge (e.g. hydroponic systems with direct nutrient delivery). The most common leafy green crops produced are spinach, kale, bok choy/pac choi, rocket and herbs. Plants are grown from seed, so typically are initiated on substrates before being transferred to either soil or hydroponic holders. Temperature and light must be well managed in these facilities as warm temperatures encourage plant bolting and cool temperatures delay harvest which can increase production costs through a need to fertilise and irrigate for longer.⁸⁶ Additional considerations such as supply CO₂, using LED lighting, and controlling other atmospheric conditions will alter the speed at which the plants produce.

⁸¹ Horticulture Innovation Australia Statistics Handbook, 2017

⁸² Horticulture Innovation Australia Statistics Handbook, 2017

⁸³ Bao Vuong, 2018, Herb and Spice Processing in Australia

⁸⁴ Horticulture Innovation Australia Statistics Handbook, 2017

⁸⁵ Bao Vuong, 2018, Herb and Spice Processing in Australia

⁸⁶ Produce Grower, 2018, Lettuce and leafy greens 101: a production guide

04 Leafy Greens

Leafy greens need to be grown relatively close to consumption locations due to their perishability, this makes the IIPH a prime candidate for this as goods can be moved to the airport and into market within hours of being harvested (be that domestic or international). Domestically leafy greens are often cut, pre-washed and bulk bagged or crated for sale at retail outlets, however the prevalence of pre-washed salads and mixed leaves in single serve or family size bags is increasing. The ability to harvest, process and pack these bags will be important to getting product to market quickly. Consumers are increasingly looking towards leafy greens as a convenient, easy-to-use way of consuming vegetables.⁸⁷

Investment Requirements:

Depending on the type of production system used (mainly substrate and protection differences) then differing investment will be required. Low-tech poly tunnel style growing of leafy greens in soil substrates is less expensive than greenhouse production in man-made substrates, supplemented soil substrates or hydroponically (via deep water culture or nutrient film technique).⁸⁸ Any poly-tunnel system or greenhouse system would need to be equipped with the requisite irrigation, nutrient delivery and climate management system to ensure optimum growth. Nutrient waste must also be managed, depending on the type of system this could be through on-site reticulation and recirculation or through disposal (in an environmentally safe way).⁸⁹ Overall low-tech systems will require less investment to establish, but will likely produce less compared to high-tech systems which may produce more vigorous crops more efficiently due to an ability to more finitely control production variables.

Market Needs and Requirements:

Domestically

Consumer preferences for leafy greens has increased due to convenience and health desires. More and more people are demanding easy-to-grab and easy-to-prepare foods, and leafy greens are a simple and easy way to consume a serve of vegetables.⁹⁰ Domestic demand is highest in the rocket, baby spinach and herb varieties. Produce must be dark green, firm and free of lesions or foreign matter (particularly if being prepared for a pre-pack bag).⁹¹ Moving goods to market quickly is required to ensure that optimum freshness can be maintained for prolonged shelf-life.

Herbs are typically sold in bunches by variety into the domestic market, with the most popular varieties being basil, coriander, rosemary,

Internationally:⁹²

Of markets Australia is currently supplying, these are largely all free trade enabled countries with relatively simple protocol or access requirements. For example, Malaysia, Singapore and Hong Kong are open access markets, whereas Thailand and the UAE require phytosanitary certificates.

- *USA* – no import permit required, phytosanitary certificate required and declaration that goods are free from lettuce mosaic virus.⁹³
- *Germany* – no import permit required, phytosanitary certificate and endorsement confirming that plants are free from certain pests and diseases.⁹⁴
- *UK* – no import permit required, phytosanitary certificate (must be within 14 days of consignments being exported from Australia) and endorsement confirming that plants are free from certain pests and diseases (e.g. tobacco white fly).⁹⁵
- *Canada* – no import permit required, imported lettuce and leafy greens generally require a licence and declaration (if total volume weighs more than 50kg)⁹⁶
- *Netherlands* - no import permit required, however a phytosanitary certificate and any relevant declarations for freedom from viruses such as tomato black ring virus.⁹⁷

⁸⁷ Nielsen, 2018, Pre-packed Fresh Salad Propelling Growth For Australian Supermarkets

⁸⁸ Greenhouse Product News, 2016, Growing Hydroponic Leafy Greens

⁸⁹ NSW Government Department of Industry & Investment, 2011, Leafy Asian vegetables

⁹⁰ Fresh Plaza, 2018, AU: New data reveals strong growth in fresh salads

⁹¹ Woolworths, 2015, Produce Specifications: Leafy Vegetable

⁹² AusTrade, 2017, Guidance for exporters.

⁹³ Australian Government Department of Agriculture and Water Resources, 2017, Manual of Importing Country Requirements

⁹⁴ Australian Government Department of Agriculture and Water Resources, 2017, Manual of Importing Country Requirements

⁹⁵ Australian Government Department of Agriculture and Water Resources, 2017, Manual of Importing Country Requirements

⁹⁶ Government of Canada, 2018, Automated Import Reference System - Online Tool

⁹⁷ Woolworths, 2015, Produce Specifications: Leafy Vegetable

04 Leafy Greens

Technology:

Technology is boosting production of leafy greens and herbs, particularly in greenhouse and hydroponic type environments being proposed in the IIPH. Technology and sensors are increasing the ability to accurately control production parameters such as nutrient delivery, irrigation and climate which impacts upon overall production volumes, quality, energy use and sustainability. These include wireless sensors, fertigation (combining nutrient and water delivery) and LED lighting control systems to create diurnal variations in production systems.⁹⁸

A significant opportunity is presented with combining hydroponics with aquaculture (described in the aquaculture activity section) to produce 'aquaponics' which has the capacity to create circular production principles by utilising 'waste' products from various industries to support the growth of the other.

ACTIVITY CONSIDERATIONS

Leafy greens could definitely be included in an IIPH, they provide short production life cycle foods, which are nutrient dense and in high demand both domestically and internationally (although some proximal Asian markets don't have as high a level of demand for green Asian market vegetables that they can produce in-country).

Additionally given their short life-cycle leafy greens will note require a large amount of space in a facility such as the IIPH, as they can be grown continuously and consistently at high volumes in a small area (should there be adequate nutrient and water inputs etc.).

In terms of producing to export these leafy green goods, the co-location of the IIPH with downstream value chain participants such as food processing, freight and logistics (and ultimately direct airside access) will be critical to leafy greens viability as generally once picked these products are highly perishable compared to other horticultural products under consideration (and may travel to market better in a cooked state).

There is a distinct opportunity for the production of leafy greens to be combined with aquaculture in a facility such as the IIPH, they both support each other's production in a closed loop or circular economy system.

⁹⁸ Auroras, 2007, Digital innovation in greenhouses: successful agriculture

05 Mushrooms

Current National Market Supply:

	Mulgoa – Luddenham- Orchard Hills	Horsley Park – Kemps Creek	Cobbitty- Leppington	Badgerys’s Creek - Greendale	NATIONAL
Tonnes	Nil	Nil	31.912	2139.75	50,388
Area under production (ha)	Nil	Nil	2.279	16.55	1435
Proportion of production within Aerotropolis	0	0	0.16 per cent	1.15 per cent	1.31 per cent
Value of production (AUD)	Nil	Nil	\$203,577	\$13,650,182	\$323,412,213
Proportion of value within Aerotropolis	0	0	0.06 per cent	4.22 per cent	4.26 per cent

National Exports

Note: specifically of leafy green salad.

2016/17 tonnes	62 tonnes (approximately 0.09 per cent of national production) For target Asian markets, this includes to Indonesia and Singapore, total volumes were highest of all the plant based activities considered. Overall, the highest volume export market was Brunei with 16 tonnes.
2016/17 value	\$4.9 million (approximately 0.12 per cent of national value). The highest value export destination in 2016/17 was Brunei with 25.8 per cent of export value.

Source: Horticulture Innovation Australia Handbook 2016/17; ABS cat. No 7503 (2015/16) and ABS cat. No 7121 (2015/16); UN ComTrade.

Current International Market Supply:

Production (ha)		Production (tonnes)	
China	25,646	China	7,797,929
Spain	558	Italy	683,620
Indonesia	467	United States	419,630
Germany	303	Netherlands	300,000
Republic of Korea	200	Poland	260,140

Source: FAO Stat, reporting year 2016.

Future Demand

National

Australian consumption of mushrooms has increased steadily over the last three years and is expected to keep doing so. HIA data shows that more than two-thirds of Australian households buy mushrooms, with per capita volumes around 2.8 kg. This could be put down to trends to reduce meat consumption and the higher protein contents of mushrooms as a vegetarian substitute in meals.

Given production has remained stable over the last three years, supply has typically come from increased imports. An increase in production domestically would likely fulfil national demand before international demand

05 Mushrooms

if prices remain consistent with current prices, only an increase or premium in export prices would lead to export while the net trade balance remains in imports favour.⁹⁹

International

Current Australian-supplied export destinations (top five)	Unmet demand for Australian mushrooms in global markets		Demand from consumers for mushrooms from global competitors (representative of the existence of demand in the global market for other producers' products; possible demand that Australia could capture).	
Brunei	Thailand	\$306,000	China	\$149 million
PNG	Malaysia	\$101,700	Netherlands	\$65.6 million
Fiji	Vietnam	\$95,100	Poland	\$58.5 million
Nauru	Indonesia	\$87,000	Romania	\$39.1 million
Philippine's	Netherlands	\$73,100	Italy	\$37.5 million

Source: UN ComTrade, Intracen Trade Map.

The amount of mushrooms traded internationally from Australia has typically been very small (average of 60 tonnes per annum since 2012/13),¹⁰⁰ and it should be noted that a portion of reported figures includes truffles so actual volumes of mushrooms traded is likely to be even lower. Demand for Australian mushrooms is relatively low compared to other countries, it is likely that Australian mushrooms will not compete significantly in the international market unless produce includes niche varieties that are higher value, ability to improve product into market as they are highly perishable and improved marketing in country to demonstrate the high quality and taste of Australian produce.¹⁰¹ Generally, demand for mushrooms is low and falling.

Sector Target Considerations/Requirements:

The production of mushrooms is a fairly unique process as it is a fungus, not a vegetable or fruit technically. Compost (that is typically a medium such as straw and acidified with gypsum) is inoculated with mycelium on grain spores (typically) and left in stainless trays in heat cells at standardised temperatures and conditions. Once mycelium has grown, temperatures are reduced to signal sprouting which produces mushroom heads. Trays can be kept in varying conditions to shift the production of mushrooms (e.g. less mushrooms, larger size or vice versa). The compost is used to harvest two-three 'flushes' of mushrooms then is disposed of. Mushrooms are very sustainable crops as the required components are often by products of other industries (compost, manure for nutrients etc.); they are typically also somewhat disease resilient as any infected crops can be disposed of, compost and trays heat treated and new mycelium inoculated fairly easily.

Typically mushrooms grown close to consumption areas due to perishability, which has meant minimal product is exported in the past. Co-locating production with the airport would allow improve the feasibility of exporting mushrooms into the international market. Domestic consumption is largely of the *Agaricus* varieties of mushroom (button, flat, cup and brown) with some additional exotic varieties consumed (e.g. oyster or enoki). Consumption domestically is around 2.8 kg per person,¹⁰² however there is capacity to increase this through improved marketing and display of consumption health benefits.

Investment Requirements:

⁹⁹ Horticulture Innovation Australia Statistics Handbook, 2017

¹⁰⁰ Horticulture Innovation Australia Statistics Handbook, 2017

¹⁰¹ Horticulture Innovation Australia, 2017, Mushroom strategic investment plan

¹⁰² Horticulture Innovation Australia, 2017, Mushroom strategic investment plan

05 Mushrooms

To consider including mushroom production in the IIPH, the establishment of an appropriate compost production/accumulation site, a grow-out and harvest facility and a packing area will need to be established on site. A link to a local spawning producer (or location of a spawn inoculation centre onsite) will be critical to ensuring that inoculation can be facilitated. Mushroom specific machinery will also be required, as the processes, handling and packaging of the mushrooms can cause them to be damaged easily if not done carefully.

Market Needs and Requirements:

Domestically

Mushroom consumption is fairly high in Australia and the major industry body has plans to grow this in the next five years. Increasing consumption through innovative processing and packaging is helping this (for example there is a shift towards pre-sliced mushrooms or pre-packed mixed bags of mushrooms ready for food preparation). Generally though, mushrooms are harvested packed and sold in a short space of time, and thus facilities tend to be located close to consumption areas (i.e. close to cities).

Internationally¹⁰³

Australia's exports of mushrooms are typically to free trade countries where no protocols are required to enter the market. For example, exports to Fiji require an import permit, a phytosanitary certificate and an EXDOC endorsement however there are no tariffs on goods. For countries with unmet demand for Australian produce, largely these are also tariff and technical barrier free markets.¹⁰⁴ For markets with higher consumption rates such as China and the EU, niche products would need to be exported as currently these regions are both already large producers themselves, and they are more restricted with technical barriers to trade (e.g. China is a protocol market).¹⁰⁵

Technology:

Standard technology in mushroom production facilities includes temperature control automation to drive efficiencies, minimising production costs and automatic harvesting reducing labour costs.¹⁰⁶

Mushroom production in climate, controlled facilities is now being adopted more and more across the industry. Additionally mushroom production has the capacity to be incorporated into a circular economy, closed loop system, mushroom farms in the US for example are already incorporating biomass technology that burns excess substrates and feedstock from production to produce electricity with excess heat from the generators helping warm water for humidity controlling functions in the mushroom growth rooms.¹⁰⁷

ACTIVITY CONSIDERATIONS

Mushrooms are also well-adapted to indoor, intensive production systems with technology well advanced to support production efficiencies (e.g. climate control growth rooms). As was noted about leafy greens however, mushrooms are quite perishable, and consideration of downstream processing prior to export on-site at the IIPH should be considered.

Generally, mushroom demand domestically and internationally is the lowest of all products considered for possible inclusion in the IIPH. Mushrooms are being superseded in regards to their consumption by other vegetables with 'superfood' claims or that are cheaper or easier to prepare (e.g. don't necessarily require cooking, the most common method of mushroom preparation for consumption).

One reason that does support their possible inclusion in an IIPH is green waste from the production of other crops could be turned into the manure used as the production substrate of mushroom farms.

¹⁰³ AusTrade, 2017, Guidance for exporters.

¹⁰⁴ Australian Government Department of Agriculture and Water Resources, 2017, Manual of Importing Country Requirements

¹⁰⁵ PS Intelligence, n.d., Global Mushroom Market Size, Share, Development, Growth and Demand Forecast to 2023

¹⁰⁶ Murray C. Tseng, John H. Luong, 2014, Mushroom Cultivation – Technology for Commercial Production

¹⁰⁷ Premier Mushrooms, 2013, Renewable Energy – Biomass Gasification Technology

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Current National Market Supply (of Salmon, Trout and Prawns):

	Mulgoa – Luddenham- Orchard Hills	Horsley Park – Kemps Creek	Cobbitty- Leppington	Badgerys’s Creek - Greendale	NATIONAL (or NSW where indicated)
Tonnes	Nil	Nil	Nil	Nil	101,794 tonnes
Area under production (ha)	N/A	N/A	N/A	N/A	1496 ha in NSW, pond or tank based
Proportion of production within Aerotropolis	0	0	0	0	N/A
Value of production (AUD)	Nil	Nil	Nil	Nil	\$1.31 billion (aquaculture only)
Proportion of value within Aerotropolis	0	0	0	0	N/A

National Exports

Note: specifically of leafy green salad.

2016/17 tonnes	<p>More than 30,000 tonnes (note this includes both wild catch and aquaculture production).</p> <p>For target Asian markets, this includes to Singapore, China and Indonesia. China had the highest export value with prawn imports in 2017 reaching \$147.5 million.</p>
2016/17 value (AUD)	<p>\$1.5 billion (approximately half total national value). Note this includes both wild catch and aquaculture production.</p> <p>The highest value export destination in 2016/17 was Vietnam with just under half of export value. However, it should be noted that Vietnam is often considered an entry market into other Asian countries where export permits are required (a ‘backdoor’).</p>

Source: Australian Fisheries and Aquaculture Statistics 2016 – Production, Exports.

There is no aquaculture production in the region to date. However, aquaculture production in Australia is increasing more generally. In 2015/16 finfish aquaculture production increased 14 per cent, particularly in less common varieties (i.e. excluding salmon, tuna and barramundi). Salmon is by far the most voluminous and valuable produced seafood. Aquaculture production of prawns and other crustaceans decreased in 2015/16, however still accounted for nearly \$100 million in value (wild-caught species value is significantly higher). In NSW aquaculture production accounts for approximately a third of the volume of seafood produced, but nearly 42 per cent of value.¹⁰⁸

¹⁰⁸ Australian Government Department of Agriculture and Water Resources, 2016, Fisheries and Aquaculture Statistics – Production in NSW

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Current International Market Supply:

Production (tonnes)

China	63,700
India	16,600
Vietnam	5,703
Indonesia	3,635
Bangladesh	2,204

Source: FAO Stat, reporting year 2016.

Future Demand

National

Australian consumption of seafood has increased steadily over the last ten years increasing more than 35,000 tonnes per capita from 2005/06 to 2015/16; ¹⁰⁹ seafood supply hasn't been able to keep abreast of this consumption domestically so instead imports have risen to meet supply gaps. Most of the excess demand was met with preserved fish (e.g. tuna) and frozen seafood. Domestically, demand is highest in prawns, canned tuna, prepared fish (e.g. battered), squid and fresh salmon. Salmon supplies have risen the most, and are continuing to do so, due to the establishment of more salmon aquaculture systems (however it should be noted that these are generally not land-based as fish are grown out in ocean ponds. ¹¹⁰

International

Current Australian-supplied export destinations (top five)	Unmet demand for Australian Salmon, Trout, Prawns and Abalone		Demand from consumers for seafood from global competitors (representative of the existence of demand in the global market for other producers' products; possible demand that Australia could capture).
Salmon – China, Taipei, Indonesia and Malaysia	Salmon – US, Hong Kong, Vietnam	\$6.2 million, \$3.8 million, \$2.4 million	Salmon Norway - \$3.3 billion
Trout – US, Japan, Indonesia and Singapore	Trout – Thailand, Malaysia	\$300,000, \$47,000	Trout Norway - \$145.2 million
Prawns – Japan, Vietnam, Thailand, Hong Kong	Prawns – US, China, Belgium	\$13.7 million, \$1.3 million, \$1 million	Prawns India - \$4.9 billion
Abalone – Hong Kong, Japan and Singapore	Abalone – Thailand, Japan, US	\$24.1 million, \$11.2 million, \$9.7 million	Abalone China - \$1.9 billion

Source: Intracen Trade Map; FAO GlobeFish Report 2017.

Australia has a diverse range of customers in the international market for aquaculture products such as salmon, trout and prawns. Largely Australia currently supplies to Asian markets and the USA; growth in demand is expected to require an additional 10 million tonnes of growth in production between now and 2023 to meet future demand. It should be noted however, that while seafood is more valuable in the global market than other produce being considered in this report that a maintained positive economic outlook will be critical to ensuring that these countries continue to have high, valuable demand and that our production systems continue to produce high quality goods compared to in-market domestic produce to ensure a premium price is received. .

¹⁰⁹ Australian Government Department of Agriculture and Water Resources, 2016, Fisheries and Aquaculture Statistics

¹¹⁰ Australian Government Department of Agriculture and Water Resources, 2016, Fisheries and Aquaculture Statistics

06 Aquaculture

Sector Target Considerations/Requirements:

Aquaculture in Australia (and NSW) is split into two distinct production systems – wild-catch and aquaculture. Relevant for the IIPH is only on-land aquaculture (despite it not currently being undertaken in the area it is nonetheless feasible in the Aerotropolis). With future demand for seafood produce increasing both domestically and internationally,¹¹¹ this is likely to only be met by aquaculture production, as opposed to wild-catch which is a size-limited sector.

Currently aquaculture is limited to some varieties of finfish and crustaceans (including salmon, cobia, crayfish and prawns). These production systems typically provide products for the domestic market where retail prices are sufficient to capture margins for producers. The reason for the limited species production variety as it stands currently is due to a lack of scientific knowledge and technology to harvest and cultivate other varieties of seafood. That is not to say however that research is underway, for example the University of Tasmania is close to designing a commercially¹¹² viable rock lobster recirculated-aquaculture production system.

Production at the IIPH would likely need to be a combination of finfish for the domestic market (such as salmon and trout, however the PPR also suggests barramundi and murray cod are also feasible) and higher value products such as abalone and king prawns for the international market. Land-based prawn production requires warmer water, pond management and specific nutrition¹¹³ to ensure targeted growth is achieved. The common land-based varieties are banana and tiger varieties, king prawns are less common however are feasible and recommended for consideration in the IIPH due to their higher export and retail value.

These two ‘prized’ products are generally in high demand, and consumed, by wealthy middle to upper class Asians who like the health benefits of the products as well as the quality and appearance of Australian seafood. Recently reported by the FAO, Australian farmed abalone was fetching \$85/kg, that’s more than double the world’s highest fish or crustaceans prices.¹¹⁴ Domestic preferences are divided between fresh and frozen products, while internationally most seafood is shipped frozen (however new technologies and air freight trade is expediting fresh export processes).

Investment Requirements:

RAS systems effectively use water and reduce environmental impacts¹¹⁵ through its recycling systems. The closed-loop also allows for very specific control of other production factors, for example nutrient and feed availability, CO² use, stocking density, light and temperature, compared to wild catch or ocean pond systems. An energy source, through electricity, will be required at the IIPH as RAS is 1.4 times more energy dependant than conventional flow-through farms.¹¹⁶

Critical to achieving aquaculture success at the IIPH will be ability to secure and utilise large volumes of water. In the first instance, the PPR identifies clearly that open, large-scale ponded systems will be unsuitable as securing large volumes of water to fill ponds will be difficult. Instead, the most suitable system will be Recirculating Aquaculture Systems. The technology and capital required to establish these facilities can be high (particularly when environmental management must also be factored into planning and design), however once operational they are technologically and digitally advanced and this will help to minimise ongoing costs.

For any of the viable sub-categories for the IIPH (prawns, abalone, finfish) the following factors would need to be controlled by infrastructure, machinery and technology: water temperature, salinity level, pH, organic matter, feeding rate, stocking density, carbon dioxide, oxygen, water flow/reticulation rate and light.

Market Needs and Requirements:

Domestically

Australians have a preference for fresh and chilled seafood over frozen and canned products,¹¹⁷ so having a large scale production facility close to consumers in the Sydney basin will provide an increase in supply of goods proximal to consumers. Additionally, consumers will choose Australian caught or grown seafood over imported seafood, unless prices are excessive and imported goods then become more favourable. So an increase in domestic supply will ensure that prices remain more stabilised. Salmon and trout are the most

111 Australian Government Department of Agriculture and Water Resources, 2016, Fisheries and Aquaculture Statistics

112 University of Tasmania, Arc Research Hub For Commercial Development Of Rock Lobster Culture Systems

113 Australian Prawn Farmers Association, 2015, Environmental Standards

114 Food and Agriculture Organization of the United Nations, 2017, Abalone production continues to grow, coupled with continuing demand, prices high and stable

115 Deep Blue, 2009, Life Cycle Assessment of Indoor Recirculating Shrimp Aquaculture System

116 Deep Blue, 2009, Life Cycle Assessment of Indoor Recirculating Shrimp Aquaculture System

117 Nielsen, 2017, Fishy Business: How New Product Development Can Boost Australian Seafood Sales

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popular finfish, followed by oysters and crustaceans which are typically consumed as gourmet foods or 'occasion foods' (e.g. Christmas time).¹¹⁸

Internationally¹¹⁹

Current supplied markets of Australian seafood are either free trade markets (e.g. Singapore, Vietnam, Malaysia and Hong Kong) or are protocol specific markets (e.g. US, Indonesia, China and Japan). Focussing in on China alone, which is expected to be a source of more than half of the global increase in seafood demand, crustacean imports have increased 23 per cent in the ten years to 2015/16 alone.¹²⁰ To capture as much export value as possible, gaining improved market access and securing higher export volumes to markets with unmet demand will be important; considerations for facilitating this include:

- *US* - crustaceans and finfish both have market access to the US with a Dept. of Agriculture Export registration; crustaceans require an FX46A certificate (certification of system); additionally as of 31 December 2018 exporters of prawns and abalone will be required to provide harvest, landing information, chain of custody and traceability records.
- *Thailand* – export registration with the Department of Agriculture, FX46 Certificate with 510 endorsement (not contaminated by radioactive goods). Established Free Trade Agreement already in place for seafood.
- *Malaysia* - export registration with the Department of Agriculture, FX46 Certificate with 3217 endorsement (compliance with Australian Pesticide Veterinary Medicines Authority compliance requirements for nitrofurans and metabolites). Established Free Trade Agreement already in place for seafood.
- *China* - export registration with the Department of Agriculture, FX46CA and 46C (attesting that fishery products are produced, packed, stored and transported under sanitary conditions, inspected competently, free of epidemiological disease and are fit for human consumption) and registration with the General Administration of Quality Supervision, Inspection and Quarantine (Chinese). There is no tariff on abalone and salmon under the new China-Australia FTA from 1 January 2019.¹²¹

Technology:

The technology behind RAS systems is still evolving, cultivation, feed, harvest and packing/processing requirements are not standardised. There is scope to facilitate the evolution of RASs at the IIPH through on-site research and development that would benefit the producer, consumers and industry concurrently. For example, research underway in 'blue economies' nearby could be a concept that is leveraged at the IIPH. Technology and production has been integrated in a closed system nearby to the Aerotropolis by Blue Farms (Urban Ecological Service Ltd) in partnership with the University of Sydney, to establish greenhouse leafy green plants and herbs growing on a suspended medium, below which are large tank fish production systems. The waste from the aquaculture feeds into a treatment tank where bacteria and worms turn it into fertiliser nutrients for the plants.¹²²

The most critical consideration for aquaculture at the IIPH as a viable activity will be the use of advanced technologies to monitor water temperature and quality (e.g. Salmon typically requires cool salt water which must be blended on site, while the temperature in Western Sydney can reach more than 40 degrees throughout summer). RAS systems can also produce a lot of waste, however the PPR notes that this could be reticulated into local industries for reuse or treated; licencing would be required.¹²³

Shipping and packing is the final area of technology that could be integrated into aquaculture production at the IIPH. The innovative design of new and improved packing containers is facilitating live and chilled airfreight of seafood minimising quality reductions that occur when products are snap frozen.

118 Australian Food News, 2016, IBISWorld reports soaring seafood consumption not matching growth in Australian fishing and aquaculture industries

119 AusTrade, 2017, Guidance for exporters.

120 Undercurrent News, 2018, Rabobank: China to drive more than half of global seafood consumption growth over next decade

121 Australian Government Department of Agriculture and Water Resources, 2017, Manual of Importing Country Requirements

122 Blue Smart Farms, 2013, Blue Farms

123 Agrolgy, 2018, Production Possibilities Report

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ACTIVITY CONSIDERATIONS

Generally, Australia has been a low export of seafood compared to other foods, however seafood is a significantly higher value activity than all other activities considered in this report. Australia produces very high quality and high value seafood, that is in high demand in export markets due to its clean status generally (Australia has very good environmental conditions compared to a number of Asian producers for example).

However, it should be noted that the IIPH would be considering on-shore aquaculture systems. This requires significant capital to establish (and in some instances, the production technology is not yet fully commercialised e.g. rock lobster). Developments in this area are underway however, exemplar facilities are being constructed and operationalised internationally that could be mirrored at the IIPH.

There is a distinct opportunity to partner with research and development organisations to develop on-shore production systems at the IIPH to produce high value aquaculture (in particular king prawns, trout, salmon, abalone and lobster). Additionally, RAS aquaculture systems can be co-located with leafy green production systems as described above.

07 Cut Flowers

Current National Market Supply:

	Mulgoa – Luddenham- Orchard Hills	Horsley Park – Kemps Creek	Cobbitty- Leppington	Badgerys’s Creek - Greendale	NATIONAL
Tonnes	Not Reported				97,046 tonnes
Area under production (ha)	2.52	20.54	17.79	14.05	4295
Proportion of production within Aerotropolis	0.06 per cent	0.48 per cent	0.414	0.32 per cent	1.274 per cent
Value of production (AUD)	\$309,557	\$6,828,671	\$2,990,980	\$3,398,762	\$317,218,767
Proportion of value within Aerotropolis	0.98 per cent	2.15 per cent	0.94 per cent	1.07 per cent	5.14 per cent

National Exports

2016/17 tonnes	N/A
2016/17 value (AUD)	\$9.5 million (approximately three per cent of total national value). The highest value export destination in 2016/17 was the Netherlands, however this only accounted for approximately 29 per cent of exports.

Source: Horticulture Innovation Australia Handbook 2016/17; ABS cat. No 7503 (2015/16) and ABS cat. No 7121 (2015/16); UN ComTrade.

Future Demand

National

Cut flowers are mainly sourced locally, however a small portion of imports (approximately 10 per cent)¹²⁴ are made each year to substitute mass markets annually (e.g. around Valentine’s Day). The most popular cuts are roses, lilies, gerberas, chrysanthemums, carnations and tulips.¹²⁵ These are expected to continue to be the varieties in highest demand too, however there is an increasing future demand for native Australian flowers. It is expected domestically that more imports will continue to enter the marketplace to meet increasing demand, and that local flower production may become static. Overall, demand is rising however at a slower rate than in previous years.

¹²⁴ Flowers Australia, 2017, Import and Export

¹²⁵ Flowers Australia, 2017, Import and Export

07 Cut Flowers

International

Current Australian-supplied export destinations (top five)		Unmet demand for Australian cut flowers in global markets		Demand from consumers for cut flowers from global competitors (representative of the existence of demand in the global market for other producers' products; possible demand that Australia could capture).
Netherlands	Russia	\$16,500	Netherlands	\$1.7 billion
Japan	Thailand	\$11,600	Colombia	\$421.2 million
US	Myanmar	\$6,800	Kenya	\$342.8 million
China	United Kingdom	\$3,700	Ethiopia	\$158.9 million
South Korea	Belgium	\$2,200	Ecuador	\$140.9 million

Source: UN Comtrade, Intracen Trade Map.

Most of the products that are sold into export markets from Australia are niche, native type species such as grasses, ferns, waxflower and Christmas bush. Generally Australia will lack the ability to meet any international demand due to the fragmented nature of the industry (large number of producers, low level of production generally). The perishable nature of cut flowers makes them difficult to transport long distances or for long periods of time; improving Australia's technical ability to export may increase Australia's ability to meet international demand which is generally rising.

Sector Target Considerations/Requirements:

The floral industry has a unique supply chain compared to other products considered here. While production can be field grown, in poly-tunnels or in greenhouses, each has quite specific growing considerations and are suited to different flower types. Greenhouse and poly-tunnel production are the most viable in the IIPH, due to the intensive nature of the facility. Poly-tunnel systems can facilitate greater temperature management and allow for most flower seasons to be extended beyond varietal 'expectation' should they have been produced outside of a tunnel. Both systems do require adequate water supplies, by either sprinkler, drip or tape irrigation. Either production system requires well-drained fertile soils (preferably in raised beds), without these flowers may struggle to establish or not bloom to full expected colour.¹²⁶

The best greenhouse varieties are oriental lilies, alstroemeria, dahlias, dianthus and gerberas. The best poly-tunnel varieties include bellflowers, dahlia, snap dragons, sunflowers etc. Typically these varieties yield slightly more than field varieties would.

Additionally, flowers produced in the Netherlands and southern America dominate the international market (e.g. roses and tulips) so these shouldn't be produced at the IIPH as they will not be able to compete on the international market based on both price and volume.

Following production storage of cut flowers is specific and labour intensive, they require water, cool temperatures, feed sources and pest control management to prevent and then maintain their bloom while being transported. Facilities to adequately store blooms, prior to transportation, will need to be on-site.

Investment Requirements:

Both tunnel and greenhouse systems would require capital investment, however greenhouses more so than tunnels. The poly-tunnels also have less investment in their ongoing operational costs, for example requiring less power and energy to maintain climate conditions.

¹²⁶ Michigan State University, Speciality Cut Flower Production and Handling

07 Cut Flowers

Market Needs and Requirements:

Domestically

Consumers generally are demanding colourful flowers all year round (i.e. using substituted imports to top up supply when local seasonal varieties are out of stock). While most 'classic' varieties of flowers are requested by customers, there has been an increase in demand for unique (looking and colour) flowers including native and non-native varieties. The emergence of on-demand consumption (e.g. daily bouquet deliveries or on request flowers delivered to your door) is also leading to a shift in the industry. Suppliers are having to alter supply chains to meet this shift. Finally, the change in consumption of florist bought flowers to supermarket and convenience store purchases is leading to a shift in supply chains too.

Internationally: ¹²⁷

To current markets, the following conditions for exports are in place.

- *Korea* – around 16 per cent, dropping to 7 per cent by 2026 (airport operationalisation), no import permit required, phytosanitary certificate required;
- *China* – no tariff;
- *US* – no tariff, no import permit, phytosanitary certificate required, must be free from light brown apple moth;
- *Japan* – no tariff, no import permit, phytosanitary certificate required; and
- *Netherlands* – phytosanitary certificate required. ¹²⁸

Ultimately the markets with unmet demand for Australian cut flowers are minor. There is a need to establish a more voluminous quantity of product, a better path to market (e.g. the WSA) or a niche product (e.g. Australian natives) to capture high value.

Technology:

There is a lot of scope for investment in technology to support production in the cut flower market at the moment. These are focussed on water use efficiencies, automated greenhouse systems (including harvesting), energy saving mechanisms and ways of improving labour use (aligned to automated harvesting).

The most adopted technology to date is hydroponics (or in some instances fertigation only), as nutrients are mixed with water and delivered directly to plants with waste products collected and treated (through reverse osmosis) for re-use.¹²⁹ This creates both economic and water/environmental benefits for growers. These systems are still being improved however and more technologies and innovations are becoming viable regularly.

Harvest systems that help sort, collect and prune stems and bunches automatically are being used for large scale operations and should definitely be considered for the IIPH.

ACTIVITY CONSIDERATIONS

Cut flowers could be a viable inclusion in the IIPH, however establishing a commercial quantity, leveraging current, innovative production technology (e.g. from facilities in the Netherlands) and minimising costs will be vital to the success of this activity.

In terms of exporting cut flowers, there is not a significant amount of unmet demand for Australian product internationally; the Netherlands, South America and Africa all have very large and well-established industries. The best opportunity for this activity at the IIPH would be in producing 'less-known' flowers or even native varieties in bulk quantities that may demand high premium prices due to their uniqueness in export markets. The export of these native flowers may create some biosecurity and quarantine issues, these would need to be better understood to fully consider their inclusion in the IIPH.

¹²⁷ AusTrade, 2017, Guidance for exporters.

¹²⁸ Australian Government Department of Agriculture and Water Resources, 2017, Manual of Importing Country Requirements

¹²⁹ Australian Government Department of Education, Employment and Workplace Relations, 2011, Sustainable Production Technologies for the Cut Flower Industry

Appendix: Insights 17 on aquaculture

Summary of further information collated on land-based aquaculture

According to the Global Aquaculture Alliance organisation who promote responsible aquaculture practices, 62 per cent of food fish will come from aquaculture. Various business models exist including sea (onshore and offshore production) and land-based aquaculture solutions for farming seafood.

A specific interest has been demonstrated by NSW DPI on land-based aquaculture given the existing opportunities for the IIPH precinct. As part of the pre-feasibility stage, despite further consultations, data inputs were not considered exhaustive and robust enough to be included in the high level economic analysis it is recommended that further investigations are carried out to refine the scenario (species and business model) and undertake detailed financial analysis to assess economic viability of land-based aquaculture. This appendix provides a summary of business insights collated from various sources of information.

From sea to land

Based on early stage consultation with stakeholders in the Australian and international aquaculture industry, there is some interest to move from sea to land.

While companies like King Salmon¹³⁰ in New Zealand is working closely with the local government to relocate several farms to off-shore with higher flow waters, the new "blue house" Atlantic Sapphire¹³¹ land-based farm is being developed in Miami to grow

salmons in a state-of-the-art recirculation aquaculture systems.

In-land aquaculture has been raising a strong interest especially due to the accrued control of the cycle enabled by a closed environment to mitigate risk of disease, environmental influence, fish escape or loss. Temperature control, automated feeding systems, water quality sensors, waste management systems, oxygen management are facilitated by aquaculture solutions. Sustainability is also a key argument for land-based aquaculture advocates. On the flip side, in-land aquaculture is a capital intensive industry presenting however some opportunities for economy of scale. It requires large land areas to grow or hold fish, reliable supplies of high quality water (fresh or sea water) and involves dealing wastes (e.g. organic waste (mainly uneaten feed and fish excreta), solid waste from filters, chemicals; fish mortalities and processing wastes, energy and greenhouse gas emissions¹³²).

According to an expert engaged in the salmon production¹³³, 90 per cent of the fresh water used in hatchery would be kept thanks to recirculating and cleaning systems and about 10 per cent of the water waste would re-purposed for irrigation. This contribution is however specific to early stage production as waste would increase exponentially as fish grow.

Waste generated from in-land aquaculture farming systems can be used as fertiliser and can create renewable energy in the form of biogas. Water waste on its end can be repurpose to irrigate fields or greenhouse.

130 New Zealand King Salmon, 2018, About Us & Our Environment

131 Atlantic Salmon, 2018, Our Product & The Bluehouse

132 Victorian Fisheries Authority, 2008, Best Practice Environmental Management Guidelines for Recirculating Aquaculture Systems

133 KPMG – Commercial in confidence information

Highlighting industry opportunities:

Lobster – Technology in development

In 2018, a new ARC Research Hub was announced to undertake research into the development of culture systems for mass production of lobster seed stock.

The University of Tasmania is leading the way to develop a cutting edge technology thanks to a \$5 million investment from the ARC over five years.

According to Professor Byrne, “Global demand, declining wild stocks and prices are making rock lobster aquaculture attractive—but there is currently no reliable or sustainable supply of seed stock”.¹³⁴

This is a practical example of collaboration and commercialisation pathway for R&D to create sustainable growth opportunities for Australian’s Aquaculture industry and enhance wild lobster stocks.

Rock lobster is a high premium seafood product which represents a serious export opportunity to consider in the longer term for the development of the IIPH in WSA, once the technology will be commercialised.

Prawns – Opportunities for export

The project SeaDragons¹³⁵ is a proposed large scale and staged development of 10,000 ha of land based prawn aquaculture to provide supply of high-quality products for export markets.

The facilities will be located across northern Australia. They will be specialised through end-to-end activities from quarantine and founder stock centre, breeding centre, hatchery in closed-environments, farming in ponds and a processing plant.

A detailed feasibility study has been realised.

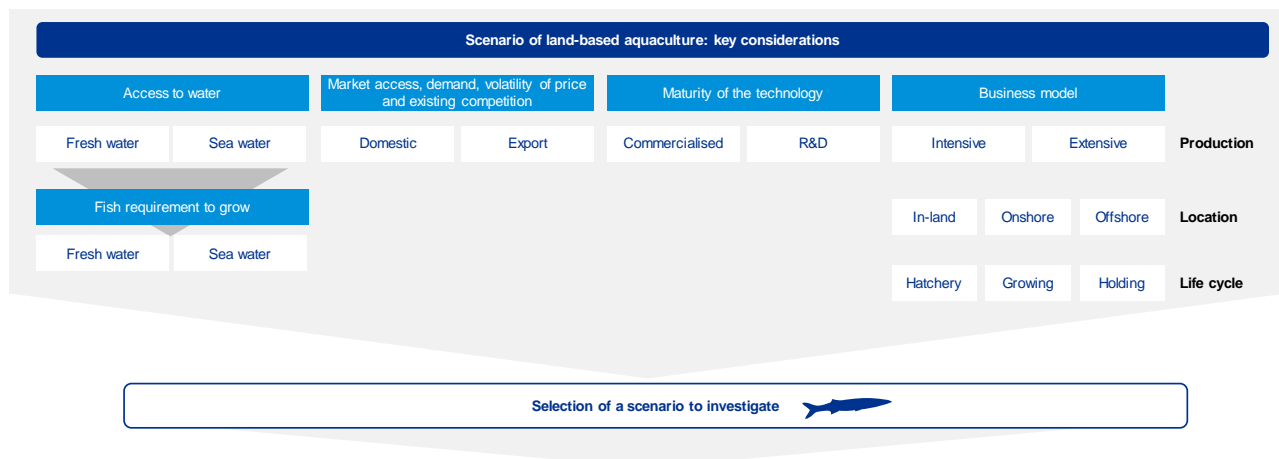
Abalone – Holding for exports to China

Since 1996, the company Ralph’s Tasmanian Seafood¹³⁶ has been exporting live abalone to China.

Approximately 500 tonnes a year (i.e. 20 per cent of the Tasmanian catch according to the company) of live abalone are caught in the wild and then exported.

The company operates set up a processing factory in southern Tasmania, and owns a fleet of temperature-controlled trucks, a charter plane and mother boat to export its produce from Tasmania to the customer.

Considerations for future detailed business viability and financial analysis



Detailed business and economic analysis: key requirements

- Detailed business and economic analysis need to be undertaken based on an agreed scenario that would highlight the business model and specie considered.
 Main requirements discussed with preliminary consultations include but are not limited to:
- Space requirement
 - Production yield
 - Life cycle of the fish
 - Breeding and optimum production season
 - Feeding – costs of inputs
 - Energy use requirements, including amount of water
 - Waste management (water, solid)
 - Oxygen
 - Best technology for the scenario
 - Resources required
 - Heating and temperature control

Source: KPMG.

134 Australian Research Council, 2014, New ARC Research Hub: making commercial rock lobster aquaculture a reality

135 Seafarms Group Ltd, 2018, About Project Sea Dragon

136 Ralph’s Tasmanian Seafood Pty Ltd, 2018, The Company & Company Milestone

Appendix: Financial considerations

18 approach

18.1 Approach and methodology

Data inputs

Data inputs for the high level economic analysis were collected through various sources of information including:

- New South Wales Department of Industry: business requirements provided for the scenarios and priorities on activities to be considered for the IIPH
- Agrolgy Pty Ltd: assumptions provided further to the development of the "Production Possibility Report" commissioned by NSW DPI aiming to investigate what forms of primary production are technically feasible and financial viable
- KPMG: expertise provided by the food and agribusiness team in regards to international best practices for the development of a world class integrated intensive production hub adjacent to an airport
- Commercial in confidence: resulting from consultations with clients in the agribusiness industry.

The farming production area of the IIPH considered for this analysis includes the following activities: snack tomatoes, capsicum, blueberries and truss tomatoes. These activities are considered as examples for the purpose of this analysis and do not reflect any form of recommendation in regards to the type of type of crop or aquaculture activity to consider for the precinct.

Other examples of activities including leafy greens, asian vegetables, native foods, land-based aquaculture, mushroom and floriculture were considered of interest based on demand and availability of standardised production systems enabling intensive harvesting. However, the following activities were not included in the modelling of estimated revenue and jobs creation opportunities for the IIPH due to lack of robust data inputs available within the timeframe of the study. Detailed individual economic and financial analysis of these farming activities must be undertaken to assess their viability in the context of an integrated intensive production hub.

Caveats

This analysis does not aim to:

- assess the economic viability of production systems;
- assess the profitability of the activities (thus the analysis excludes calculation of operational expenditures and capital expenditures);
- evaluate financial return of the different activities based on optimal land use; and
- articulate any recommendations on land use or the best activity mix.

Revenue and employment opportunities do not include at this stage estimations of jobs creation or revenue derived from the activities performed in the shared

services (including food processing, logistics, warehousing, research and development etc). This represents further perspectives of synergies, value creation, business and job creation opportunities.

Data inputs to farm capsicum in conventional Venlo greenhouse including yields, variable FTE assumptions, waste and energy use requirements have been provided by Agrolgy Pty Ltd based on their expertise, however no detailed financial analysis was developed within the timeframe needed for submission to validate profitability and financial return robustness.

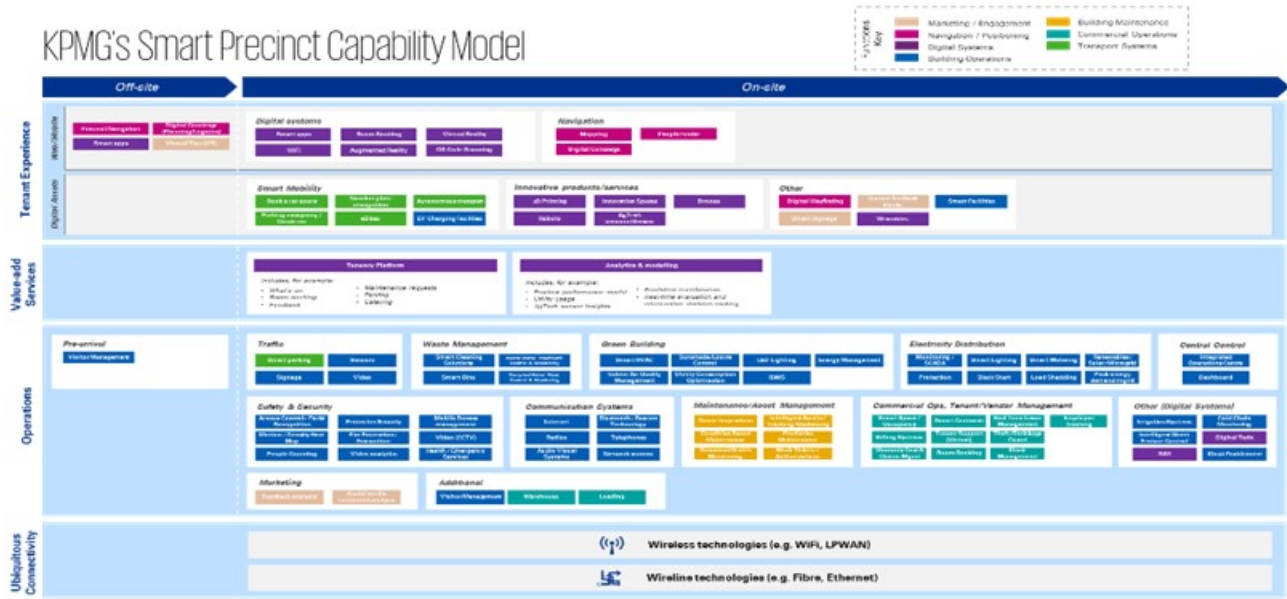
18.2 Other assumptions

The main assumptions underpinning the IIPH's outputs (including estimation of revenue, jobs creation opportunities, energy use requirements, waste generated):

- The IIPH site was considered as a standalone greenfield including access road, water and energy to site entrance and waste management infrastructure available to allow operations of greenhouses.
- The farming production area was split into units of measure of 10 ha to allow comparing profiles of activities in terms of estimated revenue generated and jobs creation opportunities (i.e. 25 parcels for scenario 1 and 50 parcels for scenario 2). Variables drivers increase proportionally with production area estimation.
- Each parcel assumed a productive land area of 70 per cent and non-productive land area of 30 per cent (storage, common areas, offices, pathways etc).
- KPIs and outputs presented in the high level economic contribution potential of the IIPH and the preliminary estimates of resource requirements assume a land development rate as explained above to reflect the capacity of the precinct to grow revenue.
- The following assumptions are extrapolated from data inputs provided by Agrolgy Pty Ltd. per type of crop for parcels of 30 ha:
 - Production yields;
 - Pricing;
 - Energy use requirements;
 - Waste;
 - Production yields and energy use requirements are estimated by type of crop based on conventional Venlo glasshouse production systems (the financial modelling carried out by Agrolgy Pty Ltd highlighted a better IRR and inferior CAPEX requirements over ten years compared to semi-closed glasshouse); and
 - Variable / fixed FTE.

Appendix: Smart 19 Precinct Model

KPMG's Smart Precinct Capability Model



Appendix: Stakeholder 20 consultation

Stakeholder consultation undertaken to date is outlined below in Table 20-1.

Table 20-1: Stakeholders consulted throughout the reporting process.

	Entity
1	Agrology Pty Ltd
2	Australian Federation of International Forwarders
3	Australian Logistics Council
4	Coffs Harbour Airport
5	CSIRO
6	CSIRO/Data 61
7	Department of Agriculture and Water Resources
8	Department of Infrastructure, Regional Development and Cities
9	Department of Planning and Environment
10	DPE Western Sydney and Aerotropolis Activation, Planning and Design
12	Endeavour Energy
13	Environment Protection Authority
14	Food Innovation Australia Limited
15	Greater Sydney Commission
16	Horticulture Innovation Australia
17	Infrastructure NSW
19	Jemena
20	KPMG
21	Leppington Pastoral Company
22	Liverpool City Council
23	Menzies
11	NSW DPI Biosecurity
24	NSW Farmers'
25	Presync
26	Qantas Freight
27	Queensland University of Technology
28	Roads and Maritime Services

	Entity
29	Suez
30	Sydney Markets Limited
31	Sydney Water
32	Tesla
35	The Perich Group
36	The Refrigerated Warehouse & Transport Association of Australia
37	Transgrid
33	Transport for NSW
34	Transport for NSW Freights & Ports Strategy and Planning
38	Veolia
39	Waste Contractors and Recyclers Association
40	Watt Exports
41	Western Sydney Investment Attraction Office
42	Wollondilly Council
43	WSA Co

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