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PILBARA 2050

Ensuring the
longterm viability
of the Pilbara

Jemma Green, Peter Newman & Johanna Mitchell

Rich picture created by Julian Ilich

Curtin University Sustainability Policy Institute



Abstract

The **Pilbara** is presently an iconic natural resources monoculture economy. Although iron ore and natural gas are the dominant sectors, there is a great deal of undeveloped potential for economic diversification that would ensure the long-term economic viability (LEV) of the region. In having reviewed more than 200 documents and conducted interviews with government, industry and academics, this report asks fundamental questions about what kind of future could be created for the region in addition to these two industries. It also investigates how spin off industries can stabilise and become self-sustaining to create an inter-generational legacy for when the peak resource legacy is reached at around 2050, ensuring the Pilbara will remain an economic powerhouse in perpetuity.



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For further information, please contact culp@curtin.edu.au

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Pilbara 2050: Ensuring the long-term viability of the Pilbara

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EXECUTIVE SUMMARY

The Pilbara could well be seen as the region that has won the lottery twice. In the 1950's, iron ore was discovered in the Hamersley ranges¹. Development started in 1961 and by the mid 1970's the region was extracting 100Mtpa in ore (Department of Mines and Petroleum, 2009), which has grown steadily to over 600Mtpa that is worth \$50 billion to the economy in 2012 (Department of Mines and Petroleum, 2012b). In 1971, natural gas was discovered, which since 1980 has generated over \$300 billion over the past 30 years (Department of Mines and Petroleum, n.d), and is forecasted to continue for the next half a century.

It's a classic tale for boom growth in a natural resources region, with the boom being faster than the ability to develop infrastructure to service it properly. History shows that, a couple of decades after a classic mine-and-boom phase, one of two things happens:

1. A Californian style evolution into multiple but related industries; or
2. A Geiju, Yunnan style decline into ghost town and tumble weed (see Figure 1).

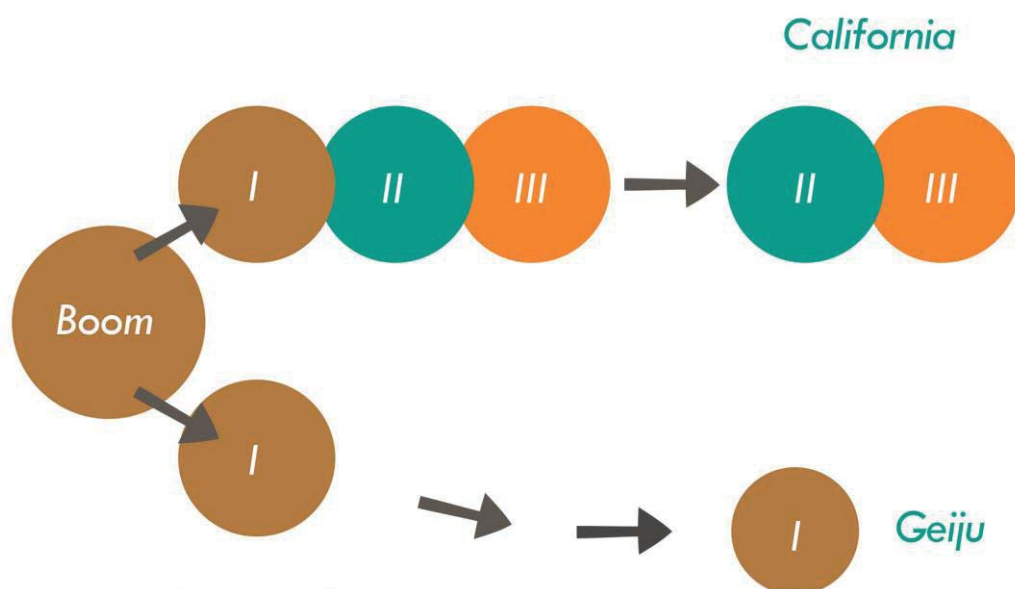


Figure 1: Boom or bust

¹ Iron ore was actually first sighted in the Pilbara in 1861 by Francis Thomas Gregory, which was documented in a journal in 1866, but not widely known (HARDIE, J. 1981. NOR'WESTERS of the Pilbara breed. Port Hedland: Shire of Port Hedland.).



The question this paper addresses is what will happen in the Pilbara?

This report argues that the difference between going down route one and route two is something that can be determined by forward thinking planning. It doesn't have to be left in the lap of the gods. With forward thinking and sound planning, route one can be secured. First of all, this paper gives an audit of infrastructure, policies, programs and initiatives, with a gap analysis of need and a comparison against other places in Australia and around the world. The analysis looks at more than 200 documents, as well as interviews with industry, government and academia. From the gap analysis, and using theories outlined by Nobel laureate Paul Krugman and Michael Porter on agglomeration economies and cluster theory, we develop a wish list of what needs to happen, followed by an investigation about how these could work. The findings of this analysis are summarized by the Long-term Economic Viability (LEV) framework below (see Figure 2). The LEV framework provides a visual representation of the primary needs and opportunities identified for various sectors in the Pilbara. The final subsection of the diagram highlights the actions required in order to work towards the realization of the key objectives. In some cases, such as the agricultural sector, the required actions are currently occurring or being put in place. In other sectors, such as energy, the required actions are yet to be enacted.

Finally, we ask what things could be done to promote the LEV of the region. We think that with proper execution of the plan we outline, the Pilbara can become a sustainable and economically diverse region, creating an intergenerational legacy to benefit the Australians of today and tomorrow.



Long-term Economic Viability (LEV)												
Area	Energy		Tourism		Industry		Agriculture	Supply Base		Cost of Living & Doing Business		
Objectives	Electrify Rail and Mines	Fully Inter-connected Grid	Online Tourism Market Info	Branding & Market Campaign	Infrastructure Delivery e.g. Roads	Special Economic Zones	R&D Biz Incubation	Agricultural Diversification and Export Plan		Strategic Supply Base & Military Presence	Affordable Housing & Commercial Space	Cost Competitive Logistics
	Renewable Energy & Plan for De-Dieseling the Pilbara	Regional Energy Masterplan	Quantified Business Plan			Technology & Innovation Strategy	Local Enterprise Strategy, Mentors & Boards	Irrigation Systems and Logistics	Local Food Production	Economic Plan for Construction & Land Cost Reduction	Port & Rail Logistics	Pacific Rim Export Market Plan

Figure 2: Long-term Economic Viability (LEV)

Pilbara 2050: Ensuring the long-term viability of the Pilbara

Chapter 1: Introduction

History of the Pilbara

Iron ore development started in 1961 and by the mid 1970's the region was extracting 100Mtpa in ore (Department of Mines and Petroleum, 2009), which has grown steadily to more than 600Mtpa. This was worth around \$50 billion to the economy in 2012 (Department of Mines and Petroleum, 2012b). In 1970, natural gas was discovered, which since 1980 has generated over \$300 billion in the past 30 years (Department of Mines and Petroleum, 2009) and is forecasted to continue for the next half a century. Apart from the Pilbara being fortunate enough to win this geological gift of iron ore and natural gas, it was also fortunate enough to be nearby to China and Southeast Asia in general, giving it an advantage over other iron ore and natural gas producers.



Figure 3: Map of Western Australia, including the Pilbara (BHP Billiton, 2013)

The Pilbara region occupies more than 502,000 square kilometres in the north of Western Australia (see Figure 3) (Landcorp, 2011). The region's history dates back as far as 40,000 years ago with evidence of the Indigenous peoples living off the land. Over 700 historic Indigenous archaeological sites and 10,000 rock engravings have been found in the Pilbara, many dating back some 30,000 years (Australia's Northwest, 2013). The Indigenous peoples lived predominantly alone in this area until around 1861 when European explorers first came to settle in the Pilbara. Economically, the region has a chequered industrial history, with an initial focus on agriculture, which largely failed, followed by a shift to iron ore in the 1950's, once it was discovered in the Hamersley Gorges.

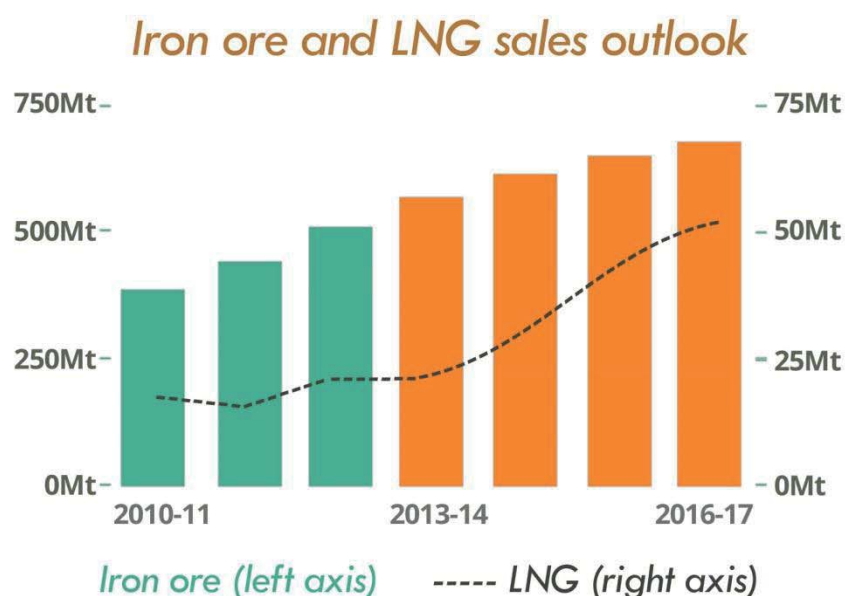


Figure 4: Iron ore & LNG sales outlook (Department of State Development, 2013)

Since the discovery of natural resources, the Pilbara has changed dramatically, with the region producing 98% of Australia's iron ore (McKay et al., 2012), and generating around \$3.5 billion dollars in royalties for the state of Western Australia. This represents 70% of the state of Western Australia's mineral revenues, and around 14% of the state's \$25.4 billion budget for 2012/13 (Department of Mines and Petroleum, 2012a).

The millennium saw the most rapid expansion and ramping up of iron ore production in history as China's growth got underway. The Pilbara now produces around 600Mtpa of iron ore per annum and is growing (Department of State Development, 2013) (see Figure 4). Compared to a decade earlier, this number was just 155Mtpa (Pilbara Development Commission, 2003). A further 477Mtpa of expansion are proposed (Department of State Development, 2013). In addition, the offshore Northwest Shelf gas projects produce around 16.3Mtpa of gas worth around \$24 billion in 2012 (Department of Mines and Petroleum, 2012a). Pluto has just come online with a further 4.3Mtpa. Gorgon and Wheatstone LNG projects are soon to be added, contributing an additional 24.5Mtpa by 2017.

Currently, the petroleum sector output represents around \$24.3 billion per annum, and by 2017 this is expected to double (Department of Mines and Petroleum, 2012b). Undoubtedly, the Pilbara is the economic powerhouse of Australia, representing around 5.5% of the nation's GDP (see Figure 5 for a list of major resources projects in the Pilbara).

Major Selected Resource Projects August 2013					
Project	A\$ Billion	Mtpe (target)	Construction Jobs	Operation Jobs	Startup
Iron and Steel					
Hancock Prospecting- Iron Ore Mine and Infrastructure – Roy Hill	9.5	55	8,500	2,000	2015
Rio Tinto - Pilbara 290 Iron Ore Expansion	9.4	53	NA	NA	2013
Fortescue Metals Group – Chichester & Solomon hub T155 (includes port & rail)	8.8	60	7,000	6,000	2013
CTIC Pacific- Sino Iron Ore – Cape Preston Mine & Processing	7.5	24 (70)	3,500	800	2013
Australian Premium Iron Ore JV – West Pilbara Mine, Rail & Port (Stage 1)	7.4	30	3,500	1,000	NA
Rio Tinto – Pilbara 360 Iron Ore Expansion	5.7	70	NA	NA	2015
Oil and gas					
Gorgon JV Gas Processing Plant	50.8	15.6 (26)	5,000	300	2014
Chevron – Wheatstone LNG	28.3	8.9 (25)	5,500	400	2016
Inpex/Total – Ichthys Gas Field	14.4"	- (8.4 NT)	1,000	400	2016
Gorgon JV Train 4	12.3	5.2 (26)	NA	NA	2018
Shell – Prelude Floating LNG Plant	12.0	3.6	NA	350	2017
Woodside – North Rankin Redevelopment	5.0	19.5	450	NA	2013
Other Projects					
Anketell Port & Strategic Industrial Area	4.6	115 (350)	NA	NA	NA

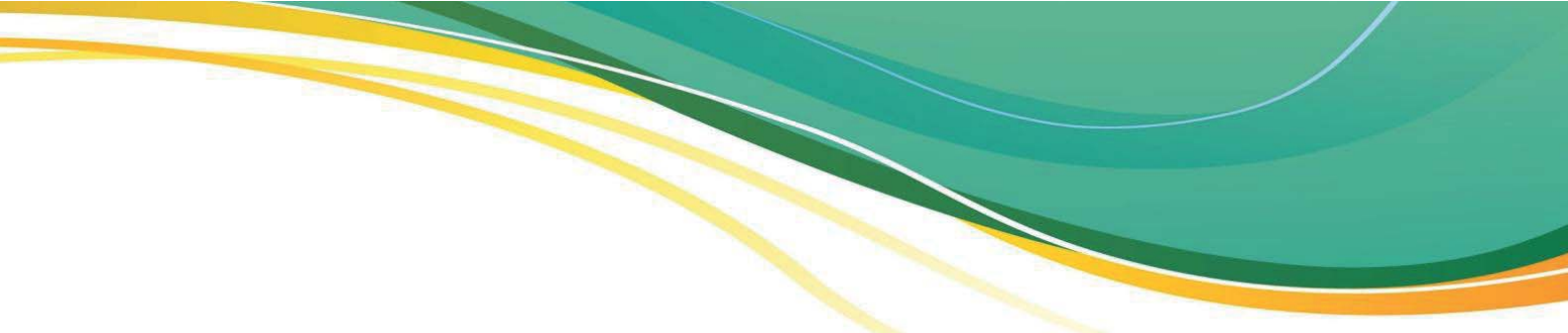
Figure 5: Major selected resource projects: August 2013 (Department of Mines and Petroleum, 2013)

Fast Facts		
Demographic Indicator	2011	Percentage Point Change from 2006
Total population (ERP ¹)	62,736	42.3% ²
Total occupies private dwellings ³	12,563	13.7% ²
Working age population (15 - 64)	79%	6.8
Male	62%	6.7
Indigenous	12%	- 1.7
Australian born	76%	- 5.9
Average household size ³	2.94	0.03 ⁴
Year 12	47%	7.4
High income	42%	25.5
Couple family with children ³	42%	- 0.5
Separate dwelling ³	77%	- 1.2
Own their home ³	23%	- 10.8
Bachelor degree or higher	11%	1.0
Unemployment Rate ⁵	2.1%	- 0.7
Participation Rate	69%	2.5
Same address five years ago	21%	- 3.9
Largest industry of employment	Mining	Mining

Figure 6: Pilbara fast facts (KPMGa, 2013)

by 2035 (see Figure 7) (Department of Regional Development and Lands, 2012), provision of adequate services will remain a challenge.

When rapid economic growth occurs there is frequently a lag in the ability to provide infrastructure, both physical and social (see Figure 6 for more details on the economic and social growth in the Pilbara). This causes a number of issues, which form the basis of the analysis in this paper. And so it is with the Pilbara. The population grew 42%, between 2006 and 2011, the largest of anywhere in Australia (KPMG, 2013). In the decade until 2011, median salaries grew 219% from \$704 to \$1,543 per week, compared with a rise in Perth during the same period of 72% (Regional Development Australia: Pilbara (RDAP), 2013a). Rapid inflation is also seen in accommodation prices in the Pilbara, with the median rent for a house in Karratha rented from a private landlord increasing from \$378 per week in 2005, to \$1,541 in 2012 (\$1,300 a week in 2013). This represents a 407% increase. As a comparison, in Perth during the same period, prices rose by 199% (Regional Development Australia: Pilbara (RDAP), 2013a). Meanwhile, the number of doctors in the Pilbara fell to the lowest in Australia (Shire of Roebourne, 2013a). These issues have become somewhat more manageable since the decline of commodity prices. However, in the advent of commodity price rises, and with the population predicted to double to 50,000 people in both Karratha and Port Hedland



To meet this problem, Western Australian Premier, Colin Barnett and Minister Brendan Grylls established the Royalties for Regions (RfR) and the Pilbara Cities programs. In 2009, the government committed \$471 million for infrastructure earmarked for airport upgrades, wastewater services, serviced land and accommodation. The RfR program in particular has built a lot of social infrastructure, as was indicated to be needed by a number of studies (Newman, 2010).

Four years on, it is clear that these programs have done a great deal to reduce the infrastructure deficit. So much has been built: marinas, playgrounds, theatres and schools. There are now a great deal more social activities to choose from in the Pilbara. Royalties for Regions and Pilbara Cities have clearly changed the Pilbara to be a better place to live.

However, while much has been done and the situation has improved dramatically, there is still a physical infrastructure deficit to be addressed, especially infrastructure needed to enable the Pilbara to diversify in its economy. Across a range of metrics such as power and water, and energy capacity and resilience, the Pilbara remains in catch up mode. There are other indicators that tell a similar story of a lagging infrastructure base (Shire of Roebourne, 2013c).

So, why is the infrastructure still lagging, despite \$1.3bn invested by both the state and private sector, since RfR started in 2009? One explanation is that the models for deciding how much infrastructure is needed often don't work as they are predicated on permanency. For example, the state fire service determines levels of service using a risk-based model that includes population.

It's a similar story for the provision of doctors and teachers. Also, currently much of the investment is going into upgrading infrastructure, including social infrastructure. While absolutely necessary, for the most part, much of this investment does not create future revenue streams as it is in the realm of the public good (Regional Development Australia: Pilbara (RDAP), 2012a). The private sector does fill some of the gaps, but the extent to which it is doing so is something we will examine in the following chapter: An audit of the Pilbara, with a gap analysis and commentary.

Pilbara: historical and forecast resident population growth (1966-2036)

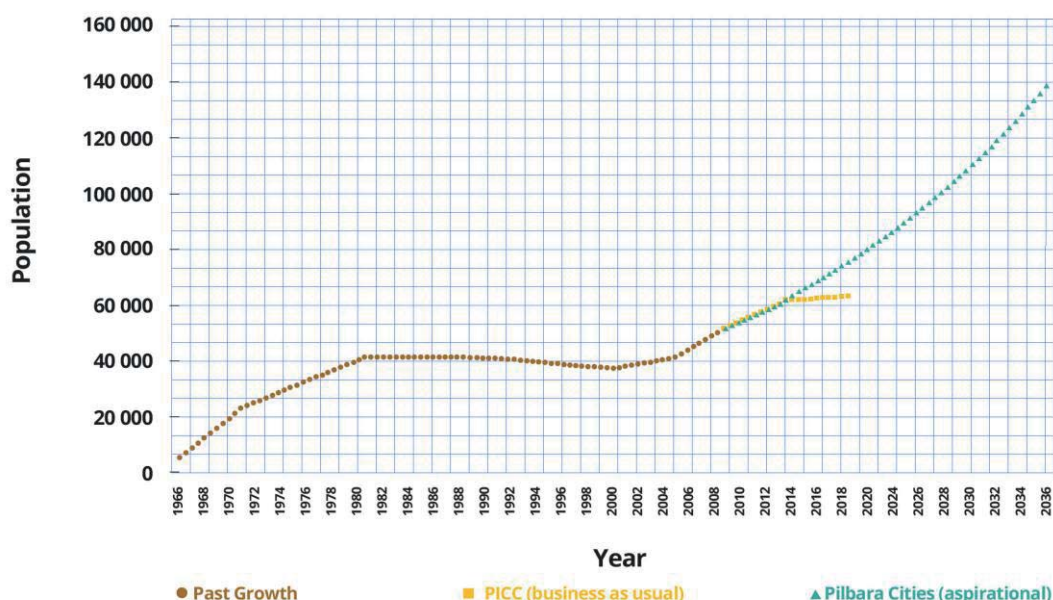


Figure 7: Pilbara: historical and forecast resident population growth (1966-2036) (Western Australian Planning Commission, 2012)

SWOT analysis of the Pilbara



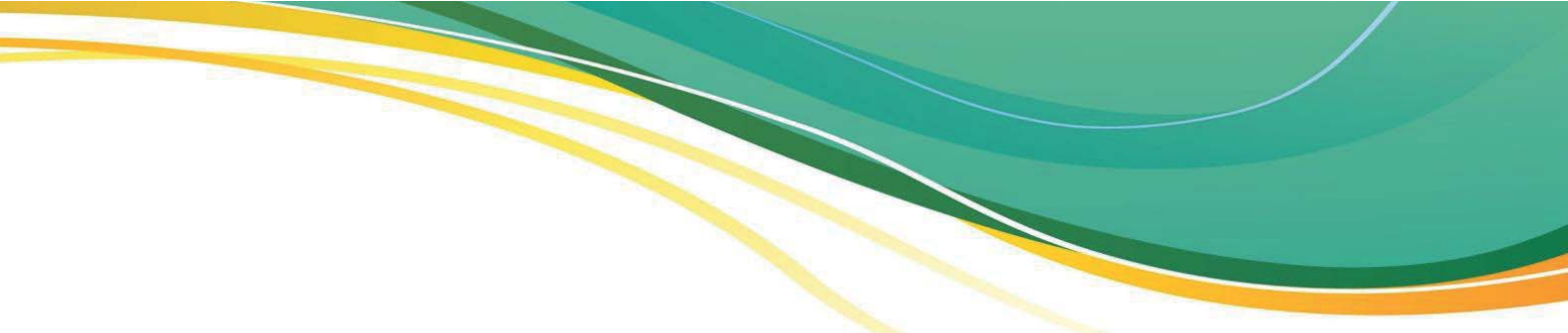
Strengths

The iron ore industry in the Pilbara is experiencing fantastic opportunity that comes from a whole variety of strengths: high-grade iron ore, political stability, a desirable geographical location. At current ore prices, the Pilbara has a 10% cost advantage by being closer to the powerhouse of the world: China (BMO Capital Markets, 2013). The petroleum industry contributes around \$24bn of output per annum, which is set to double in the next decade (Department of Mines and Petroleum, 2012a).

Iron ore growth is estimated at 2.7% on average through to 2017; beyond this, growth is expected to be around 2% per annum (BMO Capital Markets, 2013). World iron ore demand is on the increase, despite the Chinese slowdown. Analysts are adjusting forecasts to show that revenue growth is slowing and price forecasts are softening, but remain positive.

The largest iron ore producers in the Pilbara are often seen as bullet proof. They enjoy high grades of iron ore, good infrastructure to service their needs, strong balance sheets and relatively low cash costs. Some of the middle players have less perfect scenarios, with lower grade ores, which have higher moisture content; operate at higher cash costs; and have

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weaker balance sheets. But even so, they are profitable. In summary, the Pilbara enjoys high-grade iron ore, located close to its clients, in a country with political stability. That seems an unassailable place. But there could be issues on the horizon.

Weaknesses

A 2013 Bureau of Resources and Energy Economics (BREE) study, *Australian Mining Productivity* found that productivity has been deteriorating over recent decades. It attributes this in part to the strength of resource prices and investment decisions by mining companies (Bureau of Resources and Energy Economics, 2013). The report states that ‘possible reasons for a slowdown in Australian mining productivity from the millennium include: transition to lower yielding resources, inefficiencies of vintage capital, output-input lags, the lumpy nature of mining investment, and high commodity prices that place a priority on rates of extraction rather than costs of extraction’ (Bureau of Resources and Energy Economics, 2013). The Reserve Bank of Australia has cited that Australia’s productivity is also on the decline and infrastructure is what is needed to address this (Lowe, 2013). The World Economic Forum’s Global Competitiveness Index 2013/2014 has also shown that Australia ranks 128th poorest out of 148th for bureaucracy being an impediment for business (World Economic Forum, 2013). For businesses that want to set up in the Pilbara, this is a very real issue, with the number of government agencies that need to be navigated through and the associated costs for this creating an untenable impost particularly for the mid-tier and smaller companies.

The *Dutch Disease* describes the relationship between the increase in natural resource development and the decline of manufacturing sector in the same economy. This is because the revenues from the natural resources sector strengthen that country’s currency, resulting in exports of other goods becoming relatively more expensive and the industry becoming less competitive². Although these phenomena can be seen at a national level, it can also be observed at a regional level, where price inflation from natural resources pushes other segments from the market. This is the case in the Pilbara, where the cost of housing is the highest in Australia and key inputs for industry such as energy are in short supply due to high demand from the natural resources industry. It is possible to immunize against the Dutch disease. Norway and Kazakhstan have done this by implementing various policy measures (see Figure 8).

Norway’s immunization against the Dutch

Norway took a number of steps to successfully protect itself against the Dutch Disease (see Figure 8). As a result, Norway has been able to maintain a strong manufacturing base

² The Dutch disease was first observed in 1977 by The Economist magazine in describing the decline in manufacturing in Holland as a result of gas field development in 1959. The *Dutch Disease* describes the relationship between the increase in natural resource development and the decline of manufacturing sector in the same economy. This is because the revenues from the natural resources sector strengthen that country’s currency and result in exports of other goods becoming relatively more expensive and the industry becoming less competitive.

despite having a strong resource sector. Figure 9 demonstrates the strength of Norway's manufacturing base relative to Australia.

Policy measures used by Norway & Kazakhstan to immunize against Dutch Disease

1. Aggressive monetary and fiscal policies to increase national savings in the Expansion.
2. Aggressive industry policy to maximize pull-over effects to manufacturing from resource expansion. This was done with local content targets during resource expansion and operation; subsidies, investments support, training etc. to ensure manufacturing could meet local content targets at minimum cost to the resource sector; and the use of local/foreign joint ventures to establish new industries in Norway initially linked to the mining supply chain, but which now can stand alone given their global competitiveness.
3. Aggressive taxation of the resource sector with funds used to support economy-wide education and training programs knowledge cluster for research development and innovation; and regional adjustment and infrastructure expansion.
4. Creation of sovereign wealth fund, to invest offshore and minimise appreciation of the currency (National Economics, 2013).

Figure 8: Policy measures used by Norway & Kazakhstan to immunise against Dutch Disease

The State of the Regions report for 2013/14 found that Australia's economy 'remains largely untreated' from the Dutch Disease, with 'supply side measures' not being undertaken (National Economics, 2013). Although some actions are being taken at the local level in the Pilbara, this remains limited³. This represents a major weakness to the Pilbara as the region suffers from price inflation as a result of the natural resources industry, which prices other sectors out of the market.

Given the challenges with the Western Australian government's balance sheet in 2013, and the recent downgrading of its credit rating from AAA to AA+ by Standard & Poor's, no one would underestimate the difficulty of allocating capital to an infrastructure investment fund; however, if proper economic analysis is undertaken, other infrastructure assets are recycled to create government funds, and investments have a business case underpinning them, infrastructure investments can be self-funding.

Since the failure of BHP-HBI hot briquetted iron plant in 2005, no company has attempted scaled steel production in the Pilbara. It could be that industry determined steel couldn't work in the Pilbara, or just that that particular attempt didn't work, having been scaled up from laboratory too early. As a result of such high profile failures, there may be apprehension from players in the Pilbara to attempt such large-scaled endeavours; however, the long-term

³ For example, in Karratha in 2012, service worker rental accommodation was provided at a lower than market price for companies that do less than half their business with the natural resource industry.

<http://www.landcorp.com.au/project/karrathaserviceworkeraccommodation>

economic viability (LEV) of the region depends on at least some of this kind of industrial activity featuring in the economy.

Opportunities

Presently the Pilbara is predominantly a two-sector economy featuring iron ore and gas. Massive opportunities exist to diversify the region. Major opportunities exist around a few key areas: tourism, industrials, technology and agriculture. Alongside this, there is an opportunity to rationalize major infrastructure such as power generation and transmission, develop renewable energy generation, and consolidate and electrify rail transportation. These will be expanded below. The Pilbara Blueprint Stage 1, along with the Strategic Plan 2014-2017, by the Pilbara Development Commission, is the beginning of the work needed to diversify the Pilbara economy (Pilbara Development Commission, 2013c, Pilbara Development Commission, 2013e).

Norway versus Australia: manufacturing gross product per capita working age population (2000 \$US PPP) (National Economics, 2013)

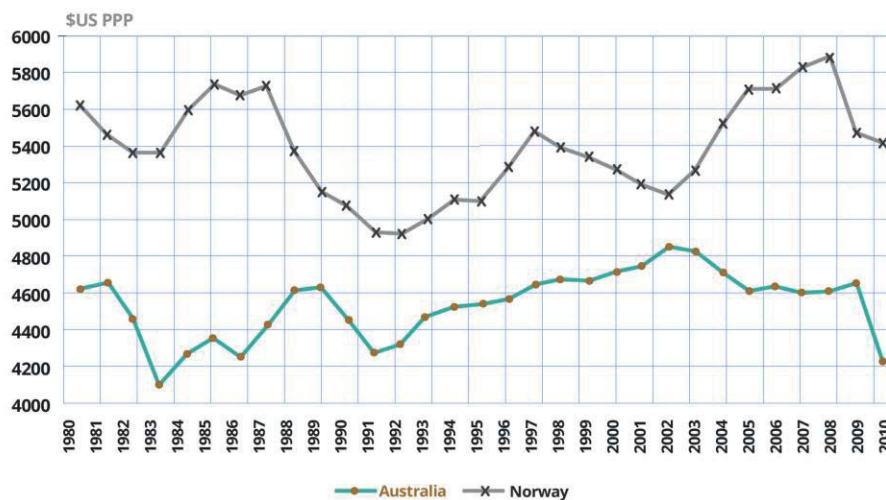


Figure 9: Norway versus Australia: manufacturing gross product per capita working age population (2000 \$US PPP) (National Economics, 2013)

Threats

In commodity markets there is a threat that price volatility could mean that with the rise of competing nations, transport, quality and cost advantages disappear. High labour and energy costs, which are rising, mean that the Pilbara's point of difference could be eroded over time. The expansion of iron ore mining in West Africa and Brazil means increased competition for the Pilbara. Within a few decades, there could also be a substitution risk from recycled steel (BMO Capital Markets, 2013) as China begins to repurpose its existing infrastructure. Other industry booms can also impact the Pilbara, such as the LNG industry

demanding labour from the same pool and the alumina industry demanding the same gas supplies.

Since the iron ore industry moved away from annual benchmarks in early 2010, iron ore prices have demonstrated far greater volatility. In the ten years prior, prices showed on average a 7.5% price move, and since, price swings are on average 11.5%. In the last twelve months, this price has been extremely volatile, ranging from \$87 to \$116 per tonne (BMO Capital Markets, 2013).

The price outlook for iron ore in the long term remains at around US\$115/t (nominal CFR China basis) (BMO Capital Markets, 2013)(see also: Figure 10).

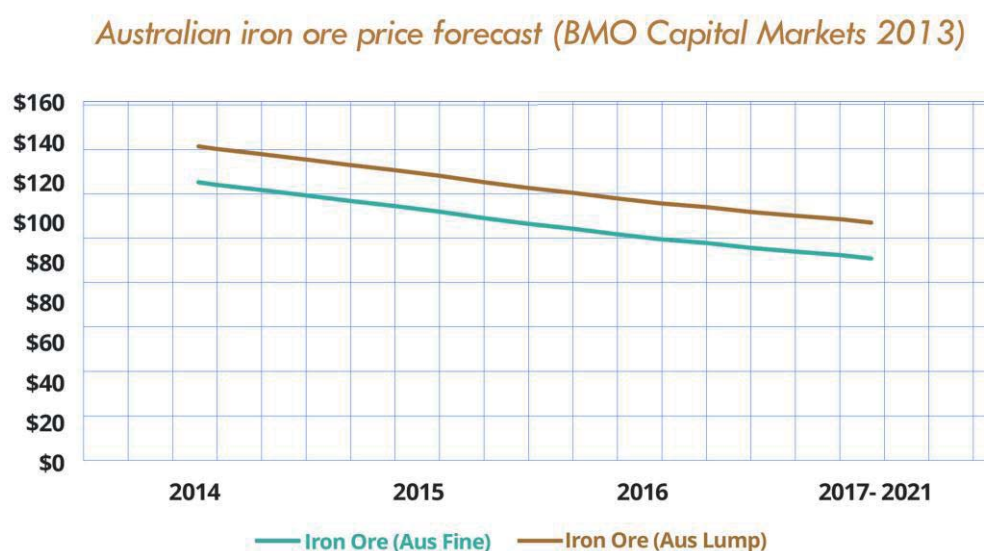
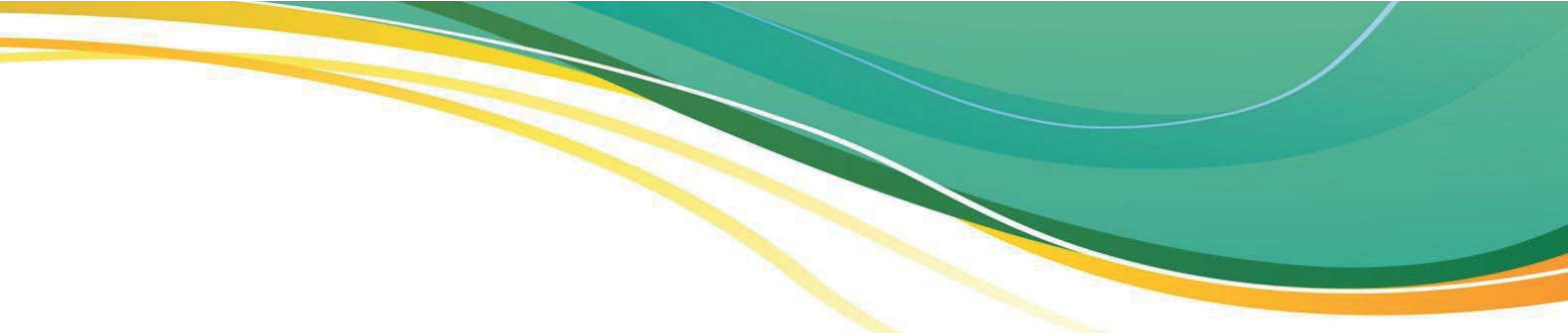


Figure 10: Australian iron ore price forecast (BMO Capital Markets 2013)

According to analyst BMO, in an environment of declining iron ore prices, and rising operating and freight costs, producer margins are expected to decline (BMO Capital Markets, 2013). Steel prices have remained lackluster, with broker consensus forecasts expecting prices to be revised downward. In addition, concerns around inflation in China could result in the government tightening its monetary policy and removing support for loss-making steelmakers (BMO Capital Markets, 2013).

Given ore grades are declining globally, beneficiation processes are becoming dominant for iron ore projects, increasing average operating costs. The Pilbara's economy, as it currently stands, is very much dependent on the rising and falling of the price of iron ore.

Whilst LNG will keep the area going for a long time, all the royalties aren't necessarily received by the Western Australian government. The royalties for Pluto, Gorgon and Wheatstone LNG projects will go entirely to the federal government since the federal government established the petroleum resources rent tax with no royalty sharing agreement



with the state of Western Australia. Further, a great deal of employment opportunities exist in the construction phase for LNG, but in the operational phases, only 764 jobs will be created between now and 2020. The majority of job growth exists in iron ore, with an additional 15,040 operational jobs needed by 2020 (Pilbara Development Commission, 2013a).

There is some psychological and ideological resistance to implementing a future in the Pilbara beyond natural resources. Some views are that the Pilbara is a quarry and should be left to do that and only that. Major companies in the region have been able to develop their infrastructure independently for many decades. This has led to duplication of infrastructure and multiple inefficiencies. However, if the natural resources sector in the Pilbara were to compete upon real points of difference, not ones that act to the detriment of Australia, a greater bounty is available to them in turn, whilst still providing essential services such as energy transmission and rail. These kinds of reforms are essential in creating meaningful economic diversity in the region.


Diversify or bust

There have been countries and regions that have lived and died by one product (for example: Detroit, Glasgow, the Midwest, Northern England, Wales, Bukit Besi in Malaysia, Gejiu in Yunnan, China and northern Spain). Until failure happened, anything but success seemed impossible.

Without promptly addressing economic diversification in the Pilbara, there could be issues on the horizon. Clearly the Pilbara's future isn't just about generating wealth, it's about investing it wisely to address today's needs and create prosperity in perpetuity. This paper looks at what has been done and what the infrastructure requirements are for a 2050 horizon. A great deal is happening to address the immediate gap, but what else needs to be done to prepare for the longer-term Pilbara cities?

Not all lottery winners stay rich. Given this, it might be good to think now on how to invest so that when the Pilbara boom dries up, distinct from Yunnan, there will be secondary and tertiary industries in its place. And to get that, you need the right incentives and infrastructure.

In Australia, Broken Hill and Mount Isa grew at a slower and more organic pace that allowed for the establishment of vital infrastructure to guarantee a future beyond natural resource extraction. These towns, however, are still in decline, with their populations growing much less than Australian averages. Mount Morgan, Queenstown at Mount Lyall, and the Goldfields have all made it big, but when the resources dried up, many of the towns did too. California, however, evolved from gold to agriculture, then Hollywood, and now the technology capital of the world. Norway turned its oil riches into the biggest sovereign wealth fund in the world, which benefits its people in perpetuity, and which has invested heavily in the right infrastructure. In doing so, it also immunized itself against the Dutch Disease.



The Pilbara Report (2012) highlighted this: in addition to ensuring the windfall revenues are invested into future revenue-generating streams, investment needs to be made into economic diversification opportunities (Regional Development Australia: Pilbara (RDAP), 2012a). It appears little action has been taken to address this to date though. The Pilbara Blueprint 2013 Stage 1 report takes the first step to develop an economic diversification strategy (Pilbara Development Commission, 2013c). This paper looks at what has been done and what the infrastructure requirements are for a self-sustaining community? What can be done now to cement a strong future in the Pilbara for when circumstances are perhaps different? How can the Pilbara exploit the strengths of its current situation to guarantee its economic future if conditions change? In other words, can the Pilbara turn its strengths of the moment into more enduring strengths? Can it be sustainable?

Chapter 2:

An audit of the Pilbara

The Pilbara economy

The Pilbara economy is dominated by oil, gas and mining operations (see Figure 11) accounting for 74.6% of all economic activity (Pilbara Development Commission, 2012d). This level of activity means the mining, construction and retail industries account for approximately 50% of the Pilbara's labour force (Department of Education Employment and Workplace Relations, 2012).

Employment percentage by industry sector



Figure 11: Employment percentage by industry sector (Pilbara Development Commission, 2012d)


Industry Sector	Pilbara Region (Feb 2012) \$M
Basic Chemical Manufacturing	\$90.36
Iron & Steel Manufacturing	\$40.50
Basic Non-Ferrous Metal Manufacturing	\$24.32
Petroleum & Coal Product Manufacturing	\$23.68
Cement, Lime & Ready-Mixed Concrete Manufacturing	\$21.82
Ships & Boat Manufacturing	\$13.59
Specialized & Other Machinery & Equipment Manu	\$11.56
Structural Metal Product Manufacturing	\$11.18
Other Fabricated Metal Product Manufacturing	\$7.21
Metal Containers & Other Sheet metal Prod: Manu	\$5.82
Aircraft Manufacturing	\$4.36
Railway Rolling Stock Manufacturing	\$4.16
Textile Manufacturing	\$3.90
Other Food Product Manufacturing	\$3.48
Plaster & Concrete Product Manufacturing	\$2.80
Soft Drinks, Cordials & Syrup Manufacturing	\$1.94
Polymer Product Manufacturing	\$1.93
Motor Vehicles & Parts ; Other Transport Equip: Manu	\$1.77
Electrical Equipment Manufacturing	\$1.36
Clothing Manufacturing	\$1.17
Bakery Product Manufacturing	\$1.09
Processed Seafood Manufacturing	\$1.04
Natural Rubber Product Manufacturing	\$0.84
Other Non- Metallic Mineral Products Manufacturing	\$0.82
Prof, Scientific, Computer & Electronic Equip: Manu	\$0.55
Printing (Inc reproduction of recorded media)	\$0.52
Furniture Manufacturing	\$0.48

The *Pilbara Planning & Infrastructure Framework 2012* has the laudable ambition to create a 'larger population in the region's main urban centres [which] will support a more diversified economic base, providing a much wider range of employment opportunities'. The report notes that mining and oil and gas companies will support local supply chains. Cities will have a locally based construction industry, and defence facilities, and higher education facilities that will provide 'significant employment opportunities' (Western Australian Planning Commission, 2012). There is widespread consensus that the broadening of the regional economy through the diversification of industry is seen as a crucial step in ensuring sustainable development, although a sophisticated economic diversification plan is yet to be produced (Pilbara Development Commission, 2013c).

Infrastructure is crucial to achieving the Pilbara Cities vision

Infrastructure investment is crucial to creating the preconditions for economic diversification, and subsequently for facilitating a high standard of living in the Pilbara. Despite a greater state government focus on the growth of the region to play catch up, infrastructure development is not occurring at a fast enough pace to adequately support the current, growing and projected population of the region.

Figure 12: Manufacturing subsections in the Pilbara (Pilbara Development Commission 2012b)



Total value added from the Pilbara manufacturing sector is \$282 million (Pilbara Development Commission, 2012d). In Figure 12 below, manufacturing has been broken down into subsectors. The leading sub-sector 'Basic Chemical Manufacturing' is made up of sub-sectors such as 'Fertiliser' and 'Explosive Manufacturing'. At the Local Government level, \$63 million of basic chemical manufacturing's \$90 million originates in the Roebourne Shire (likely to be Burrup Fertilisers). Modest amounts of iron and steel manufacturing occurs in the Pilbara, led by Port Hedland (\$25.8 million), Roebourne (\$7.2 million) and East Pilbara (\$4 million) then Ashburton (\$3.2 million).

The inadequate pace of development is evidenced in the *Pilbara Report 2012* which argues that the infrastructure priorities for the region remain the same as they were in 2008 when a call for urgent infrastructure investment was made (Regional Development Australia: Pilbara (RDAP), 2012a). Therefore, since the Pilbara Cities vision was announced in 2009, alongside a commitment of \$1.2 billion of Royalties for Regions funding to ramp up development of the region, the critical infrastructure needs are yet to be adequately met. This funding has facilitated some developments, however the latest RDA report finds that the Pilbara requires \$13 billion of investment to meet the priority needs of the region (RDAP, 2012b). Therefore, the \$1.2 billion injected into the Pilbara through the Pilbara Cities initiative only scratches the surface of what is actually required, if the region stands a serious chance of LEV.

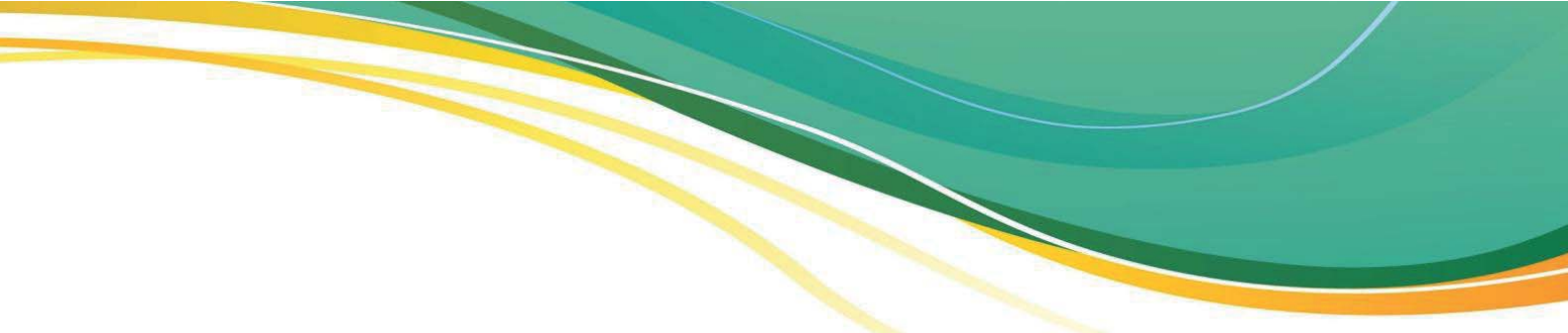
Infrastructure facilitating a high standard of living

The Investment Prospectus report, by Regional Development Australia: Pilbara (RDAP) argues that land and affordable housing supply remain the primary needs in the region (RDAP, 2012b). To facilitate this though, supporting infrastructure is required. At increasing rates, power, water and wastewater infrastructure are approaching, or have reached, their capacity and require urgent investment. These crucial areas of need are discussed in further detail in a later stage of the paper.

Transport is fundamental for economic diversification

Freight transport and air passenger transport are identified as major upcoming areas of need in the Pilbara (Pilbara Report 2012). In line with projected resources investments as well as population growth, there is a strong need for immediate investment in, for example, road (mostly for freight), port developments, and airport upgrades (RDAP, 2012b). These types of investment are included in the major plans for the region. For example, the regional airports, Karratha, Port Hedland and Onslow, will be significantly expanded, with plans to increase the number of international destinations that can be accessed directly from the Pilbara (Rehbein Airport Consulting, 2013, Town of Port Hedland, 2011, Western Australian Planning Commission, 2012). These airports are publicly owned by local government, and need substantial investment; they are ideal assets to be recycled into private ownership thus allowing further investment in other infrastructure by the state.

While freight transport focuses mainly on roads, the federal government-commissioned National Infrastructure Plan suggests investment in an interstate rail line that would reduce the need for freight to bypass Perth en route to the Pilbara. The concept of Kalgoorlie as an Inland Port has been around for many decades but is now generating considerable interest



for both road and rail links to the Pilbara (Government of Western Australia, 2000). This type of logistics investment would reduce emissions and costs for transporting freight between the Pilbara and the rest of the country (Infrastructure Australia, 2013) as well as providing enormous economic diversification opportunities for the region.

Major port developments are also occurring at Cape Preston, Dampier, and potentially Anketell (this project has environmental approval but is yet to secure funding), with expansion occurring at Cape Lambert. Much of the large-scale infrastructure in the Pilbara is commercially owned and operated by large mining companies. The big player oil and gas companies tend to build their own infrastructure, such as ports, rail networks, and power generation plants, expanding them on an incremental basis, as their commercial enterprise requires.

There are two main issues associated with this approach to infrastructure development in the region, discussed below.

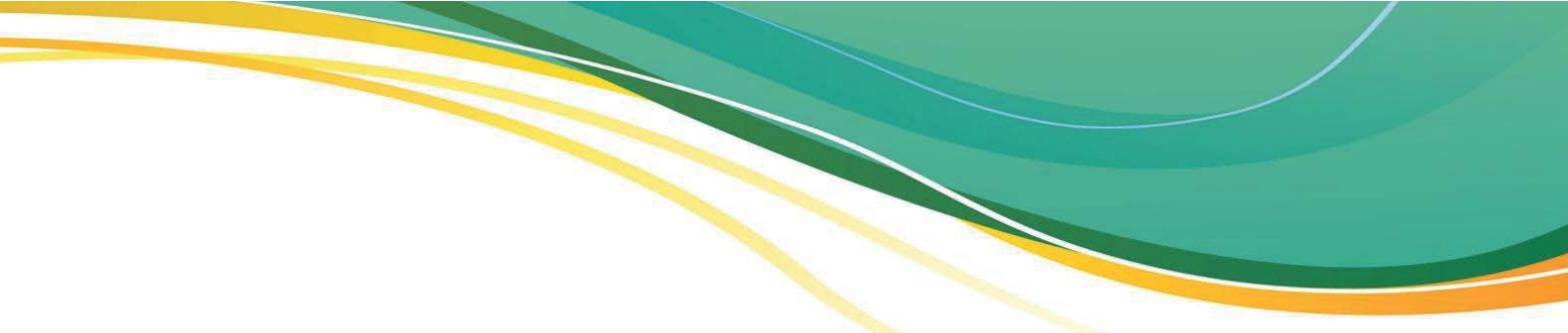
A lack of coordination leads to infrastructure duplication and inefficiency

Infrastructure development by individual companies, as opposed to a regional strategic approach to infrastructure, leads to piecemeal development, which is not necessarily in the best interests of the communities, or long term economic diversification, but instead reflects the immediate needs of mining, oil and gas companies. These major pieces of infrastructure are built with a more narrow perspective than public works, and the commercial nature of the development means that duplication is likely, and existing infrastructure is not being utilised as efficiently as it could be.

The majority of rail networks in the Pilbara are commercially owned, and commercial competitiveness provides a disincentive for competing companies to share their infrastructure. Related to this, recent requests made by junior company Brockman Mining to use the existing Fortescue railway to transport their iron ore to the nearest port were met with resistance. This highlights the way in which commercial competitiveness can lead to unnecessary duplication if cooperation cannot be achieved (Ker, 2013). Brockman Mining's ambitious bid is the first to test new state laws that attempt to promote the sharing of rail infrastructure. If they are denied they will be required to build new rail infrastructure to transport their iron ore to port.

Rather than having a connected rail network through the Pilbara, the infrastructure is disconnected and no authority exists for the management of the system as a whole. Broad regional planning documents, such as the *Pilbara Planning and Infrastructure Framework* (Western Australian Planning Commission, 2012) do acknowledge this issue, and emphasise the need to promote multi-user and multi-use facilities, specifically in relation to the region's ports and rail networks. Energy infrastructure needs are focused on the cities, but does not look at energy required for economic diversification. Despite these admissions, however, no particular strategy to achieve this is articulated.

The development of infrastructure rationalisation strategies are hampered by the difficulty of taking away ownership rights once they exist, especially when the infrastructure has been paid for by the commercial entities themselves. Therefore, there are calls from industry for co-ownership arrangements, or the introduction of an overarching government authority that would or could coordinate and manage large infrastructure networks, including rail



(Infrastructure Australia, 2013). The merging of eight separate port authorities into four larger authorities may be representative of a step towards greater efficiency and coordination of major infrastructure in the region (Department of Transport, 2012).

Whilst the future of the Pilbara most certainly involves iron ore as a dominant aspect of the landscape, this report looks at the potential for making this industry more efficient and profitable, reducing operating risk, and in doing so, providing the foundation for other businesses to establish a material presence there, guaranteeing the region's future beyond the supply and demand for iron ore.

Privatized infrastructure limits economic diversification

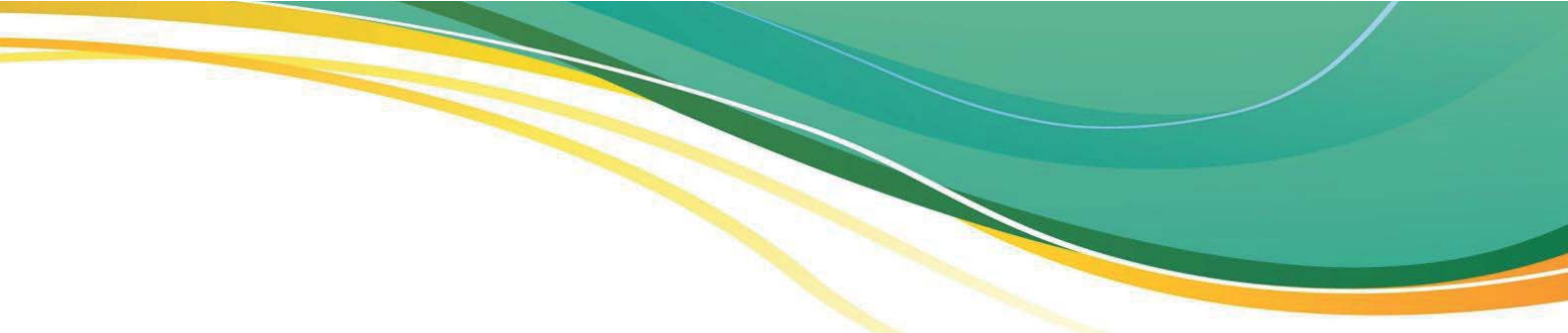
The second issue with this type of private infrastructure development is that it can limit the extent to which the small commercial entities can compete, allowing giant, often international corporations to have a monopoly on industry and profits. This outcome is in opposition to one of the key goals for the region, economic diversification, as new industries and companies have difficulty accessing, or paying for access, to crucial infrastructure that already exists. There is a debate right at the core of this situation: to what extent do we believe that the market will sort out these issues, or need there be state intervention? This report argues that some policy and regulatory intervention will be required to effectively transition the Pilbara to a sustainable economy and ensuring its LEV.

Creating a more diverse economy in the Pilbara

Economic diversification is one of the key objectives of the Pilbara Cities vision, which has seen \$1.3 billion worth of investment in the region and which seeks to drive the development of sustainable and vibrant cities in Australia's North West. Therefore, \$30 million of Royalties for Regions funding has been specifically allocated to economic diversification projects over three years (2010-2013). Funding is being channeled into projects involving industry development, supply chain development, business attraction and development, as well as transformational projects (Department of Regional Development and Lands, 2012). For example, this funding has been allocated to a number of feasibility studies, including exploration of the agricultural opportunities from mine dewatering and groundwater sources (Pilbara Development Commission, 2012b). A comprehensive economic diversification vision and plan is yet to be developed for the region.

The idea of economic diversification in the Pilbara is not a new one. In the late 1990's BHP spent \$3 billion and built a hot briquetted iron plant in Hedland called BHP-HBI. This facility was closed down in 2005 after the cost of increasing safety standards to meet new regulation proved prohibitively expensive. This was just one obstacle of many that the project faced (Phaceas, 2005), including challenges in scaling up operations and health and safety issues resulting in the deaths of workers.

The criteria used to allocate the economic diversification funding includes: supporting industry that has economic value to the Pilbara region directly, increases exports, and has long term viability (Pilbara Development Commission, 2012c). What is missing, though, is a business plan. A strategic economic plan is needed which actually identifies and quantifies



the potential of base and driver industries; assesses the barriers facing these industries; and articulates policy and economic tools that would benefit them. The Pilbara Development Commission has made the first steps to achieve this in stage 1 of the Pilbara Blueprint. Coordinated efforts for this are essential otherwise initiatives will be undertaken in a piecemeal way. This report argues that a quantified economic opportunity assessment and business strategy is urgently required for the Pilbara region as a whole.

Special Economic Zones to facilitate economic diversification

The creation of a Special Economic Zone (SEZ) in the Pilbara would provide an ongoing mechanism for generating economic diversification for the region as a whole. SEZ's have been around since the 1940's, and now number at least 3,000 globally (Murray, 2010). They are largely concentrated in a small number of countries, predominantly China, as well as South Korea, Poland and the United States (Foreign Investment Advisory Service (FIAS), 2008). SEZ's involve the implementation of special economic measures, such as tax incentives and exemptions, within a geographical region, for the purpose of generating necessary economic, social and infrastructure development.

A SEZ has been suggested for the Pilbara for some time, but with limited concrete action. The incoming Coalition Government have promised to commission a white paper on the potential for creating an SEZ in Australia's North West (Regional Development Australia: Pilbara (RDAP), 2012a). Currently, the Pilbara is governed via four separate shire authorities, who each need to prioritize their own needs and compete for funding amongst each other. In order for the Pilbara to become a sustainable economic region, funding will need to be allocated to the region as a whole. The type of economic measures utilised within an SEZ are dictated by the articulated goals and the specific needs of a region. Therefore, the creation of an appropriate SEZ in the Pilbara would be dependent upon having a strong understanding of the economic potential and needs of the region, as well as a clear long term vision that articulates what a sustainable Pilbara economy would look like. The literature recognises that supporting industry that adds value to local products is the most prudent strategy (Shire of Roebourne, 2013c). The development of an economic opportunity assessment and business plan, mentioned earlier, is vital before any SEZ could be created. For example, this would identify value add opportunities, and examine if locally produced goods could be processed a step further in the region. The remainder of this section will explore the types of facilities and industries that could be supported by the creation of an SEZ in the Pilbara.

A multi-user industrial facility would promote economic diversification

One of the more promising infrastructure projects currently being planned for the Pilbara region is the proposed development of an industrial marine-based common use facility at Lumsden Point, Port Hedland, which would provide an opportunity for small and medium-sized companies to gain a foothold in industries that support the resources sector (Department of Commerce, 2012). The facility would be similar to the successful marine-based common use facility in Henderson, Perth, which has provided infrastructure and facilities for defence, oil, gas and mining industries, and has allowed supporting industries to

establish on the adjacent precincts to service the major commercial operators. As of 2011, the Henderson facility had delivered 360 projects worth \$660 million, and had created 9,900 jobs since its opening in 2003 (AMC Management, 2011). While a similar facility in the Pilbara would have differences to the Henderson model, the facility would be a cost effective way of encouraging new, supporting industry alongside the resources sector. A steering committee was set up in mid-2012 for this Pilbara Fabrication and Services Common Use Facility and the project looks likely to proceed, however, it is currently dependent upon securing funding.


Location of a supply base could provide strategic centre for regional development

During the Pilbara Pulse Economic Summit of 2013, former West Australian Premier, Richard Court suggested the inclusion of a Supply Base in the region. Taken in the context of developing the region commercially to its fullest potential, diversifying the sectors within the industrial mix and enhancing value add and the co-location of related industries – so called ‘agglomeration economies’, we believe this strategy could deliver many synergistic benefits to the Pilbara and the northern regions of Australia.

Business incubation services are needed

The Pilbara workforce is employed primarily by a small number of large employers. Small and medium sized businesses are severely underdeveloped in the Pilbara (see Figure 13). In terms of economic diversification, the Shire of Roebourne is the most advanced, with higher levels of small business, and opportunities for financing (Shire of Roebourne, 2013c), however, research by RDAP indicates that the cost of doing business in Karratha is still approximately 131% more expensive than in Perth (RDAP, 2013a). For example, the region has a lack of general facilities, such as laundromats, dry cleaners and boat repair services. In addition, small businesses continue to close down within the difficult conditions (Lally, September, 2013). In addition, the cost of living remains high, with the Pilbara recording the highest price for a basket of goods in Western Australia in the Regional Price Index for 2013 (Department of Regional Development, 2013). Both new and existing small and medium-sized enterprises, then, require good business incubation strategies and facilities for support in order to protect against these conditions.

Commission region	Total	Number of active businesses per \$ 1B of GRP (ratio)
Gascoyne Development Commission	943	1449
Goldfields Esperance Development Commission	4651	574
Great Southern Development Commission	7049	1885
Kimberley Development Commission	2492	1133
Mid-West Development Commission	5237	1164



Peel Development Commission	8570	1128
Pilbara Development Commission	2343	225
South West Development Commission	15456	1288
Wheatbelt Development Commission	13153	2308

Source : ABS 8165.0 – Counts of Australian Businesses, including Entries and Exits April 2012

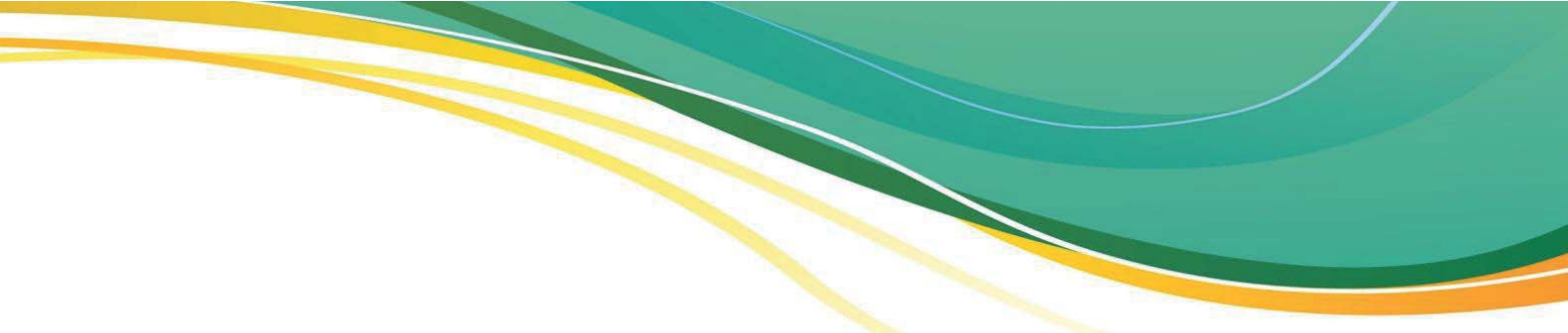
Figure 13: Number of small businesses per \$1B of GRP in the Pilbara (RDAP, 2013a)

The West Pilbara Small Business Centre (WPSBC), with funding from a range of government agencies and private companies, commissioned a report, which was released in 2012, exploring the feasibility of a business park facility for small business incubation (CCS Strategic Management, 2012). The report finds that the proposed business incubation facility would be economically valuable to the Pilbara. The business park would include 18 retail/commercial/incubator units in Karratha, and would provide affordable accommodation alongside these units. The feasibility study found that the \$38 million investment needed for the Karratha Business Park would generate at least \$200 million for the region over the first 10 years, and would create at least 460 jobs (CCS Strategic Management, 2012).

This project remains uncommitted as funding and land are sought. In the meantime, a well-designed business incubation program does not need to be expensive. The Sirolli Institute's Enterprise Facilitation program, which uses a grass roots mentor system to support local talent, provides a good example of an effective, low budget program that has wide reaching impact⁴. Improving economic diversification and long term economic sustainability in the Pilbara will require a range of different strategies and programs, of which, the proposed Karratha business park, proposed by WPSBC, would be one.

A number of potential business diversification projects have been costed by RDA Pilbara in their paper exploring investment opportunities and gaps in the region (Regional Development Australia: Pilbara (RDAP), 2012a). These include the development of a high-tech greenhouse, an aquaculture fish farm, and a fish processing plant. A number of pilot projects, both private and government-funded, have also been conducted in the Pilbara and are encouraged by the economic goals for the region. Aurora Energy completed a pilot project earlier this year in the production of algae for biofuel, omega-3 and protein products (Worley Parsons, 2012). The abundant sunshine and availability of coastal land in the Pilbara region means that algae production could be a promising new industry for the region. While the pilot was deemed successful and the state government committed \$10 million for necessary infrastructure (No author, 2013b), Aurora Energy are now looking at basing commercial production in Geraldton instead. The primary limitation of the Pilbara was identified as being a shortage of permanent workers, and the high labour costs associated

⁴ For more details see: <http://www.sirolli.com/>



with FIFO work arrangements (Sapp, 2013). Although the PDC is trying to locate another company to take over this project, it will likely face a similar fate until the underlying issues are addressed. This highlights one reason why a more permanent population base must be established in the Pilbara; otherwise labour costs will remain prohibitive to new and smaller industry. If addressed, the algae industry could conceivably be a multi-billion-dollar contributor to the Pilbara economy by 2050 as it has the highest solar radiation levels in Australia (Evans & Peck, 2011).

Agricultural opportunities from mine dewatering

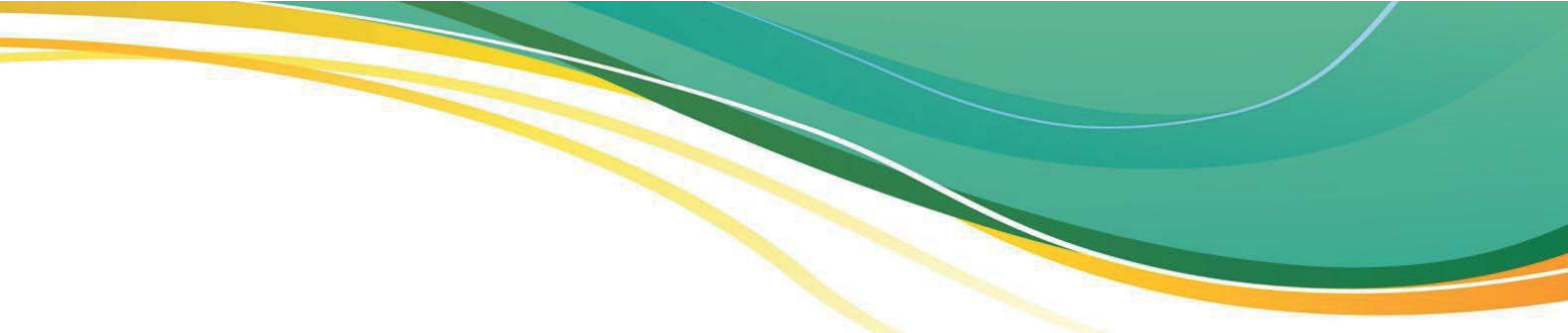
Opportunities for business diversification exist in agriculture for crops and biomass in the Pilbara. Currently, the mines have an abundance of water originating from aquifers, while the water supply in the population centres is reaching capacity. A small number of pilot projects have been carried out by both mining and private companies, capturing the excess water from mines and using it for producing feedstock crops. For example, Rio Tinto produced 3,000 hay bales in the first harvest in January 2012 of their Hamersley Agricultural Project (HAP), using surplus water from mine dewatering (Rio Tinto, 2013b). The hay was used to feed cattle on Rio Tinto owned pastoral land. Sorghum, for biofuel, has also been successfully harvested at the Woodie Woodie mine through AgGrow Energy Resources Inc. and has been deemed commercially viable (Pilbara Development Commission, 2012b) but requires funding to complete its first project.

The PDC is currently developing the Pilbara Hinterland Agriculture Development Initiative (PHADI) a new program that intends to assess the economic potential of agriculture in the Pilbara and outline a research agenda and pathways from pilot programs to commercial viability (Pilbara Development Commission, 2013b). This program represents an important and positive step in realizing the potential arising from mine dewatering surplus. It is also important that regulation around the use of water from dewatering aligns with opportunities for efficient and effective use of the surplus, so as to promote rather than hinder agricultural and biomass opportunities.

The agricultural and pastoral industries have significant potential to become high growth and employment sectors and economic contributors in the Pilbara in the next decade. Capitalising the available water from mine dewatering, good quality soils, its proximity to Asian markets, non-traditional cropping and agricultural supply chain management and existing logistics provide significant prospects for the region.

Innovative waste management opportunities

The Port Hedland Waste to Energy plant is a new project that is processing landfill waste using a low temperature gasification method to produce energy. This project will provide simultaneous practical, environmental and economic diversification benefits. The project, operated by New Energy, will be the first of its kind in Australia, and will provide new employment opportunities while simultaneously contributing to the sustainable management of waste. New Energy intends to turn 100,000 tonnes of waste a year, that would otherwise have ended up in landfill, into enough energy to power 15,000 homes by 2015 (New Energy,



2013). This is achieved using a low temperature gasification technique that has proved successful in a number of other plants worldwide.

Attracting research and education could make the Pilbara a hub for innovation

Another strategy for economic diversification includes higher education and research. For example, the *Karratha City of the North* plan suggests attracting funding for a Cooperative Research Centre (CRC) aligned with the government or a university (Shire of Roebourne, 2010). A CRC would have benefits for innovation in the region, which could lead to further development of new industries. The University of Western Australia has shown commercial interest in this area, commissioning a feasibility study, funded by Royalties for Regions, that provides a business plan for specialist education and research facilities in the region. Potential areas of specialist research include: rural health and medicine; energy and minerals; oceanography; biodiversity; anthropology; archaeology; and agriculture (Grylls, 2012).

Potential for tourism is great if affordability can be dealt with

There is an abundance of potential for tourism in the Pilbara with everything from sea kayaking and sailing in the archipelago, to diving in the southern and northern corals. There are more marine species in the Pilbara than the rest of the WA coast. According to the Pilbara Development Commission, the Pilbara tourism industry amounts to \$199 million (Pilbara Development Commission, 2012d) and employs 4% of the working population. The authors of this report, however, believe the number stated in the PDC report of March 2012 to be grossly overstated as 55% of this figure relates to accommodation and food services which are more likely to be predominantly associated with catering for employees of the mining, oil and gas industries. To put this into context, tourism in the Kimberley region currently amounts to \$276 million dollars, and this is a region that is far better known for its tourism offerings (Kimberley Development Commission, 2013).

Tourism is an industry with great promise in the Pilbara, as it features good access to, for example, the Montebello Islands, Karijini National Park, The Canning Stock Route, as well as the world class coral reefs around the Dampier Archipelago (Regional Development Australia: Pilbara (RDAP), 2012b). The region is also home to extensive aboriginal rock carvings. Tourism in the Pilbara has suffered from a lack of policy focus, with attention mostly focused on the highly profitable resources industry.

Figure 14 shows that Western Australia is highly dependent on mining for state GVC, and is less dependent on tourism than every other state in the country (Duc Pham et al., 2013). This is despite the natural beauty and opportunity the West Australian state possesses for attracting visitors. Considering the focus and energy being invested in the resources industry in the Pilbara, the regional ratio of dependence on mining versus tourism is likely to be even more pronounced than the state as a whole.

Tourism does not have a real chance of succeeding in the Pilbara until issues such as affordable housing and commercial land are dealt with. There has also been a large loss of small tourism businesses with major resource industries offering successful businesses

more money to work for them during the boom times when employment was desperately needed. The major barrier to growth in the Pilbara tourism industry, then, is the dominance of the resources industry in the region. The availability of accommodation for tourism is currently limited due to the overall housing shortages in the region. Therefore, short-stay visitors are 'crowded out' of the region as a result of a lack of available and affordable accommodation (Duc Pham et al., 2013). While the *Shire of Roebourne Local Planning Strategy* states that this focus may shift as of 2014, as short term construction declines, and more permanent operational staff remain (Shire of Roebourne, 2013c), industry projections for the region see a sustained increase in the non-resident population to 2020 (Pilbara Industry's Community Council (PICC), 2012). Therefore, while non-permanent employee numbers continue to increase, and the focus remains on the resources sector in the Pilbara, tourism is likely to remain a marginalized industry. In order to encourage growth in this industry, a stated goal of the Pilbara Cities initiative, and the major shire plans, tourism will need to be supported within the broader strategies for economic diversification.

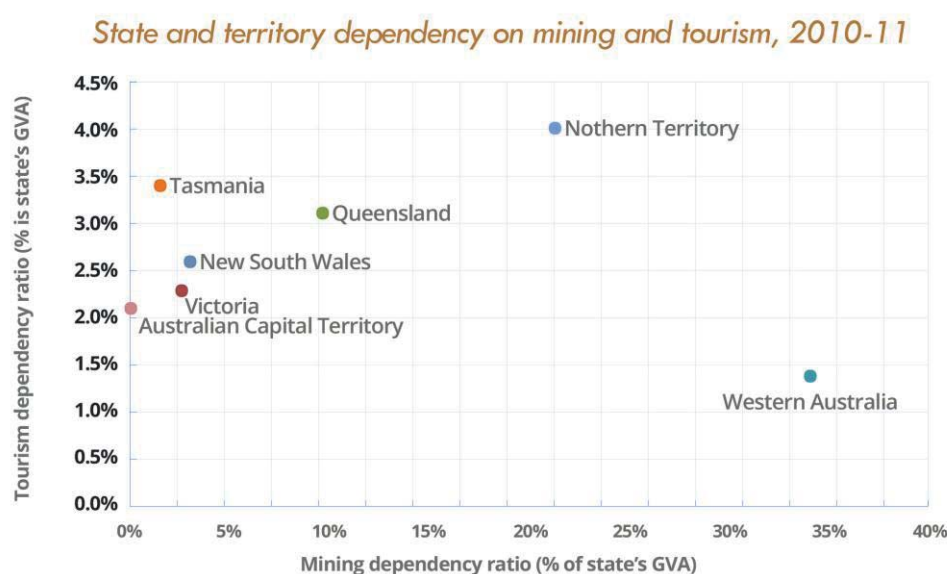
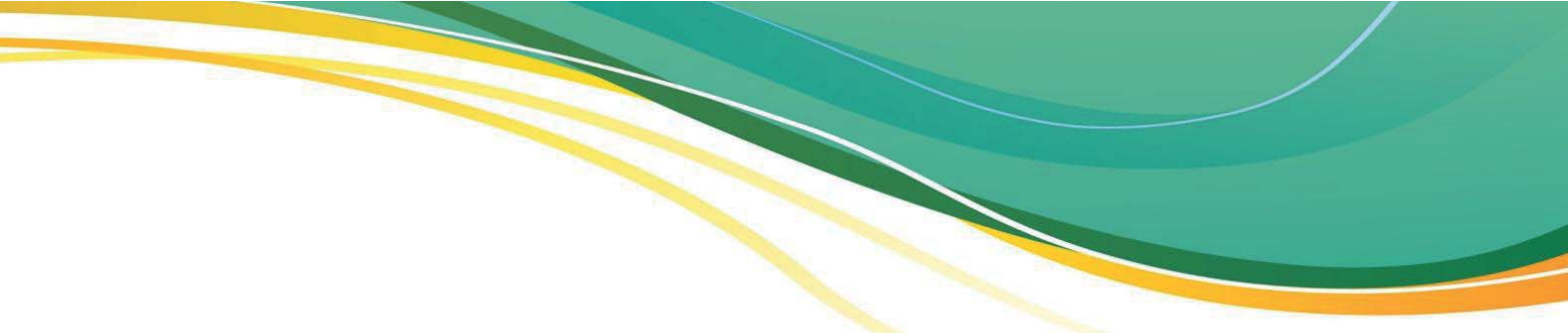


Figure 14: State and territory dependency on mining and tourism, 2010-11 (Duc Pham, Bailey & Marshall, 2013)

A new model for Indigenous participation in the economy

Substantial economic opportunities exist in devising a new model for engaging with Indigenous people in the Pilbara region. Instead of the conventional approach in which resource companies gain access to Indigenous land by providing one-off cash payments or packages, a new approach is suggested in which the traditional owners receive an equity stake in the project. The value of that equity stake is determined by the value of the heritage asset land contribution. Further, the Indigenous equity stakeholders participate in the management of the project, receiving a place at board level with a view to eventually take on



a chairperson-level position. As a result of this approach far greater benefit is derived for both the Indigenous participants and the project proponents. This type of alliance presents greater economic opportunities because projects are far less likely to be affected by lengthy delays, litigation and conflict. While the government will receive a smaller stake in profits, we believe this would be more than offset by the benefits gained. This is because the project would have the potential to create a much larger asset and generate larger revenues at lower cost sooner.

The potential for supporting sustainable industries

The goals for economic diversification in the region present a great opportunity for the renewable energy industry and clean-tech innovation in the Pilbara. Shifting the reliance on mining, oil and gas could involve a simultaneous move towards sustainable technologies and industries if the right incentives and vision exist. For example, while industrial parks or precincts are recognized as effective mechanisms for economic diversification, business incubation, and regional competitiveness (UNIDO, 2012), if not well managed, can become dirty, polluting industrial precincts. Therefore, the development of infrastructure for industrial precincts and business incubation should occur as a part of a wider plan to promote sustainable industry and projects that align with the long term economic goals for the region. The global shift towards the green economy can mean that new industries, small and large, that seek to assist the economy in reducing its carbon and environmental footprint, could find a niche in the Pilbara (OECD, 2013). A sustainability focus would be valuable in the Pilbara alongside and as a part of the regional goal of economic diversification and minimizing reliance on resource extraction.

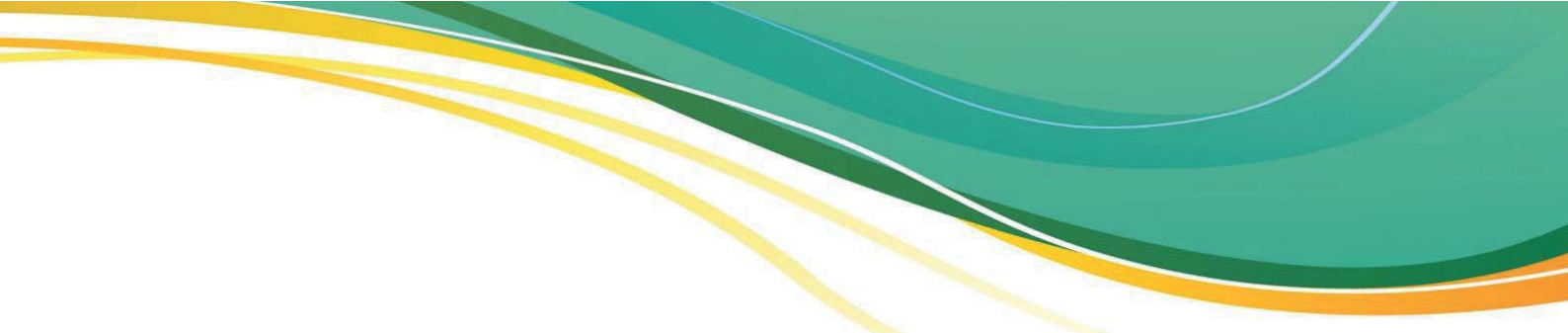
Climate risk and the need for climate led engineering and design based on future risks

Long term infrastructure planning and development must recognize the climate risks of the Pilbara region. The Pilbara experiences cyclonic risk seasonally. In line with climate change projection, the Pilbara is likely to experience more extreme weather, increasing the climate risk for the region. One report by Future Directions International in 2013, questions the long-term economic viability (LEV) of the region as home to people. This report argues, however, that the climate risks of the Pilbara are largely engineering problems that can be addressed. These engineering solutions could be the basis of new industries that are able to work in other similar global locations.

Having a long-term vision is needed

Infrastructure and economic diversification in the Pilbara are currently developing in a piecemeal fashion. While aspirations for the region abound, a cohesive, quantified business strategy that actually articulates what an economically diverse Pilbara would look like is presently missing.

Although infrastructure investment has substantially increased, it has yet to catch up with actual and projected growth of the region in the long-term. The Pilbara remains in an economically volatile position, with commodity prices having a large effect on resource



company activities, and therefore the entire region. Infrastructure that promotes economic diversification, and policies to deal with the cost of doing business in the Pilbara by incentivising new business creation, provide the best way to protect against a volatile commodity price in the Pilbara.

Overall, there is an urgent need to channel the profits from the existing resources boom into infrastructure that will benefit the long-term economic, social and environmental sustainability of the region. In addition to an LEV strategy, long term economic planning could include, for example a sovereign wealth fund, like the one in Norway, which funnels mining revenue into long-term infrastructure and investment priorities. The Western Australian government has committed to establish a sovereign wealth fund in 2016, with 1 per cent of mining royalties to be directed to this fund. This is a good start, but more funding is definitely required. This report argues that infrastructure investment must be strongly aligned with a long-term economic vision and strategic plans for the region. While the current strategic plans hint at this need, for example through economic diversification initiatives, there is no genuine long-term vision for a more sustainable economy that is less reliant on the resources industries. Without a coherent vision, infrastructure investment will remain in catch-up mode.

The Pilbara Cities initiative has led to an injection of funding for infrastructure that has improved the liveability of the region; infrastructure such as hospitals, leisure complexes, and waterfront developments. If the LEV of the region is really to be ensured, however, it will be crucial to prioritize infrastructure development which is not necessarily politically attractive; infrastructure that creates energy, land and transport grids and which stimulates the economy, particularly that which supports diversification of industry. The private sector has a major role to play in the development of the latter type of infrastructure, however, it must be recognized that the big corporate players, such as major resource companies, are somewhat resistant to supporting economic diversification in the region as it may compete with their own needs for resources such as land, water and power. Therefore, a strong government role is required in ensuring that any private sector-led development aligns with the long-term strategic goals for the region.



SWOT Analysis: Economic Diversification in the Pilbara

Strengths

- Some logistics setup (access to port facilities, industrial facilities).
- Proximity to China compared with competitors.
- Major tourism potential (reef, fishing, Aboriginal sites, close to Karijini National Park).
- Water for biomass (surplus from mine dewatering).
- Abundant sunshine for solar.

Weaknesses

- High labour costs and labour price volatility.
- Cost and availability of accommodation (residential and commercial).
- Train infrastructure to move products not developed.
- The high cost of doing business in the Pilbara.

Opportunities

- Potential for an interconnected grid.
- Potential for renewable energy and renewable natural gas.
- Rebranding the Pilbara as a destination for business and tourism (not just a mining town).
- Potential for value add industries.
- Potential for a new model of Indigenous participation in the economy.
- Potential for a supply base in the region.

Threats

- Lack of commitment to infrastructure development that is not politically attractive, but is crucial to economic diversification (e.g. transport and energy grids).
- Natural resources industry cost inflation in the Pilbara for other industries (unless an SEZ is created that addresses this for alternative industry).
- Resistance to economic diversification by existing major companies.
- Perception of the Pilbara as a quarry without long-term potential.
- No quantified economic/business plan.
- No long-term economic vision.

Figure 15: SWOT analysis: economic diversification in the Pilbara



Community Services

Community infrastructure has improved dramatically but remains in deficit

Infrastructure is the primary element needed for secondary and tertiary wealth creation and sustainability in the region; however the current level of investment remains in deficit. While the Pilbara Cities vision and the Royalties for Regions funding has provided much needed investment incentive and focus on community services in the Pilbara region, after three years there are still critically low levels of essential services in the region. For example, there remains virtually no access to tertiary education, and while health services have improved due to the opening of the Nickol Bay hospital in Karratha and the South Hedland health campus, there remains a major shortage of specialist health services, see Figure 17 (Shire of Roebourne, 2013c).

Community services are perhaps the most vital area of investment in terms of creating the population growth and character defined in the Pilbara Cities vision. Services such as health care, police, transport, water supply, garbage collection and sewerage, and infrastructure such as housing, roads, rail, airports and telecommunications can be inadequate if they are funded and built for the usually resident population but are actually used by a larger 'service' population. Until health, education and social services are substantially improved, the goals of sustainable population growth will continue to be hampered (Briggs and McHugh, 2013).

Disadvantage, despite wealth created by the resources industry

Socio-Economic Index for Areas (SEIFA) scores are generated by the Australian Bureau of Statistics, and measure the relative advantage or disadvantage of an area based on indicators including: household income, education, and employment. The latest SEIFA data, based on 2011 census information, shows that despite the wealth created by the resources industry, there continue to be differing levels of disadvantage in the Pilbara (Healthfirst Network, 2013) (see Figure 16). It has been shown that more disadvantaged areas have higher proportions of reported ill health or risk factors for ill health. A score below 1,000 indicates an area is relatively disadvantaged. Despite the Shire of Roebourne being given an overall SEIFA score of over 1,000, the town of Roebourne itself was given a score of only 669, demonstrating that there is high need even within this relatively advantaged area (Healthfirst Network, 2013).

In many cases, the regional health statistics are worse than the state average. The mortality rate in the Pilbara is significantly higher than the state (Wood et al., 2012). This is largely a product of the high proportion of indigenous residents in the region (Wood et al., 2012). Indigenous Australians in the Pilbara, as across Australia, face significant disadvantage, including much higher rates of preventable health problems, and a shorter life expectancy than much of the developed world (more than 20 years less than the non-Indigenous population) (Australian Government, 2013).

Lifestyle risk factors are of particular concern in the Pilbara. For example, 25.1%, or one in four, adults smoke (Wood et al., 2012). This is significantly higher than the state prevalence

of 16.6%. A high proportion of adults who drink alcohol (67.3%) drink at rates likely to cause long-term harm (Wood et al., 2012). For this reason, the Pilbara region has a higher hospitalization rate for cases involving the consumption of alcohol and tobacco than the state (Wood et al., 2012).

This could perhaps explain why the amount of families are decreasing in the Pilbara

Improving community services is vital to attracting and retaining a permanent population. However, in spite of this, between 1996 and 2006, the number of families in the Pilbara decreased by 4.1%. In this period, all of the LGAs in the Pilbara, apart from Roebourne, saw a decrease in families (Australian Bureau of Statistics, 2009). A recent report by Rio Tinto, which published a survey of residents to understand their perceptions of life in the Pilbara, found that more than 70% of residents rate access to goods and services as poor or very poor (Rio Tinto, 2013a). This study builds upon a baseline community assessment first conducted in 2011.

In addition to the lack of services, the Rio Tinto report also found a 60% increase in the number of residents identifying social divisions in the community, particularly between industry and non-industry workers (Rio Tinto, 2013a). Anti-social behaviour, and a growing binge drinking culture among FIFO workers (House of Representatives and Standing Committee on Regional Australia, 2013), has also been identified as an emerging issue (Rio Tinto, 2013a). Culturally, the large number of temporary workers in the region can have a negative impact. The federal government inquiry into the impact of FIFO work noted that permanent residents of resource towns often feel torn between supporting the major industry, and maintaining the existing culture of the town (House of Representatives and Standing Committee on Regional Australia, 2013). Therefore, addressing the cultural and social issues of the Pilbara, as well as improving community services, is crucial to developing the vibrant, liveable region planned in the Pilbara Cities vision.

SEIFA (Socio-Economic Indexes for Areas) Scores 2011	
Town of Port Hedland	1,057
Shire of Roebourne	1,060
Shire of Ashburton	1,033
Shire of East Pilbara	962

Figure 16: SEIFA (Socio-Economic Indexes for Areas) scores 2011 (Healthfirst Network, 2013)

Regional Relative Strengths: Essential services

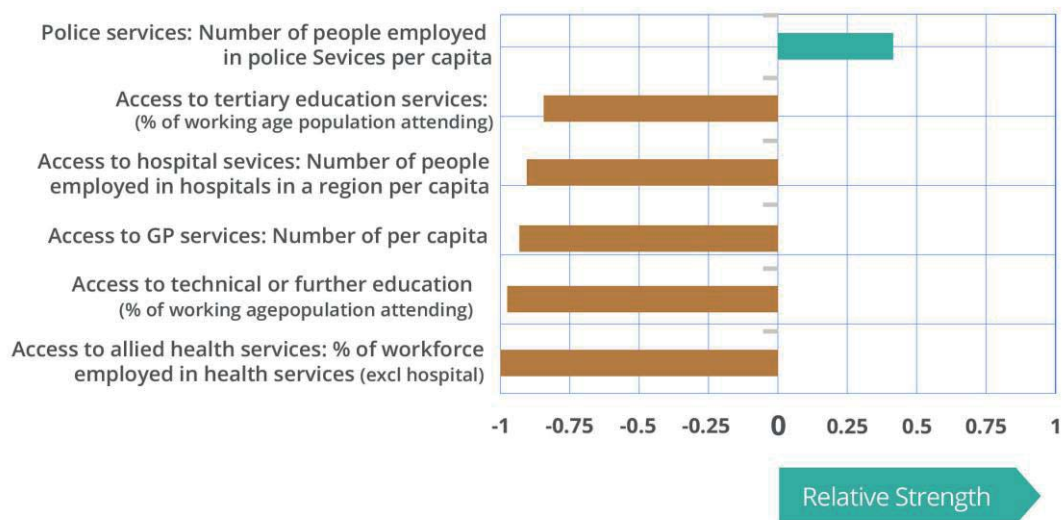


Figure 17: Regional relative strengths: essential services (Shire of Roebourne, 2013a)

FIFO workforce puts strain on community services provision in the Pilbara

Community services in the Pilbara have been strained from the high numbers of temporary FIFO workers in the region (see Figure 18). Figure 19, generated by the Pilbara Industry's Community Committee (Pilbara Industry's Community Council (PICC)), demonstrates this current dominance, and shows that industry projections expect non-resident workers numbers will continue to grow to 2020 (Pilbara Industry's Community Council (PICC), 2012). FIFO workers, and the mining sector as a whole, have dramatically inflated the cost of accommodation, which in many cases have priced out community services workers and programs. Therefore, there is a shortage of community services workers in the Pilbara, and the prohibitive costs associated with relocation to the Pilbara means that it is difficult to attract the necessary workforce on a permanent basis. A recent report commissioned by RDAP and the Pilbara Development Commission (PDC), which looked at the gaps in the NGO sector in the Pilbara, calls for a specific, long-term plan for the sustainability of the NGO/ community services sector,

Permanent and non-resident worker populations in the Pilbara 2006 & 2011

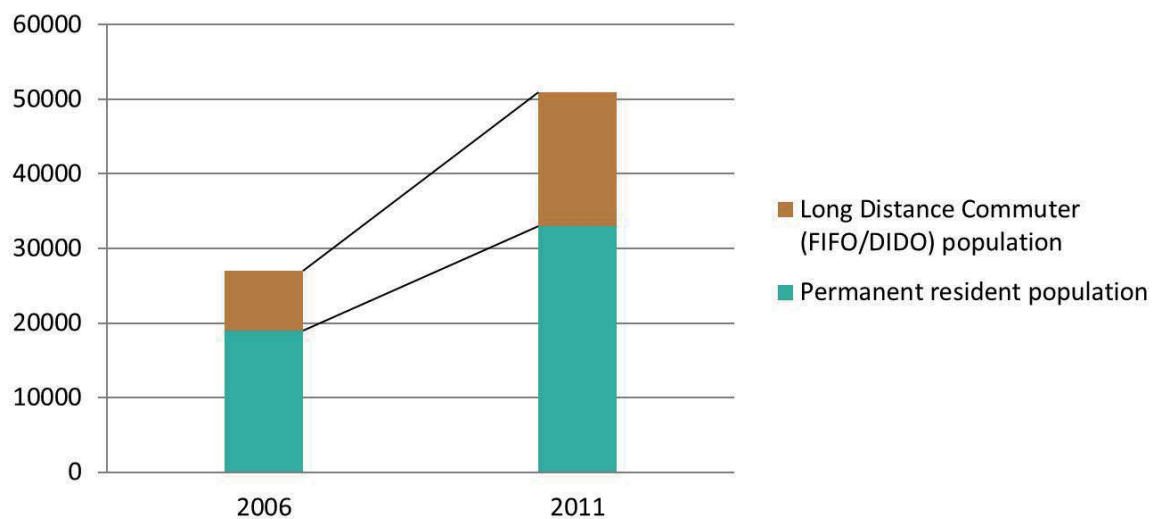


Figure 18: Permanent and non-resident worker populations in the Pilbara 2006 & 2011 (KPMG, 2013b)

especially in terms of setting aside accommodation for vital services and ensuring the availability and affordability of such accommodation over time (Jill Cameron and Associates, 2012). RDAP and the PDC have stated their commitment to working together to progress the nine key recommendations of this report.

Resource Sector Workforce by Residence Incremental to 2011 - All Projects

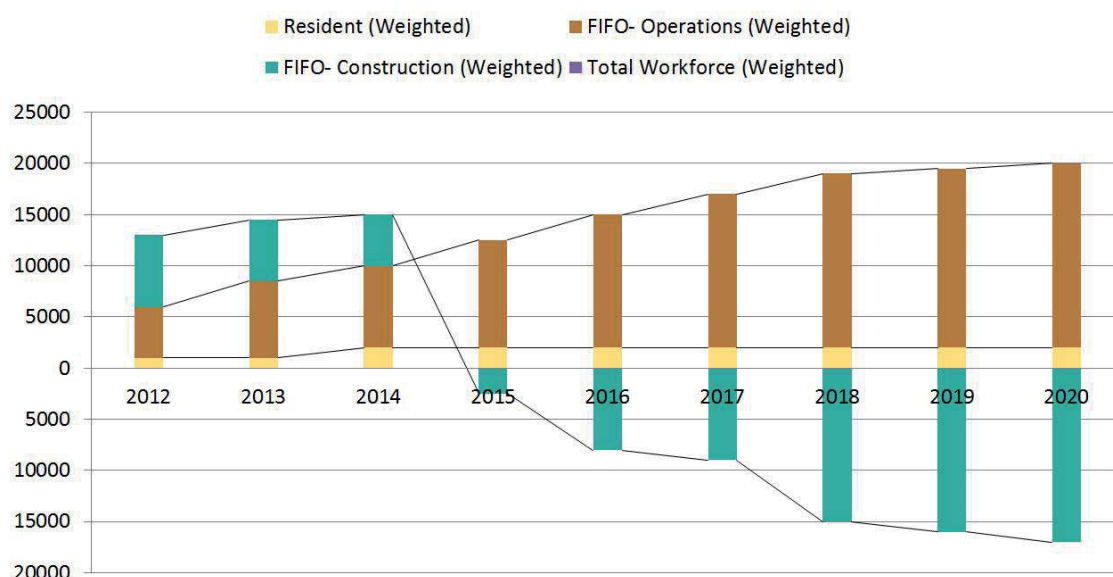


Figure 19: Resource sector workforce by residence (Pilbara Industry's Community Council, 2012)

FIFO workers strain hospital and emergency services

In addition to pricing community service workers out of the market, the dominance of FIFO workers in the region inflates the population, putting a strain on already stretched services, and limiting the availability of services for the permanent population (House of Representatives and Standing Committee on Regional Australia, 2013). For example, Figure 19 above highlights the inadequate supply of GP's and specialist services for the population. The shortage of physicians, combined with a culture of impermanence where temporary workers are unlikely to seek out a regular doctor, leads to a greater reliance on emergency and hospital medical services. According to health data from 2010/11, 75% of all emergency admissions were classified as semi-urgent or non-urgent cases, meaning that many could have been treated by primary medical practitioners instead (Wood et al., 2012) (see Figure 20).

Emergency attendances by triage category

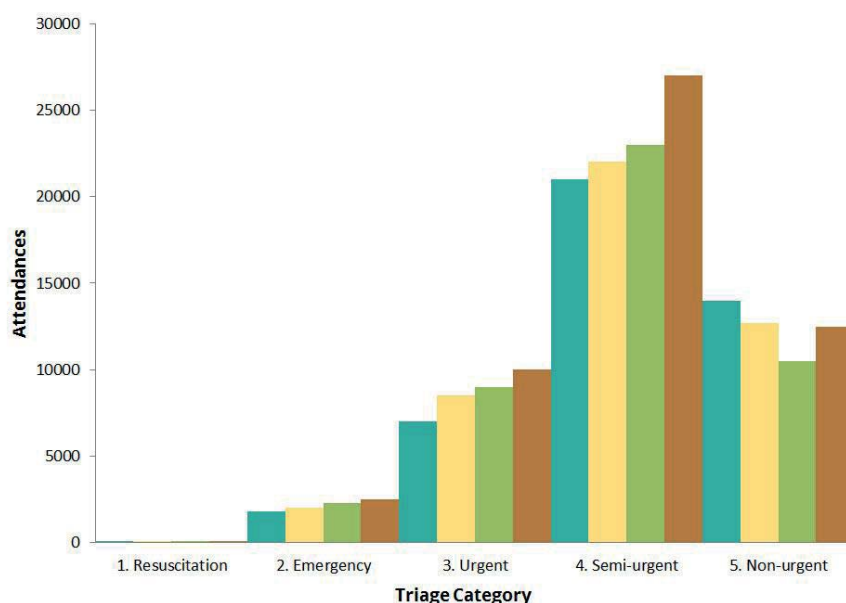


Figure 20: Emergency attendances by triage category (Wood, Newton, Bineham & Lockwood, 2012)

Underestimation of FIFO population leads to inadequate services

It is important that government adjust their resourcing models for community services taking account of the temporary population in their demographic figures. The underestimation of FIFO workers currently and in future population projections means that planned infrastructure will not meet the true future needs of the community. The federal government has oversight over the region via the Regional and Local Community Infrastructure Program, which allocates funds to local governments for the implementation of community infrastructure. This was considered a major concern by the Federal Government, who commissioned a report that explored the consequences of FIFO work in regional Australia (House of Representatives and Standing Committee on Regional Australia, 2013). The inquiry found that initiatives such as this use permanent population figures to allocate their funding and therefore create a disadvantage for resource communities who have dwindling resident numbers and growing temporary, non-resident populations (House of Representatives and Standing Committee on Regional Australia, 2013). Although this report has been viewed at a ministerial level, very few concrete actions have followed it to develop the recommendations into practice.

A lack of direct action to minimize FIFO workforce & impact

The Federal Government commissioned report into the impact of FIFO work on regional areas provides a similar recognition of the issues as the state planning strategies, but endorses only incentive-based policies for reducing FIFO dominance. The Pilbara Cities vision aims to create sustainable urban centres in the North West that will provide the incentive for permanency. The negative impact of the dominance of FIFO workers on community services is acknowledged in the long term strategic plans for the region (CCS Strategic Management and Geografia, 2009, Town of Port Hedland, 2012). Therefore, the long term vision for the region is to reduce the numbers of FIFO workers relative to permanent workers. The strategies for doing so, however, are currently through a soft policy

approach. Presently, minimizing FIFO work is being solely pursued by making the city more liveable, vibrant, and affordable (Department of Regional Development and Lands, 2012). There is no discussion of policy options for mandating a reduction of FIFO workers. Therefore, the current strategy for reducing reliance on FIFO workers is lacking in that it assumes that once the town is more attractive workers will stay. This strategy ignores the other drivers of FIFO dominance, such as economic incentives of FIFO work for companies and the preference of workers to live in Perth or other urban centres. The inadequacy of the current policy approach is particularly evident in Figure 19 above, which demonstrates that industry itself expects the proportion of non-resident workers to *increase* over the long term to 2020 (Pilbara Industry's Community Council (PICC), 2012). Soft strategies are important, however this report argues that a combination of incentive and regulation would be a more effective and direct way of seriously dealing with the significant impact FIFO dominance has on the creation of sustainable, regional communities.

SWOT Analysis: Community Services in the Pilbara

Strengths

- Pilbara Cities vision providing incentive & funds for community service investment.
- Strong NGO sector presence.

Weaknesses

- Cost and availability of accommodation (residential and commercial).
- Difficulty attracting service workers to work outside profitable resource industry.
- Lack of cultural capital/ opportunities discouraging permanent resident families.
- Pockets of disadvantage (health, socio-economic).

Opportunities

- Coordinate NGO work to increase efficient service delivery and minimise duplication.
- Create a strategy, including hard and soft policy tools, to reduce the dependence on FIFO work.

Threats

- No plan to manage FIFO numbers.
- Community service provision based on permanent resident numbers that ignore large temporary population.
- Low priority of community service provision comparatively despite importance in creating liveable cities.

Figure 21: SWOT analysis: community services in the Pilbara

Land and housing

Housing in the Pilbara: affordability

Although the cost of housing in the Pilbara reduced substantially in 2013, housing is still the most expensive of any of the regions in the Pilbara. Land supply has done a great deal to improve the situation; however commodity prices dropping off has also caused a slowdown in the Pilbara economy, which has reduced the demand for housing. Commodity prices could very well rise again, and given the still high cost of housing, affordability is a critical issue affecting all sectors and compounding many other issues, including attempts to diversify the regional economy. The affordability issue is demonstrated by the average rental price for a home, which, in the quarter to September of 2013 was approximately \$1700 per week in Port Hedland, and \$1,207 in Karratha (Pilbara Development Commission, 2013d). This compares to a median weekly rental price of \$450 in the Perth metropolitan region (Department of Planning, 2013). The price of home ownership in the Pilbara escalated alongside increased mining activity in the region to a peak of \$900,000 in 2012 (Connoley, 2013). As a point of comparison, the median house price in Perth for the June quarter 2012 was \$480,000 (Department of Planning, 2013). As shown in Figure 22, as of 2012, housing prices have fallen since 2012, and have continued to fall since that time, largely as a result of declining mining investment (Connoley, 2013). However, despite a normalizing housing market, the median house price in Karratha remains high at \$741,000 (Pilbara Development Commission, 2013d). Therefore, housing prices continue to be a barrier to non-resource industry development, limiting economic diversification efforts.

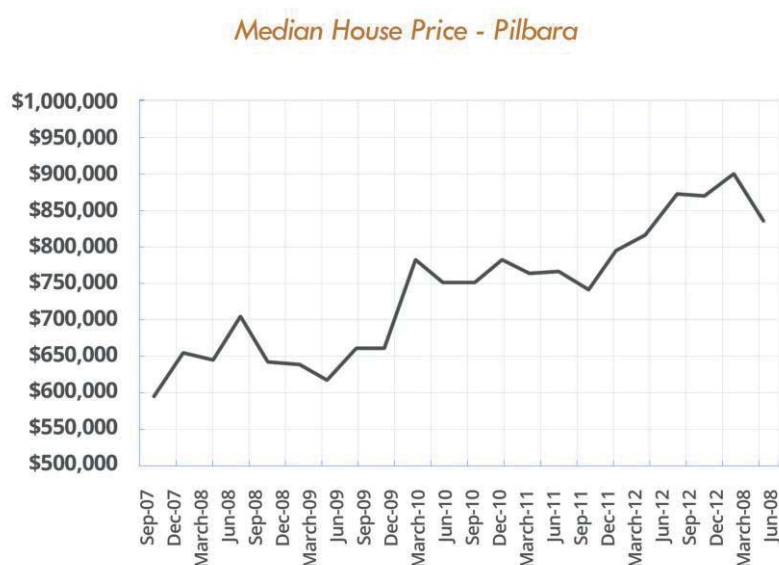


Figure 22: Pilbara median house price (2007-2012) (Connoley, 2013)

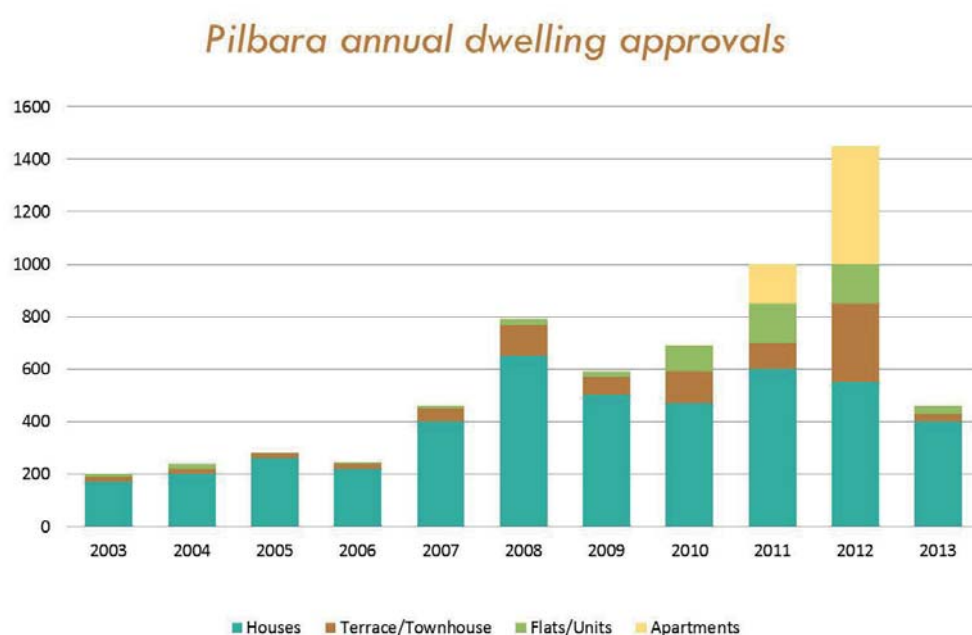


Figure 23: Pilbara annual dwelling approvals (Connoley, 2013)

Land release delays continue to constrain housing supply

Land release for housing is identified in the major strategies for the Pilbara as the primary mechanism for addressing the lack of affordable housing (Shire of Roebourne, 2010, Town of Port Hedland, 2012, Western Australian Planning Commission, 2012). This is also a key recommendation of the Federal Government commissioned report that looked at the impacts of FIFO work in regional Australia (House of Representatives and Standing Committee on Regional Australia, 2013). The assumption is that an increase in the supply of houses will drive prices down. Therefore, there are plans for the continued streamlining and fast tracking of land release and development approval in the region.

While the rate of land release and dwelling approvals have increased since the rollout of the Pilbara Cities scheme (see Figure 23 & 24), it has to date remained inadequate to address the significant lack of supply that currently exists (Regional Development Australia: Pilbara (RDAP), 2012a, Pilbara Industry's Community Council (PICC), 2012). The four shire's plans, which include Karratha and Port Hedland, have identified land to accommodate the

projected populations of 50,000 for each city by 2035 (Town of Port Hedland, 2012, Shire of Roebourne, 2010). The delivery mechanism for converting this land into housing supply, however, has to date remained insufficient. The Regional Development Authority: Pilbara, in their detailed progress report of 2012 on the supply gaps in the region, show that of the 8,614 dwellings required in the Pilbara by 2015, less than 50% of that number had been brought to market in 2012 (Regional Development Australia: Pilbara (RDAP), 2012b). The needs projection of 8,614 dwellings by 2015 is also thought to be underestimated

(Regional Development Australia: Pilbara (RDAP), 2012a)
(see Figure 25 for a breakdown of the shortfall).

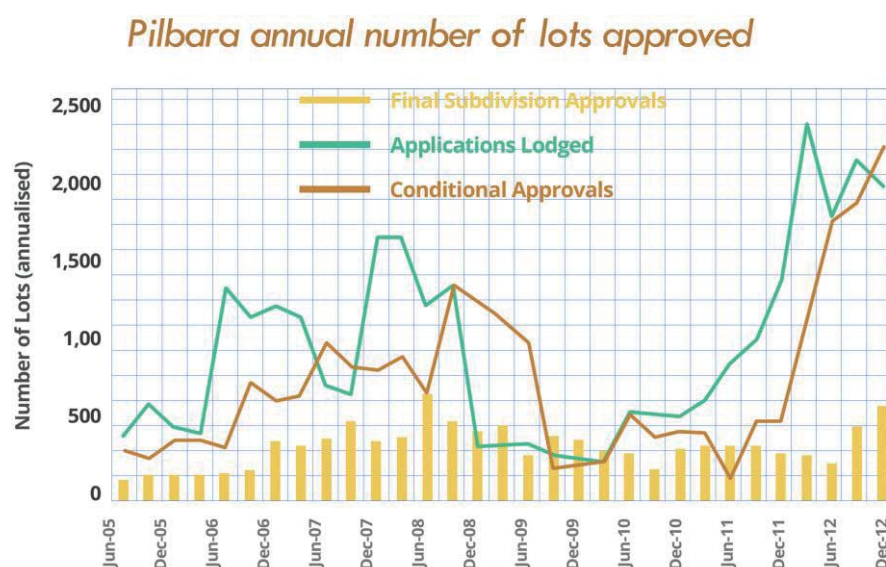


Figure 24: Pilbara annual number of lots approved (Connoley, 2013)

Potential housing demand in Pilbara population centres (dwelling units)

Town	Existing Supply 2012	Forecast Supply 2016	Forecast Demand 2016	Development required	Shortfall
Port Hedland	6,054	11,455	11,440	5,401	- 15
Karratha	5,680	8,551	9,907	2,871	1,356
Newman	1,859	2,431	3,044	572	613
Total	13,593	22,437	24,391	8,844	1,954

Figure 25: Potential housing demand in Pilbara population centres (dwelling units) (RDAP, 2012b)

Pilbara 2050: Ensuring the long-term viability of the Pilbara



Fast tracking development hampered by limited construction industry in the region

Constraints to bringing housing to market include delays to land release, as well as a shortage of housing construction labour. For example, the Western Australian Chamber of Minerals and Energy claim that the new housing needed would require a doubling of the current local construction industry (PricewaterhouseCoopers, 2012). Off-site manufacture of housing has considerable potential in the Pilbara and could be a major source of employment to replace the need for bringing materials and workforce from Perth (SBE NRC, 2013)⁵. Quality of prefabricated housing needs to be improved though, and due to the harsh climate, in-situ houses are considered to be of a better quality and look better over time than prefabricated houses.

Another challenge of fast tracking land release is the difficulty of providing the hard and soft infrastructure required for housing developments (power, sewer, water supply etc.) at a commensurate pace. In this way, housing affordability is an inter-related issue. Sourcing and accommodating workers to construct the necessary infrastructure for housing supply is itself made difficult by the lack of affordable and available housing. In this way, addressing housing affordability is critical to achieving the strategic for the region, as without it, infrastructure development, economic diversification, liveability, and community services development will continue to be limited.

Affordable housing and the importance of local governance

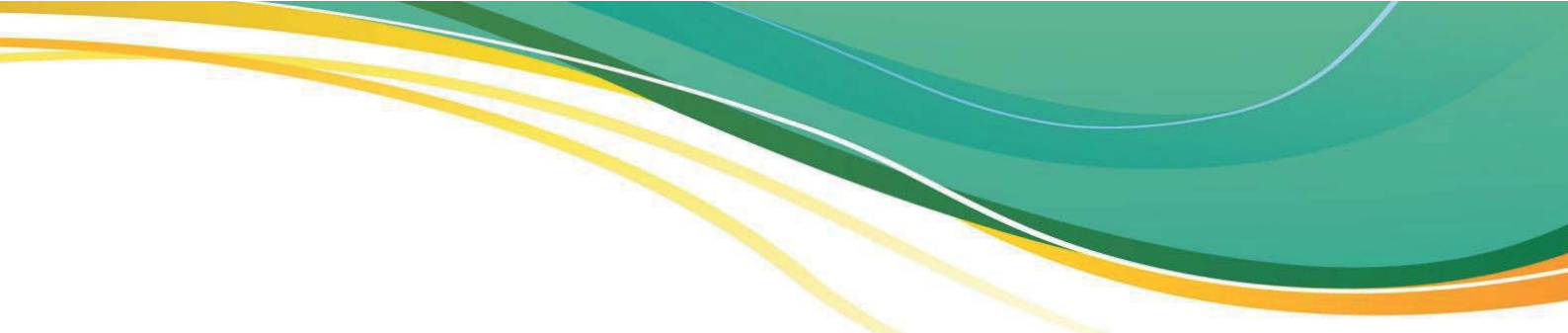
Housing affordability features in all the state and local planning strategies for the Pilbara, however, none of these agencies have produced a strategic plan specifically addressing affordable housing. It is argued that in order to seriously address this crucial issue, detailed and specific plans must exist at a local government level that complement measures endorsed by state and federal planning for the region (Shelter WA, 2013). In addition, regional planning could be improved through the development of a local development authority whose role it is to work alongside housing projects, and ensure best practice sustainability and affordability outcomes are incorporated and met (Newman et al., 2010).

Housing & the FIFO population

The inflated cost of housing has largely been a result of the rapid influx of workers to the region over the past decade. Large oil, gas and mining companies have been willing to pay ever-higher prices to house their workers in existing and temporary accommodation, which has put a strain on housing supply, and has driven up prices through their capacity to out price the mainstream market for housing that is available (Landcorp, 2011).

Some of the recommendations of the inquiry into the impact of FIFO work in regional Australia included the removal of existing tax incentives that promote these working arrangements (House of Representatives and Standing Committee on Regional Australia, 2013). For example, one recommendation included removing the fringe benefits tax

⁵ The National Research Centre for the Sustainable Built Environment is looking at the potential for manufactured building systems to deliver sustainable and affordable housing options in Australia and believes the market potential is significant.



exemption for those working close to or within regional towns. While a long-term strategy is endorsed for decreasing the dominance of FIFO workers, there is concern that any increase in the permanent population, occurring as a consequence of such strategies, would currently place even greater strain on housing supply and affordability (Shelter WA, 2013). If planning authorities do adopt a policy of reducing the dominance of FIFO work in the region, this will need to be strongly aligned with housing supply and community services plans to ensure that the supply of housing and services continues to match demand as workers relocate to the area.


New housing quality limited by immediate need

In addition to extremely inflated house and accommodation prices, the *Pilbara Vernacular Handbook* (2011), developed by Landcorp, argues that the majority of built form in the Pilbara has been driven by short-term cost factors, and materials and designs of buildings are not necessarily appropriate to the climate (Landcorp, 2011). The report argues that this has occurred largely because development has progressed alongside commercial project development on an ad-hoc needs basis.

Low quality design and construction is also an outcome of: the high cost of building in the Pilbara (double the cost of building in Perth (PricewaterhouseCoopers, 2012)), the small number of construction workers available, and the limited skills that exist within the small population of construction workers. Therefore, much of the current built form in the Pilbara, including housing, is built inappropriately, and will need upgrading or replacing to comfortably support the population growth projected in the Pilbara Cities vision (Karratha and Port Hedland to be cities of 50,000, and Newman to be home to 15,000 by 2035 (Department of Regional Development and Lands, 2012)).

Considering the scope of the accommodation needs in the Pilbara, this type of short-term focus will lead to unnecessary costs in the long-term, and will lead to a duplication of works that could have been prevented. Therefore, this report argues that the standards of current work, and the appropriateness of new buildings for their desert environment, need to be addressed. The Pilbara Development Commission, who are overseeing the Pilbara Cities initiative, have a role to play in negotiating building standards and regulation with the region's local councils to ensure the new housing stock is climate appropriate. Urban planning for the region has largely been based on practices used in Perth, which has a significantly cooler climate than the desert conditions of the Pilbara (Newman et al., 2010).

The local and state planning strategies need to ensure that the built environment, both housing and the surrounding public space, is suitable to the climate. As an example, narrow roads in this region would provide more effective shading for the streets (Newman et al., 2010). These types of considerations do not feature strongly in the current planning documents or indeed the cities built form. Better planning and regulation, however, will also require some education or incentive-based policy tools for energy and water efficiency within the home. In the Pilbara, where resource companies commonly pay utilities as part of the accommodation and employment package for their workers, air conditioning is often used



excessively, with locals reporting that it is common to see householders using their air conditioning with the doors open (Karratha & Districts Chamber of Commerce & Industry (KDCCI), October, 2013). Therefore, the right policy tools are required to ensure better quality housing, as well as operational energy and water efficiency.

Housing affordability is critical for all sectors of development in the Pilbara

The lack of affordable housing is a compounding barrier for all areas of the development in the Pilbara region. Until accommodation is both available and affordable, the prospects are limited. This is in terms of increasing tourism; attracting permanent residents; supporting small business and economic diversification; and maintaining sufficient non-resources employees for community services and construction. For this reason, if the region is to become a sustainable economy, much more must be done to seriously tackle the lack of affordable housing. Off-site manufacture of housing may offer the most promising direction for achieving this, especially if it can be well designed for a Pilbara climate and style.

The building of cities themselves will aid in diversifying the economy in the Pilbara; however, when cities are thought of as incrementally expanding places, development outcomes are less than optimal. Although the outlook is still very positive, the slowdown caused by the global financial crisis presents a good time to rethink and plan for the longer term. Critical to the success of the Pilbara Cities vision, then, is to actually define the future, and then work back from there in terms of putting the right incentives and policies in place to make it happen.

SWOT Analysis: Land & Housing in the Pilbara

Strengths

- Pilbara cities vision has motivated longer-term regional planning for housing development.
- Land does exist for growth.

Weaknesses

- Inadequate supply.
- Inflated house/land/rental prices due to resource companies accommodating workers and out-pricing the market.
- Poor quality built form (climate inappropriate).
- Lack of construction workers.
- The high cost of construction.

Opportunities

- Better streamlining of land release processes.
- Incorporate environmental regulations in built form to ensure climate appropriate development.
- New off-site manufacturing of housing can be cheaper and more appropriate to the Pilbara climate.

Threats

- Shortage/ high cost of accommodation threatens all other industries/ sectors – limits economic diversification, tourism, small business, liveability, community service provision.
- Short-term needs driving poor quality development.
- No environmental focus in planning/ regulation.

Figure 26: SWOT analysis: land & housing in the Pilbara

Water in the Pilbara

Infrastructure development regarding water in the Pilbara is currently in catch-up mode and is dominated by securing adequate supply in the short term. This is a result of the urgency of the situation, in which water sources are already at capacity. The average annual rainfall for the Pilbara is 200mm-350mm (Department of Water, 2010b). The low rainfall levels in the region are also compounded by the tendency for long periods of drought followed by unpredictable and extreme flooding (Department of Water, 2010a). Episodic flooding, which the cyclonic Pilbara region experiences, is crucial to replenishing the groundwater aquifers in the region, and for recharging surface water supplies (Regional Development Australia: Pilbara (RDAP), 2013b). Therefore, water is an extremely important, though unreliable, resource in the Pilbara that requires long-term planning and management to ensure ongoing supply.

Pilbara water supply

Water supply for the Pilbara is provided by two separate schemes: the West Pilbara Water Supply Scheme (WPWSS), which services Karratha, Dampier, Roebourne, Cape Lambert and Point Samson; and the East Pilbara Water Supply Scheme (EPWSS), which services Port and South Hedland as well as Wedgefield. The WPWSS sources water from the Harding Dam (surface water), with the Millstream Aquifer (groundwater) providing backup supply when required. The EPWSS primarily sources water from the Yule and DeGrey River borefields (groundwater) (see Figure 27 for a visual map of the region's water sources). Water plans in the Pilbara are informed by the State Water Plan (Department of Premier and Cabinet, 2007), and the Intergovernmental National Water Initiative (National Water Commission, 2004).



Figure 27: Pilbara water sources (Department of Water, 2012a)



Current infrastructure developments

Since the announcement of the Pilbara Cities vision in 2009, the Department of Water has commissioned three planning guidelines for the region: The Pilbara Regional Water Plan (for the overall strategic plan and identification of priority issues) (Department of Water, 2010a), the Pilbara Water in Mining Guideline (Department of Water, 2009), and the Water for the future; the statutory water planning for the Pilbara (to create a strong understanding of groundwater allocation and availability in the region) (Department of Water, 2010b). These documents specifically relate to current long-term population growth and development in the Pilbara.

Large population growth projections, alongside the Pilbara Cities vision, can be seen to have spurred on water services projects. These include the Karratha wastewater treatment plant upgrade, the Dampier main supply upgrades, and the relocation of the Port Hedland wastewater treatment plant to South Hedland. In particular, the relocation of the Port Hedland wastewater treatment plant directly relates to the blueprints for increased residential development, and plant relocation is required in order to use the land for residential development and population growth in Port Hedland.

An investment of \$47 million is being used to upgrade the EPWSS mains between Yule Borefield and South Hedland, adding 2 billion GL of supply per year to the population centre (Redman, 2013). In Onslow, Chevron is contributing to major and minor infrastructure upgrades in the town as part of the agreement relating to their large-scale Wheatstone Project, which will increase the population of the town. In terms of water, Chevron is providing a new desalination plant, and is also upgrading the waste water treatment plant as well as providing new waste treatment facilities (Department of State Development, n.d).

The 2012 Investment Prospectus report by RDAP calculates the required investment for the WPWSS alone as being \$1.5 billion, with almost half of this sum required up to 2015 (Regional Development Australia: Pilbara (RDAP), 2012b). Based on government documents recording infrastructure works, including those not expected for completion until after 2015, the actual infrastructure investment appears to be substantially less than this (Department of Regional Development and Lands, 2012).

Water supply for the Pilbara population is stretched

Despite an injection of infrastructure funding, the Pilbara is experiencing a shortage of water in the populated coastal areas, even as inland areas have additional capacity (Western Australian Planning Commission, 2012). The 2012 *Pilbara Planning and Infrastructure Framework* records the WPWSS, and the Onslow town water supply, as being 'at capacity', with the EPWSS being 'near capacity' (Western Australian Planning Commission, 2012). Water demand for the WPWSS was approximately 14GL in 2009-10 (Regional Development Australia: Pilbara (RDAP), 2013b), and is set to grow to 33GL by 2020 (see Figure 28) (Shire of Roebourne, 2013b).

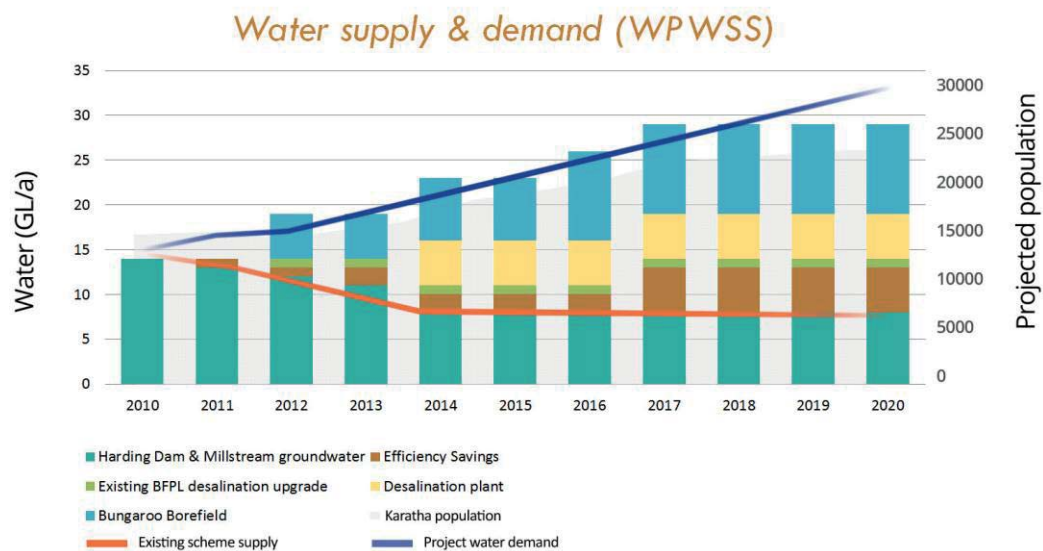


Figure 28: Water supply & demand (WPWSS) (RDAP, 2012b)

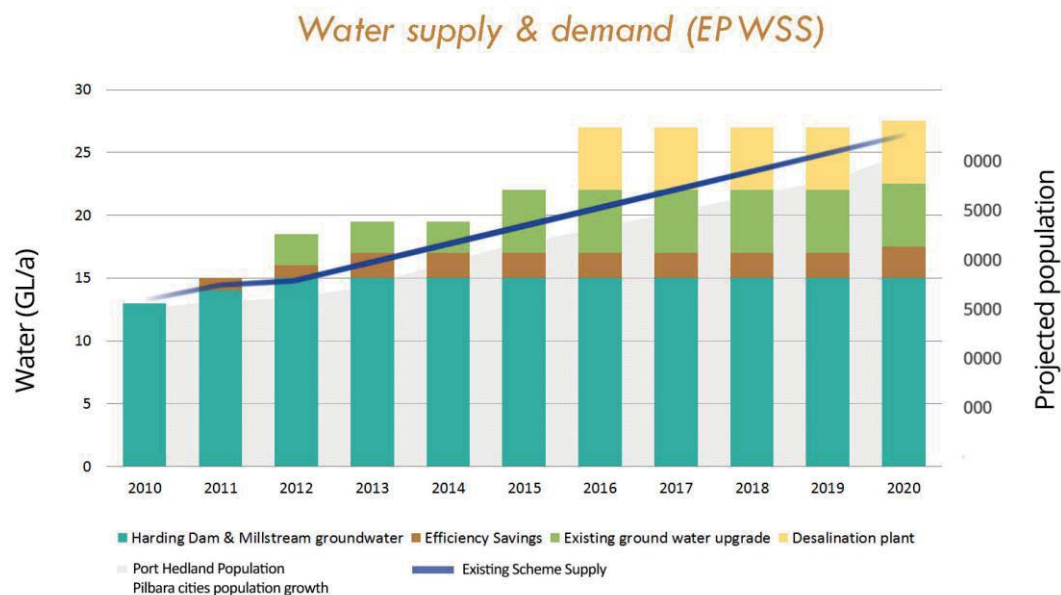
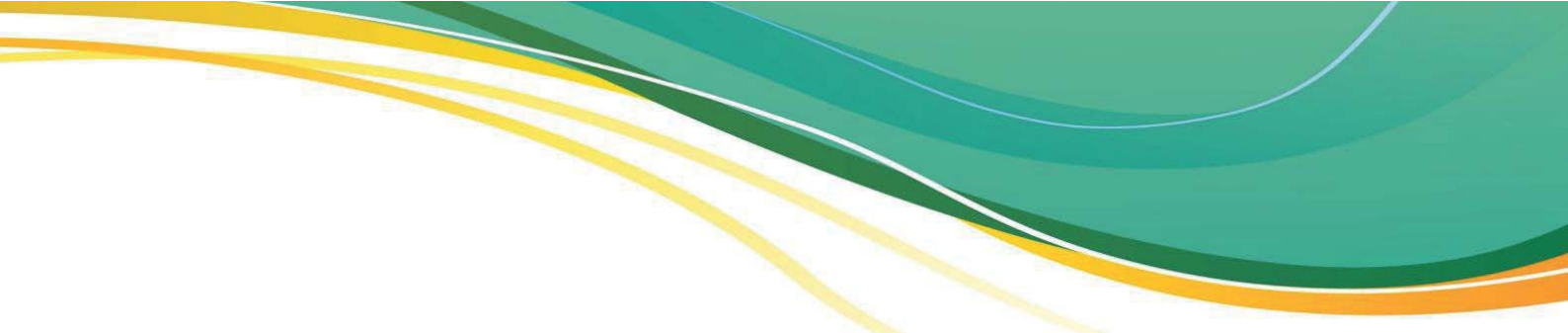


Figure 29: Water supply & demand (EPWSS) (RDAP, 2012b)

The water supply situation in the Pilbara is currently constraining development and population growth in the region, and is therefore impeding the Pilbara Cities long term plans. The RDAP *Pilbara Report* from 2012 states that “if a supplementary source of water supply is not provided for Karratha within the next 12 months it will not be possible for Karratha to support further population growth” (Regional Development Australia: Pilbara (RDAP), 2012a). In late 2013, it appears that decisive action regarding the development of a secure



water supply for the shire has been delayed. This is largely due to the Rio Tinto development of the Bungaroo Valley borefield, and associated WPWSS infrastructure investment which is expected to generate additional supply for the West Pilbara in the short term.

In 2011, Rio Tinto surrendered their water entitlement from the Millstream Aquifer to the WPWSS in exchange for approval to develop their own water source in the Bungaroo Valley. The development of the Bungaroo Valley borefield provides a water source for Rio Tinto's Bungaroo Valley mining operations. The Water Corporation have agreed to upgrade the WPWSS, at a cost of \$42 million, to allow for additional flows from the valley to the population centres, and expect that the Rio Tinto development of the borefield will free up existing groundwater providing a new town water source (Marmion, 2013).

The development of the Bungaroo valley borefield is expected to provide 10GL of water annually to the WPWSS, ongoing by mid-2014 (Shire of Roebourne, 2013b). It does not appear, however, that any certainty exists around this figure, nor any formal agreement with Rio Tinto that stipulates the proportion of water supplied to the WPWSS compared with that used for their own mining operations. Therefore, the security of this water source appears dependent upon Rio Tinto's own needs as well and the continuation of their mining operations in the valley.

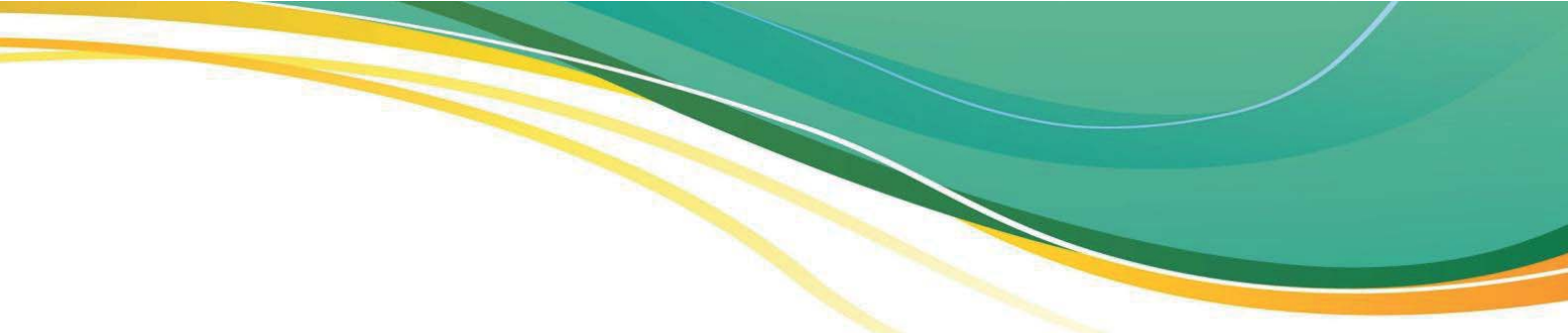
In terms of water supply for the EPWSS, feasibility studies are being conducted to determine whether the West Canning Basin could provide a new industrial water source. The basin, located 120km East of Port Hedland, is estimated to be able to provide up to 10GL of water a year for the water scheme, and if exploration indicates that this is possible, this water would be used for industrial purposes, freeing up the existing supply for residential and public use (Department of Water, 2012b, Department of Regional Development and Lands, 2012).

Securing a sustainable water supply

As the current water supply sources for the WPWSS have no potential for expansion, they urgently require identification of a new long-term water source. A desalination plant has been flagged as a promising option, with the potential to supply up to 15GL of water per annum for the scheme (Regional Development Australia: Pilbara (RDAP), 2012a, Western Australian Planning Commission, 2012). The benefit of a desalination plant is that it would be a sustainable water source independent of rain fall, however, desalination is very energy intensive, thus adding to the power infrastructure pressures on the region.

In contrast, the current water sources for the Pilbara are all rainfall dependent and therefore subject to vulnerability and the impact of climate change (for example, increasing frequency and duration of droughts). While the idea of a desalination plant on the Burrup Peninsula has been talked about extensively, with WA premier Colin Barnett even pledging \$370 million towards the project in 2010 (No author, 2010), the project has been postponed, with the government citing strong rainfall and the development of the Bungaroo borefield as the justification for the delay. This report argues then, that the delaying of water infrastructure development based on the development of this source, particularly the delaying of plans to construct a desalination plant on the Burrup Peninsula, represents political short sightedness.

Water supply management in the Pilbara urgently requires a specific long-term strategy that will provide a secure water supply to meet the needs of a growing population. The Pilbara



Water Research Assessment report, being carried out by the CSIRO, will provide valuable information to guide sustainable planning for water use in the Pilbara in the short and long term (CSIRO, 2012). It will provide specific reports for each major water source in the Pilbara and include climatic projections and recommendations for each. This research is being funded by the Western Australian government and industry and will be available in 2014.

Economic diversification opportunities from mine dewatering surplus

Approximately 70% of water consumption in the Pilbara is used for mining purposes (Western Australian Planning Commission, 2012). Although water in the Pilbara cities is scarce, there is an abundance of water from dewatering mines in the region. Water from mine dewatering represents one of the strongest opportunities for economic diversification in the Pilbara. Mining in the region is commonly occurring below the water table, and significant quantities of high quality water are being extracted as part of this process. Mining companies are required to first use any surplus water for reducing environmental impacts of their operations (Department of Water, 2013). Historically, after this, surplus water was disposed of into waterways; however it is understood that this practice is now discouraged and companies must find alternatives for disposing of the excess water.

As discussed in the agricultural section, the PHADI programme provides significant opportunities to grow the agricultural sector in the Pilbara.

Water efficiency is also important

In addition to increasing the capacity of water infrastructure in the Pilbara, local plans must also consider strategies for water efficiency and reducing use. The *Pilbara Regional Water Plan 2010-2020* sets the aspirational target of improving water use efficiency by 20% by 2030 (Department of Water, 2010a). The focus of these efforts is stated as being residential outdoor use and targeting resource companies to promote more efficient water use in their operations. Indoor residential use is not targeted as the majority of this water is already recycled. The construction of the South Hedland Wastewater treatment plant will improve this further as it will include a new water recycling facility (Regional Development Australia: Pilbara (RDAP), 2013b). This will provide recycled water for industries and businesses that do not require high quality drinking water, making for more efficient use of water supply from the scheme.

The Water Corporation has successfully installed 14,000 smart meters across the Pilbara, after a successful trial in Kalgoorlie-Boulder (Water Corporation, 2012). Smart meters make individual household water usage known to both the Water Corporation and homeowners, allowing efficiency opportunities to be identified, and leaks to be identified early. This program represents an effort to improve water efficiency in the Pilbara, however more must be done. While smart meters are an important incentive-based strategy for reduced use, common practice in the Pilbara is for resource companies to pay utilities bills as part of the employment and accommodation package for their workers. In these circumstances, where the user does not pay, smart meters are unlikely to encourage reduced consumption.

Landcorp and housing developers in the Pilbara have a critical role to play in ensuring that water-sensitivity is embedded in urban design and specification guidelines for new homes (Regional Development Australia: Pilbara (RDAP), 2012a, Landcorp, 2011). While planning

documents state that water needs should be addressed holistically alongside urban planning, regulatory policy tools are not being adequately utilized (Western Australian Planning Commission, 2012). Instead, in light of the severe housing shortage in the Pilbara, water and climate-sensitive design appears to feature low on the priority list.

Grey water and storm water capture must become the norm across new developments in the Pilbara, and gardens should feature local plants that require minimal water (Regional Development Australia: Pilbara (RDAP), 2012a). The *Pilbara Report* from 2012 notes that the inclusion of water-sensitive design specifications, including mandatory grey water and storm water capture facilities into new developments, are yet to exist (Regional Development Australia: Pilbara (RDAP), 2012a). Considering the stretched capacity of current supply, water efficiency measures, including mandatory requirements in new developments, are achievable now, and therefore should be implemented as soon as is practical.

SWOT Analysis: Water in the Pilbara

Strengths

- Surplus water exists from mine dewatering.
- Land available for desalination plant.

Weaknesses

- Irregular rainfall, limited supply.
- Crisis management approach to infrastructure.

Opportunities

- Reduce dependence on climate/rainfall through construction of a desalination plant.
- Improve regulatory standards for urban planning & housing specifications that mandate water efficiency (grey water, rainwater capture, water sensitive plants).
- Substantial surplus water available for agriculture from mine dewatering

Threats

- Lack of long-term strategy.
- Short-sighted and just-in-time investments.

Figure 30: SWOT analysis: water in the Pilbara

Energy in the Pilbara

Electricity

The on-grid energy production and transmission system in the Pilbara consists of numerous standalone networks supplying townships and some commercial activity, which were developed in the 1970s and then interconnected in 1985, called the North West Interconnected System (NWIS). The NWIS extends 400km east to west, and 350km north to south, across the region, servicing all the major population centres. The NWIS is powered entirely by gas. The NWIS is not regulated by any governing body and multiple parties own and operate parts of the NWIS, including Horizon Power, BHP, Rio Tinto and Alinta. Figure 31 provides a visual map of the network.

The current off grid power situation (non-NWIS) in the Pilbara is characterised by limited coordination, commercial ownership (and lack of shared information due to commercial competitiveness), and increasingly inadequate infrastructure for current and future needs of the region and to facilitate economic diversification (The Allen Consulting Group, 2008, Shire of Roebourne, 2013a). Off grid power is generated by a combination of gas and diesel. According to ACIL Tasman (July, 2013), the following energy generation exists or is tabled for construction in the Pilbara:

NWIS

637MW Installed capacity from gas

620MW Planned (deals with need until 2020)

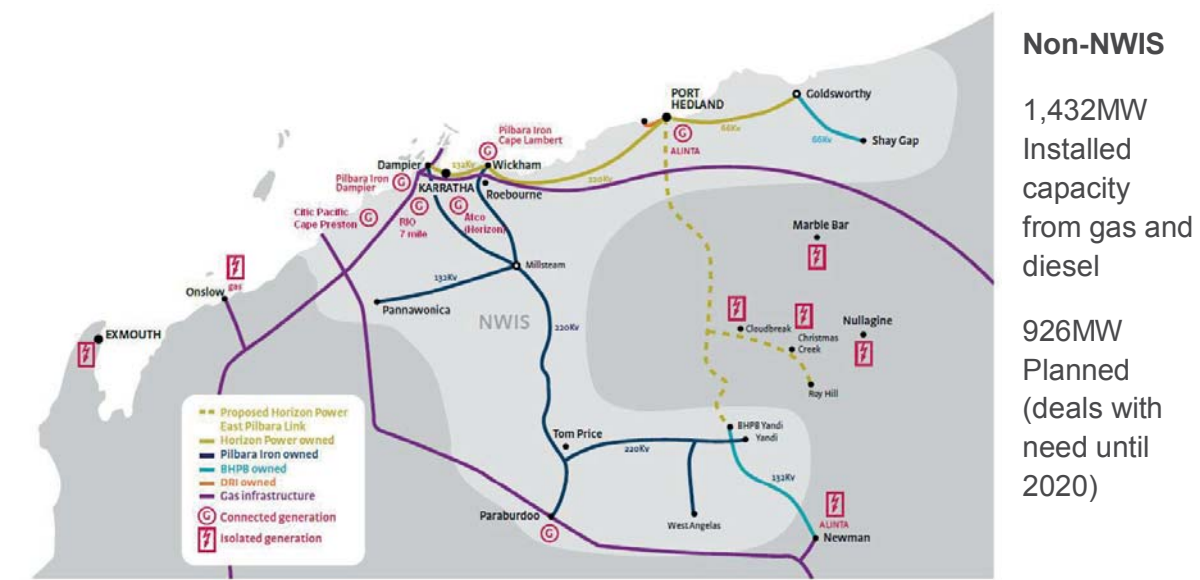


Figure 31: Existing power & gas infrastructure in the Pilbara (Evans & Peck, 2011)

Australian iron ore price forecast (BMO Capital Markets 2013)

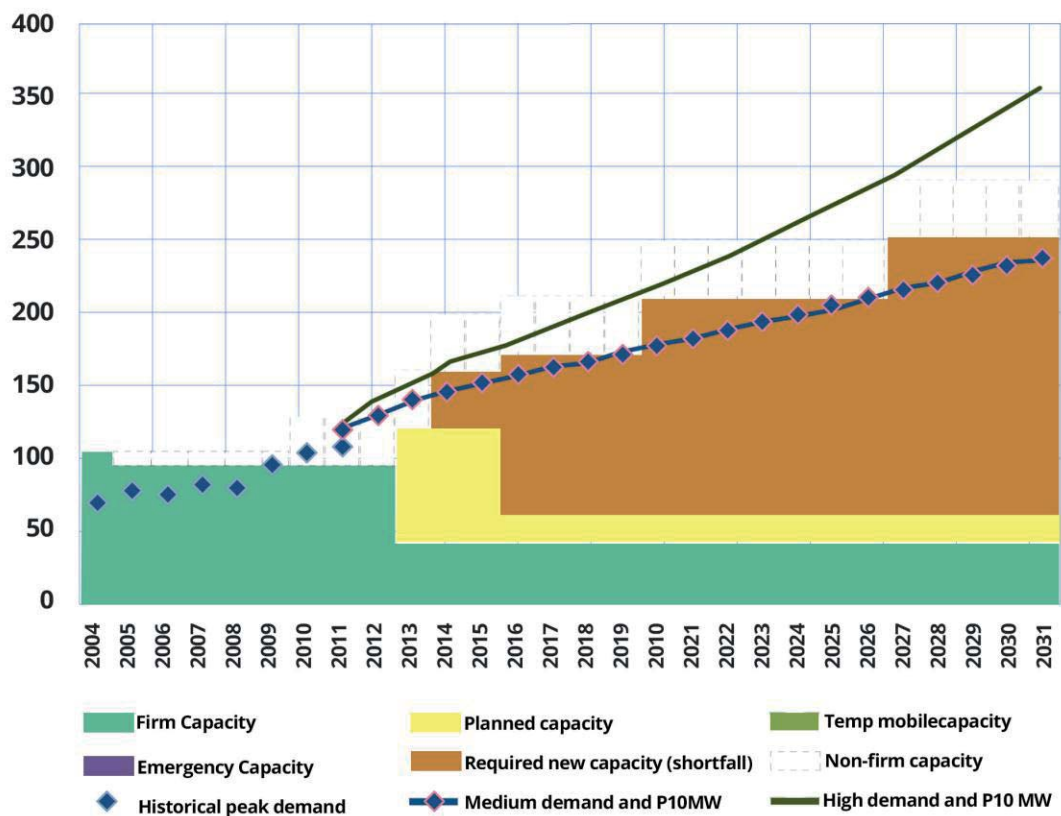


Figure 32: Indicative demand forecasts: NWIS summer peak load trends (Shire of Roebourne 2013B)

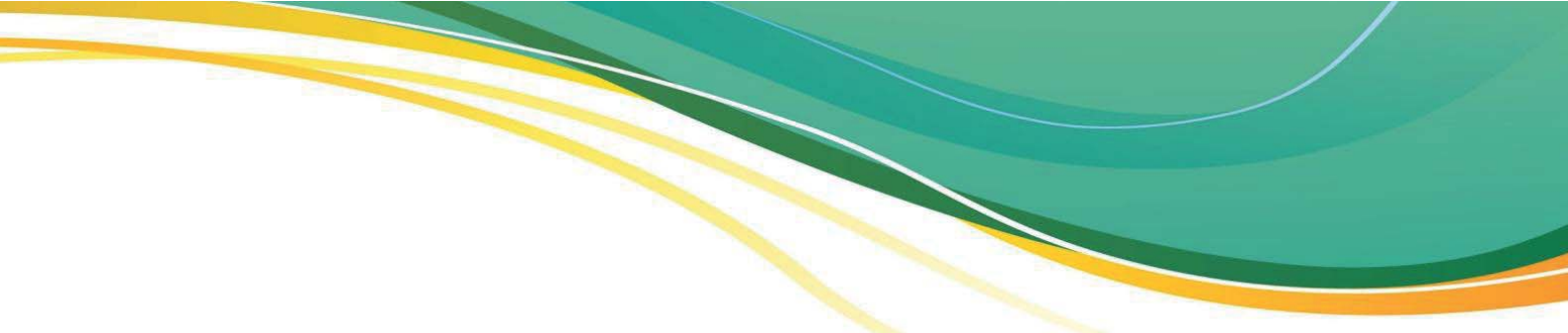
NWIS needs investment based on current demand

Horizon Power is installing a 67MW gas power station in South Hedland which is due to be operational in 2014 to ensure demand is met until 2016 based on current growth projections.

A major energy infrastructure project worth \$100 million is underway and due for completion in 2014 in Karratha, which involves the transition of overhead electricity wires underground (Horizon Power, 2013). This will improve the reliability of domestic and small industrial power supply in a cyclonic region. In addition, a new 60MW power station is being constructed in South Hedland to cater for the substantial growth and development of the area. This responds to the findings in the RDAP 2012 Investment Prospectus report found that an immediate additional supply source of at least 100MW is required to meet short-term demand through to 2015 (Regional Development Australia: Pilbara (RDAP), 2012b).

Medium term demand, estimated to be in the order of 350MW, will require further investment of at least \$930 million in power generation (Regional Development Australia: Pilbara

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(RDAP), 2012b). For the transmission system upgrades and interconnections to meet the short and medium term demand, the investment required is estimated at \$760 million (Regional Development Australia: Pilbara (RDAP), 2012b).

Pilbara Power Project Board

The WA Department of Finance has established a Pilbara Power Project Board to support development of a whole of government solution to addressing future power supply requirements in the Pilbara Region (Shire of Roebourne, 2013b). The WA government, via the Pilbara Power Project Board, is working to develop a solution to meet shorter and longer-term generation capacity requirements of Horizon Power (and potentially other mining loads in the Pilbara Region) while also minimizing the effect of these arrangements on State debt. The Project Board comprises representatives from the Departments of Finance, Treasury, State Development, the Pilbara Development Commission and Horizon Power and was established in 2012. The Project Board is also overseeing the development of a Temporary Generation Supply Project to meet Horizon Power's additional generation capacity requirements over 2014 and 2015.

Energy for LNG

For the non-NWIS, by 2020, approximately 1GW will be generated for the dedicated use of LNG production. However, it needs to be considered whether the energy used for LNG production be thought of separately to a broader interconnection project.

Energy for transport

In addition to the non-NWIS figures below, great quantities of diesel (approximately 1.5GW of installed capacity) are used to power trains to bring iron ore to ports from the mines. 46% of the overall energy used in mining in the Pilbara is for transport (ACIL Tasman, 2012), representing considerable volumes of diesel as well as the associated carbon emissions.

Energy for iron ore

Iron ore is generally classified by its iron content into two categories: hematite and magnetite. The level of processing necessary for shipment of ore determines the energy intensity of the end product. In general, hematite ore tends to be less energy intensive due to lower levels of impurities, while magnetite contains higher levels of impurities, and thus requires more processing and energy by a factor of 10 (ACIL Tasman, 2012). Over 96% of the ore mined in Australia is hematite. In fact, the Pilbara region is host to one of the largest deposits of hematite ore in the world, after Brazil.

Although current energy intensities are low for mining operations in the Pilbara, worldwide and Australian trends have shown decreasing levels of hematite production as current reserves deplete. This has caused a shift in ore extraction towards magnetite mining. In fact, a number of new mining projects in the Pilbara region are designed for magnetite mining with estimates of magnetite mining capital investment around \$18 billion (ACIL Tasman, 2012).

To ensure LEV of the Pilbara, the non-NWIS and NWIS requires unified governance

The idea of a fully interconnected grid in the Pilbara has been around for decades, and has been endorsed by a number of regional stakeholders (e.g. Horizon Power, Citic Pacific⁶, Worley Parsons) as well as Infrastructure Australia, but still hasn't happened. Energy intensities and overall energy consumed would reduce if an integrated transmission network could be established; and a new coordinated governance framework is developed and adhered to (The Allen Consulting Group, 2008, Sinclair Knight Merz, 2012, Worley Parsons, 2008). The investment required for connecting the NWIS with the non-NWIS has been estimated to be upwards of \$600 million (RDAP, 2012a). The keys barriers to upgrading the system (both in terms of infrastructure and governance) have been the difficulties of coordinating competing commercial interests, and the subsequent delaying of long-term decision making (Shire of Roebourne, 2013b). RDAP noted in their *Pilbara Report 2012* that 'The Office of Energy, Department of State Development, and Horizon Power, in cooperation with the private sector must develop a long-term (post 2013) power supply strategy for the Pilbara, based on market principles' (RDAP, 2012a). The analysis conducted in this report supports the prompt development of such a strategy, with the creation of a Pilbara Energy Corporation (Sinclair Knight Merz, 2012).

There is currently a significant amount of under-utilized and standby generation capacity in the Pilbara resulting from the number of self-generation facilities without network connection (SKM, 2013). If assets from natural resource producers could be accessed to make more efficient use of existing capacity, less new dedicated government and private sector infrastructure-based generation investment would be required. The implementation of an integrated power supply network would also mitigate future constraints on marginal costs of production when commodity prices are volatile. Although these marginal costs are passed onto the customer, natural resource producers in the Pilbara would be in a relatively better position than their international competitors.

Although upgrades are needed to address the immediate energy shortage on the NWIS, the *Pilbara Report 2012*, the SKM report of 2012 and a host of other studies, show a greater investment in energy infrastructure is required to meet the significant domestic and small industrial growth demanded for the region (Regional Development Australia: Pilbara (RDAP), 2012b, Sinclair Knight Merz, 2012, Shire of Roebourne, 2013b). This is the case, particularly if the region is serious about creating the preconditions necessary to facilitate material economic diversification and ensure its long-term economic viability (LEV).

⁶ See Citic Pacific Mining submission:
http://www.infrastructureaustralia.gov.au/public_submissions/published/files/335_citicpacificminingmanagement_SUB.pdf

Greenhouse gas emissions

Western Australia's greenhouse gas (GHG) emissions are approximately 80 million tonnes per annum (see Figure 33).

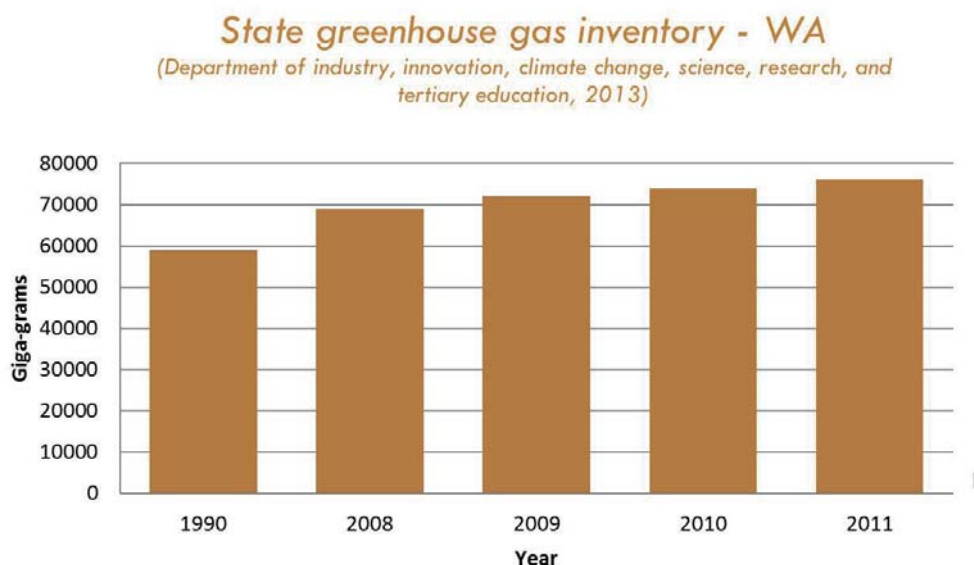


Figure 33: State greenhouse gas inventory - WA (Department of industry, innovation, climate change, science, research, and tertiary education, 2013)

The Pilbara's GHG emissions make up approximately one third of the West Australian total at 25,000,000 tonnes per annum (see Figure 34 for a breakdown of emissions per major resource project).

Current Major Greenhouse Gas Emitters: Pilbara

Location	Company	Forecast Scope 1 GHG Emissions C02e	Total	Source
North West Shelf LNG	Woodside Energy Ltd	8,229,511	8,229,511	NGER 2010-11
Alinta Gas reticulation /power gen	Alinta Energy	3,687,078	3,687,078	Est. NGER 2010-11
Burrup Ammonia Plant	Burrup Fertilisers Pty Ltd	1,484,877	1,484,877	NGER 2010-11
North West Shelf: Varanus Island Hub	Apache Northwest Pty Ltd	671,471	671,471	NGER 2010-11
Telfer Project	Newcrest Mining Ltd	674,566	674,566	NGER 2010-11
Pilbara Iron Ore & Infrastructure Project: East West & Mine Sites (Stage B)	Fortescue Metals Group Ltd	643,500	643,500	EPA Bulletin 1202
Browse Basin Prelude FLNG	Shell	2,300,000	2,300,000	Draft EIS
Onslow Ashburton North (Scarborough) LNG	BHP Billiton	3,000,000	3,000,000	Estimate based on production
Burrup Peninsular Pluto	Woodside	4,100,000	4,100,000	EPA Bulletin 1259 and press
Horizon Power	Horizon Power	328,261	328,261	Horizon Power 2012
Total			25,119,264	


Figure 34: Current major greenhouse gas emitters: Pilbara (Chapple, 2012) and Horizon Power (2012)

Future Major Greenhouse Gas Emitters: Pilbara

Location	Company	Forecast Scope 1 GHG Emissions C02e	Total	Source
Gorgon Gas (Barrow)	Chevron Australia	10,328,000	10,328,000	EPA Report 1404
Onslow Wheatstone	Chevron Australia	12,000,000	12,000,000	Browse LNG strat assessment report
Cape Preston iron ore and downstream	Mineralogy Pty Ltd	2,700,000	2,700,000	EOA Report 1340 Higher estimate in GHG mgmt plan
Cape Preston Central Block Sino Iron	Sino Iron (CITIC)	5,558,000	5,558,000	EPA Bulletin 1056
Browse upstream Brecknock, Calliance and Torosa	Woodside Energy Ltd	1,114,430	1,114,430	Draft upstream EIS
Timor Sea, Sunrise gas	Woodside Energy Ltd	1,800,000	1,800,000	Press reports
Jack Hills magnetite	Crosslands	1,738,586	1,738,586	Public environmental review
Total			35,239,016	

Adding in future infrastructure in the Pilbara will more than double the GHG emissions of the region (see Figure 35).

Figure 35 Future major greenhouse gas emitters: Pilbara (Chapple, 2012)



As global pressure to reduce carbon will inevitably grow it will be to the Pilbara's advantage if it can begin to show how it is going to decarbonize its industrial base. This can be a major source of new business in itself as well as providing large cost savings to the resource industries.

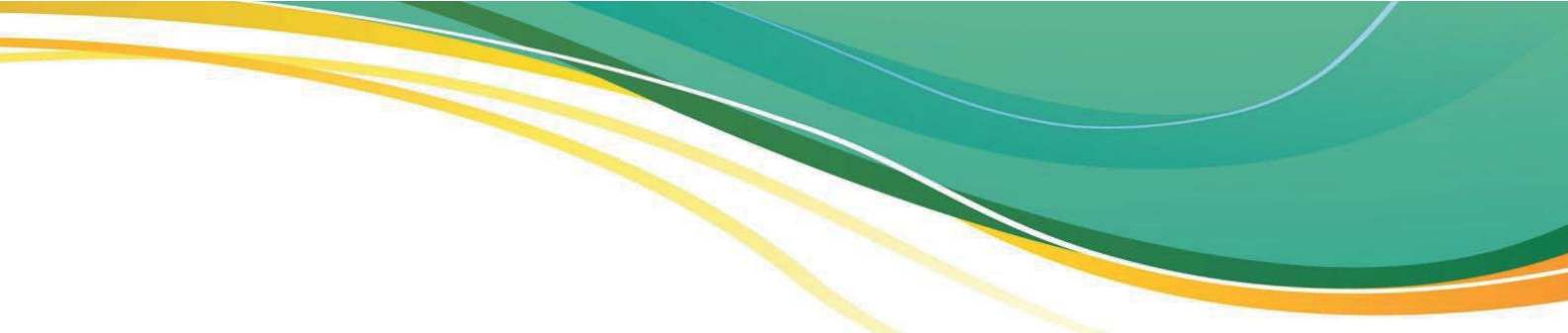
A holistic energy system in the Pilbara

Views about the potential for a fully interconnected grid vary. One person interviewed for this report said: 'there is a zero percent chance the mining companies will share their electricity infrastructure'. Another said: 'it's not the role of government to get involved in this. The Pilbara is a quarry, let's not try and make it anything else'. Another person said 'this can and should happen, it's an idea whose time has come'. These comments are perhaps illustrative of the diverse views that exist, and highlight concerns that would need to be addressed.

Arguments against a fully interconnected grid in the Pilbara

- Some mining companies stand to gain and lose more than others from sharing essential infrastructure such as rail and electricity transmission lines⁷. Understandably some companies would not want to share their fuel cost (gas) savings with their competitors via a grid. Any program of work to integrate the energy infrastructure would therefore need to offer quid pro quo benefits to the individual players for their contribution.
- Presently, iron ore production energy inputs account for approximately \$5 (gas) and \$9 (diesel) per tonne, and are sold at about \$115-120 a tonne. Natural resources companies have argued that potential power savings are not material compared to other costs, but as has been evident in the public conversation about the introduction of a carbon tax, the mining companies fought vehemently against the introduction of a tax that would add an equally immaterial cost to the cost of production. Resources companies tend to argue that the same costs are both material and not material. This report therefore concludes that reducing energy costs is of material concern to resource companies.
- Reliability of power supply is presented as a reason against energy infrastructure sharing. Resource companies present this as a risk management strategy: that they need an uninterrupted power supply and if this was relegated to a third party, there is a business continuity risk. This report concludes that while continuity of supply is required, in the West Australian market, reliability of supply can be ensured and therefore this concern could be addressed.
- Another argument against creating an integrated power grid is that this idea could have worked 5-10 years ago, but now the major resource companies have constructed their own generation and transmission assets, so it's not needed.

⁷ See for example: <http://www.ncc.gov.au/images/uploads/DERaFoTD-002.pdf>



Although this is in part true, as many assets have indeed been constructed, they could still fit into a strategic infrastructure framework (managed by a market entity such as a Pilbara Energy Corporation), and deliver the same commercial benefits to their current owners, whilst providing wider benefits to the region.

- According to the 2012 SKM report (Sinclair Knight Merz, 2012), sensitivity to electricity costs are usually related to the proportion of total expenditure it represents. Therefore, due to low energy intensity of hematite mining, electricity costs currently have a low impact on mining activity in the Pilbara. According to SKM, this gives mining companies somewhat lesser incentive to initiate or even participate in the development of a more efficient electricity system. SKM's analysis however, does not factor in the energy costs relating to transportation. In spite of their view, SKM also note that an integrated power supply network is expected to provide a more cost effective solution to magnetite mining operations in the Pilbara (Sinclair Knight Merz, 2012).

Arguments for a fully interconnected grid in the Pilbara

- Creating an interconnected grid would reduce the cost of production for natural resource companies and form an opportunity for other industries to establish themselves in the Pilbara. The majority of diesel power generation could be replaced with gas and renewable energy.
- All open pit mines could sustain a substantially longer mine life as a result of electrification of the pits. This is because, as an open mine develops, the strip ratio of ore to waste rock declines, increasing the cost of production and cash costs. Electrification of the machinery and processes would significantly reduce these costs, thus making it economically viable to extract ore from pits for longer periods (Hammond, October, 2013).
- Rail, which is currently entirely powered by diesel, could instead be powered by gas and renewables, significantly reducing transportation costs, both due to fuel switching and reductions in energy use due to lower power demand from using a different regenerative braking system (Milligan and Newman, 2010) which could actually generate power for the grid as trains head over escarpments to port facilities.
- Producers that currently have the best quality assets stand to create another revenue stream and reduce their operating costs.
- Producers with the lesser quality assets stand to reduce their operating costs and de-risk their operations.
- Another benefit to the mining companies in reducing their operating expenditure is having an improved standing with credit ratings agencies. With high price forecasts for input fuels, reducing overall costs and energy intensity provides an opportunity to improve credit ratings.
- An interconnected system would allow ramp-up of production to be handled more productively, responding dynamically to increases in commodity prices without exponentially increasing operating costs.

- Although the future of Australia's emissions trading scheme is unclear, in the case of it continuing, or in the case of Direct Action legislation being passed, the largest emitters will be expected to reduce their energy intensity. An integrated grid and electrification of the rail provides the most cost effective way to achieve this.
- Natural resource companies have an opportunity to strengthen their brand, and improve their reputation with stakeholders, NGOs and the media, by establishing a cooperation agreement that would have landmark results in the Pilbara and Australia in facilitating economic diversification, improving the regions productivity, and substantially reducing GHG emissions intensity in real terms.

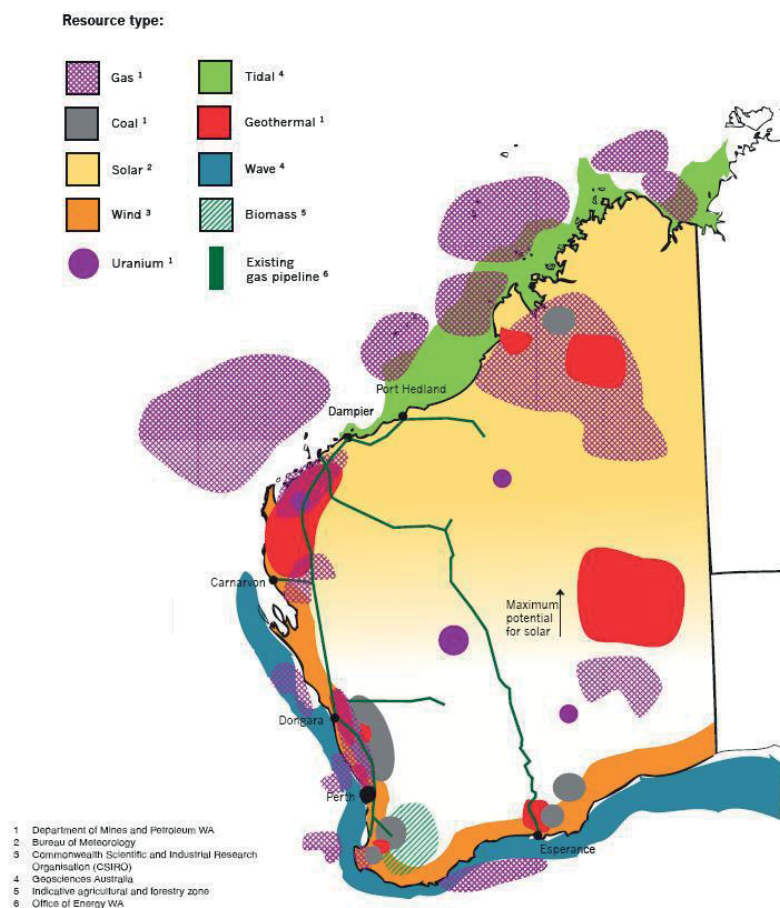
Therefore, the primary call to action is to fast track the creation of a coordinated and integrated power network in the Pilbara, with a holistic governance framework that has long-term planning capabilities. ACIL Tasman have flagged that while an integrated power network would be desirable, it would be impractical without an adequate supply of gas (Chatfield, 2012). This is because despite the Pilbara exporting enormous quantities of LNG to the rest of the world, domestic and commercial gas supply within the region is insufficient, and therefore relatively expensive (Chatfield, 2012). The assumption here though, is that an integrated power network would be powered entirely by gas into the future. As demonstrated below, however, renewable energy offers genuine potential now as a commercially viable strategy, and should be viewed as a legitimate and substantial contributor to power generation in the region. Therefore, an integrated power network could rely on a mix of energy sources, rather than being entirely dependent upon gas supply.

This report concludes that the current primary issue is the political commercial separateness of the big players, who would need to cooperate and see beyond their own narrow self-interests, in order to receive greater benefits for themselves. Therefore, in order to make this happen, it will be necessary to broker a deal that would see those stakeholders with the most infrastructure receive a quid-pro-quo benefit for their contributions to a fully interconnected system.

The potential for renewable energy in the Pilbara

Renewable energy does not feature strongly or specifically in the Pilbara Cities Vision or in the long term strategic planning for the area. This is despite the region possessing a number of natural assets such as abundant tidal movement, sunshine, and geothermal energy (see Figure 36). The focus on the non-renewable commodities in the Pilbara has meant that investment has not occurred in the renewable energy sector. An extensive 2011 report created by Evans & Peck assessed the commercial viability of increasing the renewable energy production in the Pilbara (Evans & Peck, 2011). The report found that wind power generation was already a cost-effective investment. According to Evans and Peck, solar power, however, was expected to be a more likely investment in the Pilbara, due to its simplicity and familiarity. The report argued that for electricity generation, 'solar PV is technically proven but relatively expensive and solar thermal has the capacity to deliver high quantities but would best do so in a grid context' (Evans & Peck, 2011).

In addition to growing energy demands from the population centres, the region requires enormous quantities of energy to carry out mining, oil and gas operations, and transport ore to ports. Much of these operations currently run on fossil fuels, predominantly diesel. One 2009 report coming out of Curtin University in Perth, argues that this reliance on fossil fuels



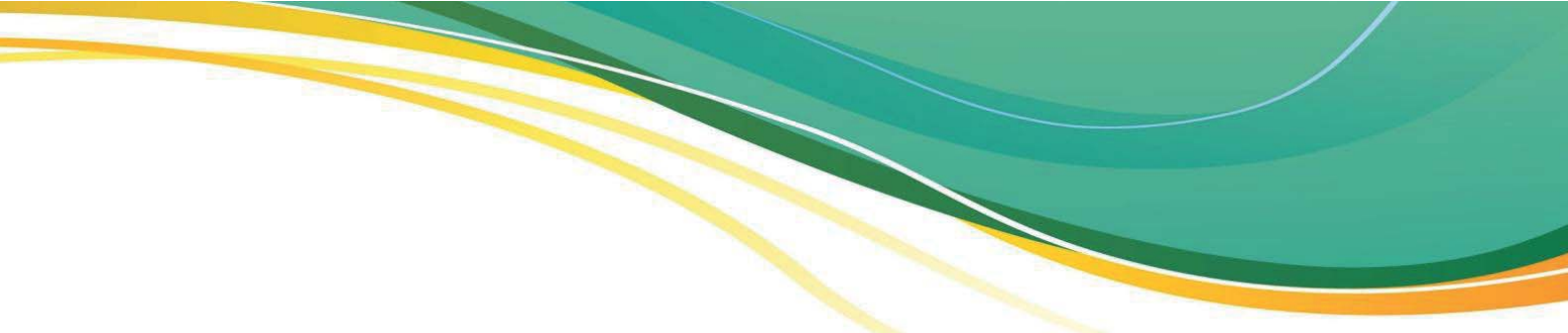
for mining is unnecessary, and that some industry can be virtually 'de-oiled' in the medium to long term, while simultaneously cutting operating cash costs by more than 20% (Milligan and Newman, 2009). This could occur using a variety of approaches including, but not limited to, the effective utilization of existing and proven private sector knowledge and university research (Milligan and Newman, 2009). The authors note that this transition is not only possible, but is required, to protect the region's major industry from the impact of climate change and increasing energy scarcity.

Figure 36: WA Renewable energy source locations (Office of Energy 2011)

Energy wholesalers purchasing large volumes of energy (>100 MW capacity) are currently required to purchase Renewable Energy Certificates (RECs) through the federally funded Clean Energy Regulator.

This is becoming an incentive for some generators in the Pilbara to install solar generation, which costs approximately \$350/ MWh (cost of diesel plus \$40 for the cost of the REC). Some companies are considering installing PV to hedge against rising diesel prices, which currently costs about \$300/ MWh to produce, but is predicted to increase (Evans & Peck, 2011).

RECs are one of the policy tools being used to achieve Australia's Large-scale Renewable Energy Target (LRET). This target is only just becoming an incentive for some larger generators to install renewable electricity generation in some mining areas in WA and it



currently does not apply to smaller generators. Up until now, liable entities have been simply buying RECs from renewable energy created elsewhere and smaller non-liable entities have not been required to participate at all. Lowering the RET liability threshold may be one mechanism to take a more strategic and integrated approach to renewable energy planning in the Pilbara.

One of the barriers to investment in renewable energy is the widespread concern about the reliability and capacity of alternate power sources. This has led to a situation where renewable energy is often mentioned briefly in strategic plans, with the promise to investigate potential further. As the Evans and Peck report suggests, however, there are a number of renewable energy sources which are already commercially viable, represent a low operational risk, and could therefore reduce the strain on the current system when it is experiencing peak loads (Evans & Peck, 2011)

The development of industry around renewable energy generation represents a strong opportunity for economic diversification. Renewable energy tends to have higher employment associated with it than fossil fuels (Clean Energy Council, 2013). For this to be fully realized though, renewable energy needs to feature in government planning and objectives. The development of alternative energy industries including: biofuels, algae production, and alternative energy production methods, could therefore develop alongside goals for greater economic diversification. Potential projects seeking funding would benefit from framing their argument in terms of contributing towards providing a stable energy source and facilitating economic diversification.

Energy Efficiency Opportunities (EEO) program

Until 2014, an Australian Government initiative, the Energy Efficiency Opportunities (EEO) program, mandates cost effective energy efficiency measures amongst major energy users of more than 0.5 peta joule of energy annually, such as large scale mining, oil and gas companies. The program has created \$800 million a year in savings, which represents 1.5% of Australia's total energy use (Department of Resources Energy and Tourism, 2013). While initiatives like this are important in reducing emissions, they incentivize incremental changes and improvements on a business as usual basis. They do not provide a strategic transition plan to move away from non-renewable energy sources like the one proposed and outlined by the Curtin University's 'De-oiling the Pilbara' study (Milligan and Newman, 2009). The EEO program also fails to provide incentive for holistic and integrated energy transition, as it does not encourage cooperation amongst companies, something that would be crucial to reducing emissions and improving efficiency of existing resources.

Bigger energy futures for the Pilbara

Ideas around European and Asian super grids have been touted for decades (see Figure 37 for a visual representation of the idea). The proposition for an Asian super grid is one that has been attracting growing attention (Campbell et al., 2013). Certainly, given the high quality solar radiation that the Pilbara receives, it would make renewable energy for such a

project a viable candidate. This kind of economic activity has the potential to create a long term and sustainable future for the Pilbara.

In conclusion, the major facilitator of the LEV opportunities identified in this paper, and the first step in creating the potential for a Supergrid in the future, is the integration of the NWIS.

To optimize the economic diversification potential and renewable energy potential in the Pilbara requires a holistic, long-term transition plan for creating an interconnected transmission network and moving away from non-renewable energy, which will become more expensive and scarce within a matter of decades.

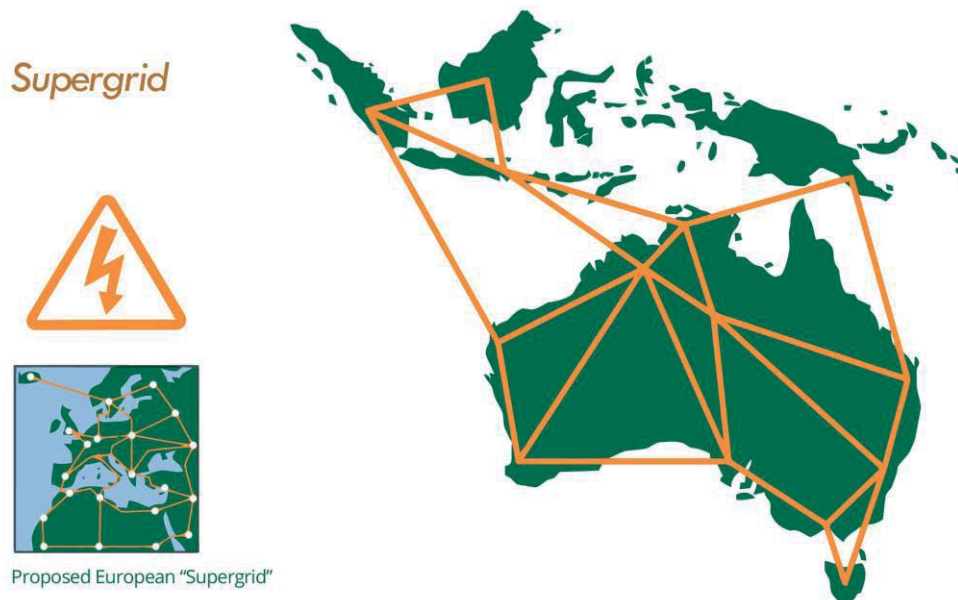


Figure 37: Supergrid (www.ecoscape.com.au)

Carbon utilization for creating hydrocarbons

Finally, known carbon utilization technology, with further research, could provide a significant use for carbon dioxide to reverse engineer it to make hydrocarbons. Research so far conducted by reputable research centres around the world, has shown this potential for utilizing waste carbon dioxide. The industrial process uses carbon dioxide, rare earth minerals and a direct catalytic conversion with concentrated solar power (CSP). In a similar way to how California created a technical research hub which resulted in the famed 'Silicone Valley', the Pilbara, given its carbon intensive industries, could turn this to its advantage and become a research hub for carbon utilization to find alternative uses for this material.



SWOT Analysis: Energy in the Pilbara

Strengths

- Substantial renewable potential.
- Significant installed generation capacity.
- Significant indigenous fossil fuel available in the region (LPG, natural gas).

Weaknesses

- Large geographical distances.
- Small population centres.
- Reliance on imported diesel.
- Large operators have narrow focus.
- Carbon intensive industrial base.

Opportunities

- Reduce energy risk to current and new operators.
- Pilbara cities program (investment incentive).
- New industry development.
- Emerging renewables industry.
- Electricity transmission network.
- Co and tri generation.
- Risk sharing.
- Fuel supply swapping.
- Carbon utilisation research and pilot projects.

Threats

- Lack of cooperation of big commercial players.
- Increasing energy costs due to scarcity of easily accessible resources.

Figure 38: SWOT analysis: energy in the Pilbara



Chapter 3: Boom vs. bust and the mathematics of infrastructure

California & Norway versus Yunnan: Canada & Australia's ghost towns

As discussed in the introduction, boom growth in a mining country can have serious long-term implications, especially when the boom is faster than the ability to develop infrastructure to service it properly.

History shows that, a couple of decades after a classic mine-and-boom phase, one of two things happens:

1. Geiju, Yunnan-style decline into ghost town and tumble weed; or
2. A Californian and Norwegian-style evolution into multiple but related industries.

What will happen in the Pilbara?

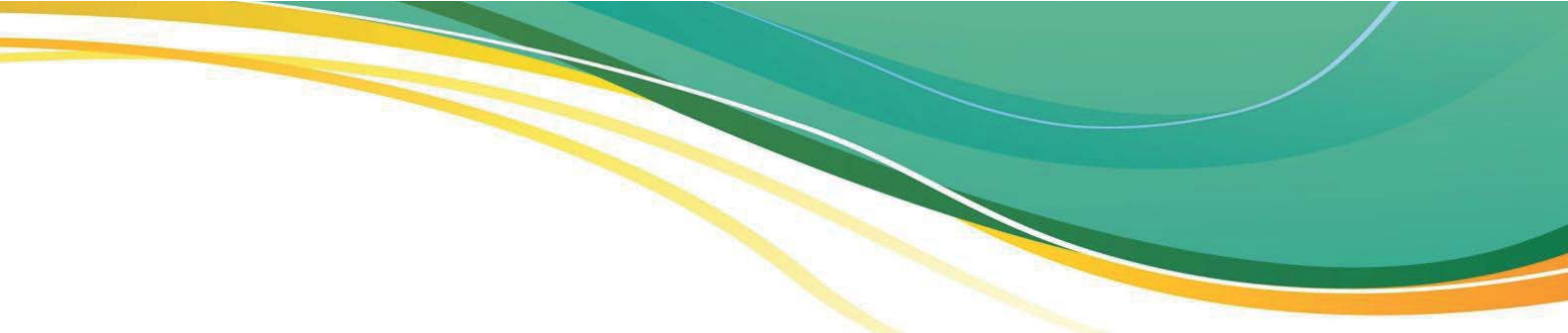
This report argues that the difference between going down route one and route two is something that can be determined by forward-thinking and planning. By forward thinking and sound planning, route two can be secured.

The below case studies show the divergent paths two places can take, depending on the type and timing of infrastructure development.

Lessons in leaving diversification until it's too late

Geiju, Yunnan: Ore companies began to lay off employees in the 1990s as production and resources dwindled. By 2008 the area's tin reserves had largely been exploited. The Chinese government estimated 90 percent of Geiju's ore had been mined and the remaining ten percent would take only three to five years to extract. Unemployed miners today number in the tens of thousands. Failed efforts were made to rehabilitate the most derelict parts of the city. The government also poured money into social programs. As of 2008, almost 50,000 people, one-eighth of the city's population, were receiving government assistance money.

Western Australia: Is littered with more than 87 ghost towns, the rest of Australia having just 75 combined (No author, 2013a). Dozens of Goldfields towns were developed and then died in the late nineteenth century. Throughout the rest of Australia, a tale of rise and decline in mining towns can be seen, where towns such as Broken Hill and Mount Isa, that did not diversify and have been in a state of decline since, now have population growth rates significantly slower than those of Australia as a whole (Ville, October, 2013).



Canada: The Canadian province of British Columbia has hundreds of ghost towns, which speak of an important history with lack of economic diversification. They include the pioneer coal mining communities of the Crowsnest Pass in the province's mountainous southeast, to the silver mining towns of the Valley of the Ghosts, to the copper producing communities of the Boundary Country, and to the gold mining towns in the Bridge River Valley, Caribou Country and Vancouver Island. B.C.'s ghost towns also lay in the province's far north. Some ghost towns lasted until recent years, with the Giant Mine Town Site ceasing operations along with the town in 2004. Phoenix, B.C., was once a bustling copper-mining town of more than 5,000 people, complete with an opera house, but in failing to diversify, the town disappeared in 1919.

California: In the case of California, there was a recognition that they couldn't stay where they were, and they therefore built something new, while the going was good.

California's economy became prominent in 1848 with the discovery of gold. This was quickly followed by gas in 1850. Rail and port infrastructure was built around this, along with a shipping industry. The influx of people triggered the expansion of the agricultural industry. As the natural resources boom dried up, the transport infrastructure was used to deliver food and agricultural products around the US and across the world.

In the 1910's, sparked by a backlash against the monopolistic film industry in New York, Hollywood was established and by 1930 it was the focal point of the US and the world. Around 1940, a nascent airline industry boomed, along with the shipping industry, in preparation for war efforts. Over 1.9 million new residents arrived between 1940 and 1945. Manufacturing employment increased from under 400,000 in 1939 to over 1,000,000 by 1943. This infrastructure saw California grow and prosper in a booming post-war economy. The industrial development of this era also laid the groundwork for California to become a leader in several high technology fields later in the century. In 1950, high technology companies in Northern California began a spectacular growth that continues to this day.

The adoption of a Master Plan for Higher Education in 1960 allowed the development of a highly efficient system of public higher education, and by creating an educated workforce it attracted investment, particularly in areas related to high technology. By 1980, California was recognized as the world's 8th largest economy. Thus, California entered the millennium as the world leader of emerging industries that will be centre stage in the economy of the future.

Norway: tells a similar story of successful economic diversification but using a distinct approach. See the SWOT analysis of the Pilbara in Chapter 1 of this report for more details.

Lessons from Krugman and Porter's work: infrastructure as a catalyst for economic diversification

Why are infrastructure benchmarks important? This paper argues that vital infrastructure is a precondition to crucial secondary and tertiary industry and a diverse community. They allow for stabilization and maturation of a city. For example, California has high-tech and no more

gold. Yunnan simply has high unemployment and no more tin. The difference may well have been their ability to plan for diversification of industries, which then become self-sustaining.

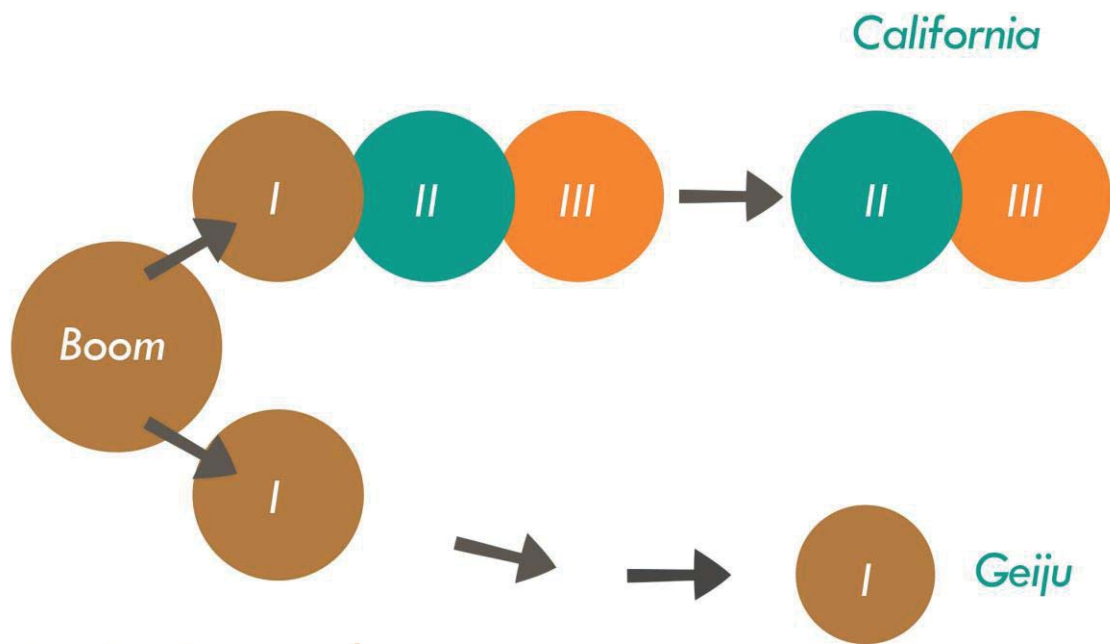


Figure 39: Boom or bust

Figure 39 shows how when a boom dries up what's often left is the secondary and tertiary infrastructure. This can be enough to sustain a city, but only if such infrastructure has already been created. The diagram shows the tales of two cities, that either grows then shrinks, or grows and multiplies. The difference is the *choice* of investment. This report argues for shared essential services, such as energy and trains, as well as electrification of the rail. Incentives can then be put in place so that base or driver industries can be established and built to scale at a pace that supports economic diversification.

Presently, the Pilbara is an iconic monoculture economy derived from natural resources. This can be seen both in terms of economic output and employment in Figures 40 and 41 below.

Pilbara output by industry




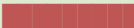















Industry	Output \$M	
Mining	\$47,499.278	
Construction	\$6,004.931	
Manufacturing	\$1,642.907	
Rental, Hiring & Real Estate Services	\$1,008.360	
Transport, Postal & warehousing	\$994.050	
Accommodation & Food Services	\$421.165	
Professional, Scientific & Technical services	\$413.284	
Administrative & Support Services	\$352.486	
Electricity, Gas, Water & Waste Services	\$287.117	
Public Administration & safety	\$279.651	
Wholesale Trade	\$247.196	
Education & Training	\$203.684	
Health Care & Social assistance	\$187.481	
Other Services	\$175.697	
Retail Trade	\$151.376	
Financial & insurance Services	\$97.306	
Information Media & Telecommunication	\$55.511	
Agriculture, Forestry & Fishing	\$40.842	
Arts & Recreation Services	\$19.332	
Total	\$60,081.655	

Figure 40: Pilbara output by industry (Pilbara Development Commission 2012a)

Pilbara Employment by Industry

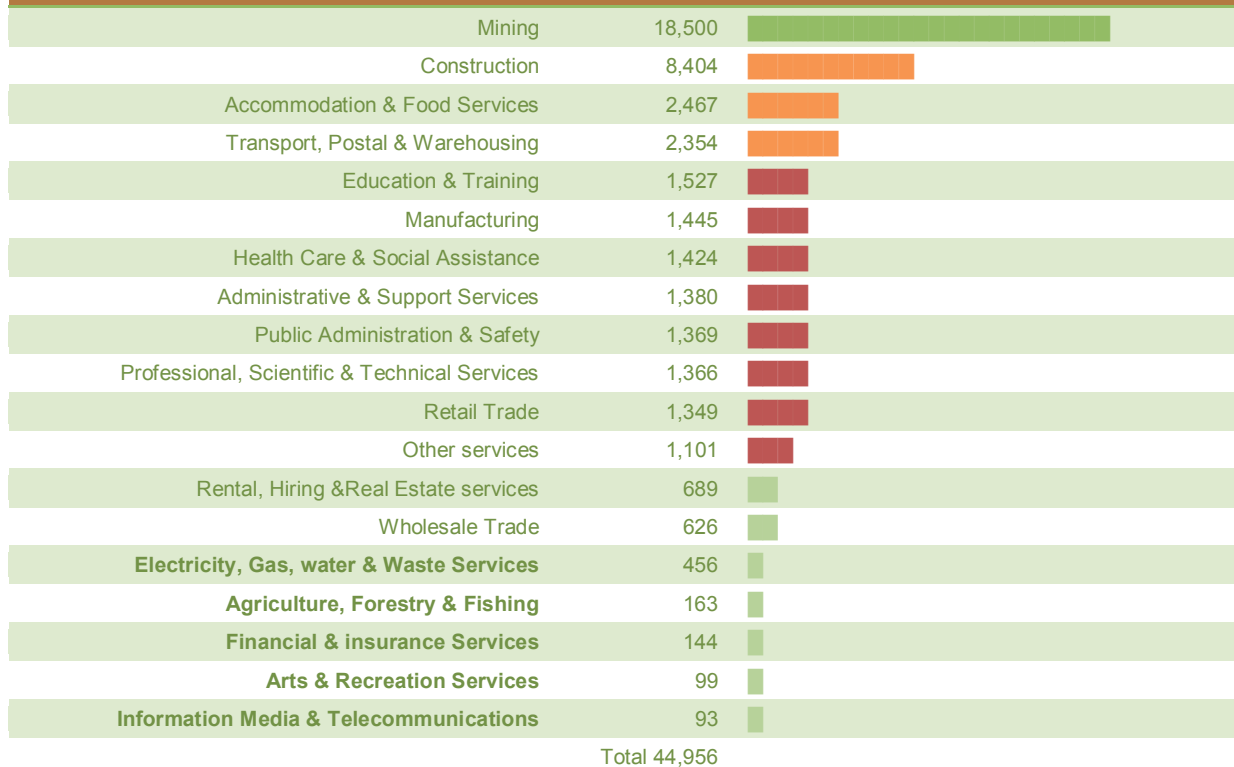
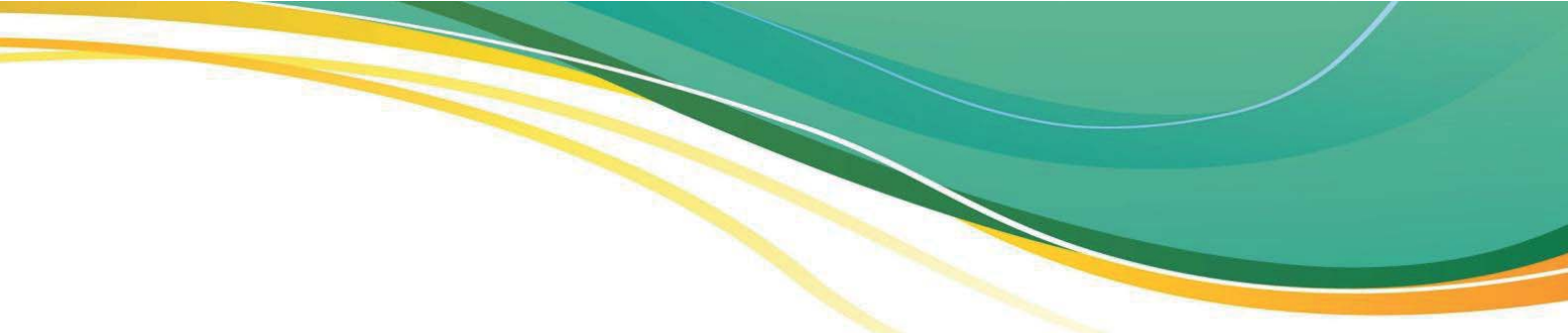


Figure 41: Pilbara employment by industry (Pilbara Development Commission, 2012a)

There have been countries and regions that have lived and died by one product (for example: Detroit, Glasgow, Liverpool). Until they failed, anything but success seemed an impossibility. Can the Pilbara survive on the iron ore and gas industries alone?

The obvious project for the Pilbara is to facilitate the growth of a related ecosystem in order to avoid the ghost town scenario. Krugman and Porter's analysis explains why towns become a collection of industries around a theme. For example: Detroit /cars, New York City/finance, Hollywood/movies, Silicon Valley/technology, Washington & Brussels/politics. Their infrastructure makes them efficient and once it has grown organically, it provides them continued efficiency and therefore price advantage.

Krugman shows how a country can endogenously become differentiated into an industrialized *core* and an agricultural *periphery*. In order to realize scale economies while minimizing transport costs, manufacturing firms tend to locate in the region with larger demand, but the location of demand itself depends on the distribution of manufacturing. Emergence of a core-periphery pattern depends on transportation costs, economies of scale, and the share of manufacturing in national income (Krugman, 1991).



The Pilbara's natural advantage of being close to Asia is one of its relative strengths for iron ore and gas production. This could also be one of its relative points of strength in developing other industries. Higher transportation costs act against regional divergence. With lower transport costs, and a higher manufacturing share than other regions, Krugman finds that 'causation sets in' meaning that manufacturing will concentrate in this area (1991). The model doesn't address other economies on a standalone basis, rather, factors them in via transportation costs. Therefore if the Pilbara develops a manufacturing base, it can profit from the advantage of its closeness to Asia relative to other parts of Australia and many other Asian countries.

Krugman's clustering model found that 'first, the concentration of several firms in a single location offers a pooled market for workers with industry-specific skills, ensuring both a lower probability of unemployment and a lower probability of labour shortage. Second, localized industries can support the production of non-tradable specialized inputs. Third, informational spill-overs can give clustered firms a better production function than isolated producers' (Krugman, 1991).

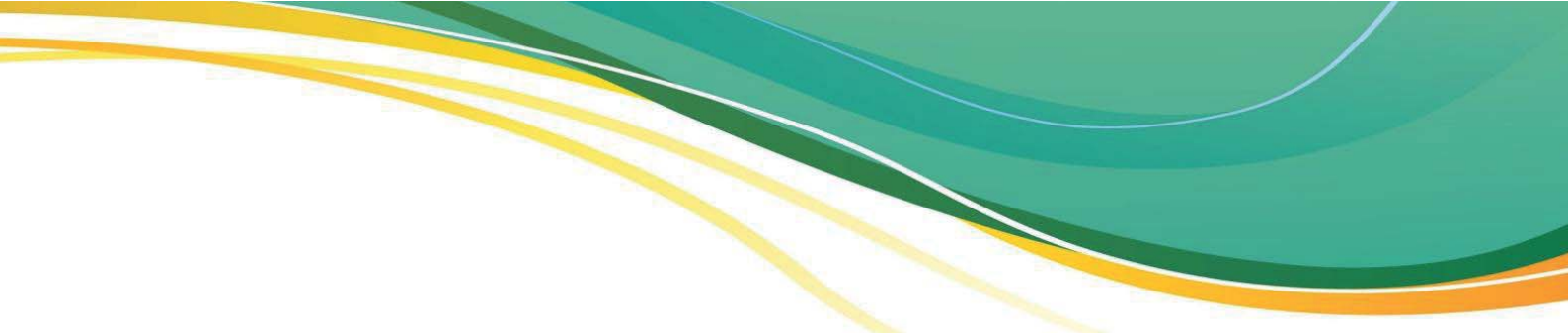
Successful clusters are highly specialized: Tainan Science Park in southern Taiwan, for example, developed on the back of liquid crystal technology. Bristol's so-called 'Silicon Gorge' in the UK evolved around microchips. Once a specific focus emerges, governments need to identify it, and then work to remove any barriers to competition.

Governments can do much to create an attractive business environment (and a good place to live). Easing planning rules, tweaking the tax code, removing penalties for failure, smoothing visa and immigration processes, ensuring intellectual property (IP) protection are all examples of what governments can and must do to support cluster development. Some take extreme measures: Russia's new Skolkovo cluster is developing its own legal framework, distinct from the state, to encourage its development. What shouldn't be forgotten is the importance of also ensuring a good quality of life for prospective employees, to support efforts to attract and retain talent.

There are numerous options for economic diversification that have been imagined for the Pilbara. Some are slowly coming to fruition; others remain in the realm of blue-sky ideas. There are two overall streams that could be followed that are not mutually exclusive. The first would be to cluster development in support of the oil, gas and mining industries. The second would be non-resource based developments that nevertheless build off the infrastructure provided by the mining and gas industries. These tend to fall into two categories: agro-industry and renewable energy.

Taking this into consideration, what can be done to ensure the long-term economic viability (LEV) of the Pilbara region? What are the levers available? What kinds of things can be done? Is a dirigisme approach⁸ required to make the most necessary things happen, or can

⁸ A dirigisme approach is an economic system in which the state directly controls and influences investment. This approach contrasts a regulatory system in which the state plays a more indirect role.



the various stakeholders in the Pilbara cooperate and draw greater benefits for themselves in the process?

Blue sky thinking: what is the potential for Australia?


Asia will not just be the most populous region in the world. Asia is becoming the biggest economic zone, the biggest consumption zone. and the home of the majority of the world's middle class (Australian Government, 2012). Evidently, 'economic growth in Asia will continue to drive demand for Australia's energy and mineral resources. Asia's transformation and rising middle-class will bring unprecedented opportunities for Australia well beyond the mining and energy sectors' as Asia will demand 'quality housing and food; more sophisticated consumer goods; a broader range of services, including tourism, education, health and aged care, entertainment, financial and professional services; and many products not yet invented' (Australia in the Asian Century, 2012). When the natural resources peak arrives in the Pilbara, what is done now will determine whether the region will service the Asian markets, leaving intergenerational assets and equity, or intergenerational liabilities.

If we get all this right, what's possible for Australia?

Maximizing the potential of the Pilbara provides significant opportunity for Australia. Critical to attaining this is capitalizing on this moment in time where something can be done to guarantee the Pilbara's LEV. This is also a strategic way to build stronger economic relations with our Asian neighbours. 'Australia's commercial success in the region requires that highly innovative, competitive, Australian firms and institutions develop collaborative relationships with others in the region' (Australia in the Asian Century, 2012).

This report suggests there is a critical need for a long-term plan for the Pilbara. It needs a plan to help the Pilbara punch its proper weight, not just in two sectors now, but for the long term to create a diverse and viable economy that is linked closely into Asia. There is a debate right at the core of this: to what extent do we believe that the market will sort out these issues, or will require state intervention?

There have been government reports about the long-term future of Australia by both the Coalition and by the ALP. The Australia in the Asian Century Report was an ALP long term plan with bipartisan support. The Coalition similarly produced a bipartisan report on the long-term needs of Australian governments due to changing demographics. The report called the Intergenerational Report (IGR1), first published in 2002, assessed the long-term financial implications of policy commitments (Costello, 2002). In 2007, Peter Costello circulated another version (IGR2), looking at the issues and effects of demographic change on future economic growth (Costello, 2007), which was informed by a consultative document entitled Australia's Demographic Challenges (Commonwealth of Australia, 2004). The report anticipates Australia's population will reach nearly 30 million people by 2047 (Costello, 2007). The report also emphasizes the need to improve labour force participation and importantly labour productivity. Since this report, the Australian Productivity Commission has found further declining productivity across many sectors including mining. Reforms in the Pilbara, outlined in the LEV strategy could certainly play a critical role in addressing these



long-term structural issues for the region and Australia but will need a similarly long term plan to guide it.

The pathway to LEV for the Pilbara

RDAP's *Pilbara Report 2012* highlighted that 'although infrastructure is a necessary prerequisite to diversification, if the cost of productive investment is prohibitive, or the infrastructure is not geared to diversification, then such diversification will not take place or will only occur at a slower, organic pace' (Regional Development Australia: Pilbara (RDAP), 2012a). The case for cooperation between State and Federal Governments is evident. RDAP argues the need for an increasingly dirigisme approach to achieve this.

There is a clear pathway for ensuring the LEV of the Pilbara. Part of the solution relates to building some infrastructure, but perhaps more critically relates to creating network ability (interconnectedness) in existing infrastructure. It is increasingly important that the government invests in infrastructure which aligns with the economic diversification goals for the region. This includes the need for greater interconnectedness of infrastructure, particularly in transport and energy. This will require commitment from the government to provide funds for projects that are not necessarily the most politically attractive, but will benefit the region more in the longer term.

Australia is well positioned to take advantage of these emerging opportunities but our success will be based on choice not chance (Australia in the Asian Century, 2012). The choice is to become like California, or, like Geiju, where a region became fixated on a limited resource, which came and eventually went. The choice is between living in the present only, or planning for the future, and planning for a more permanent prosperity.

Chapter 4: Conclusions

Long-term Economic Viability (LEV)

The Pilbara Cities vision of 2009 has been integral to focus minds on what the future of the Pilbara could look like. The establishment of the Royalties for Regions program has also made a substantial mark in allocating capital for important infrastructure projects. The Pilbara is a much better place to live in as a result of Pilbara Cities. There is however, broad recognition about the need for economic diversification in the Pilbara. Many new and innovative technology businesses are establishing in the Pilbara, with everything from waste energy and other renewables, as well as innovative farming projects, utilizing the abundance of water and sun that exists there. These are all still small, but represent a growing web of innovation in the region that could develop into something greater. To succeed in economically diversifying the region, this will need growing support.

Base and driver industries have been suggested (see for example: (Shire of Roebourne, 2013c, Pilbara Development Commission, 2012c, Regional Development Australia: Pilbara (RDAP), 2012a)) but the region is yet to come up with a comprehensive economic vision, quantifying the economic size of the opportunities and the targets and a pathways to get there. The Pilbara needs to:

- Invent a future for itself, diversified from gas and iron ore; and
- Find new ways to cut costs and maintain profit margin.

The implications for the Pilbara are significant. Without the organic slow growth of infrastructure, the ore industry is operating solely on its advantage of being close to China and having high quality ore. As these benefits are eroded, unless action is taken, there will be no related ecosystem of activity to continue. And the outcome might be a ghost town like Geiju, Yunnan.

Many questions exist such as: What kind of infrastructure will have the most effect on economic activity? What do other industries need to establish themselves and ramp up their operations? What types of infrastructure are required? What kind of incentives will bring industry to the Pilbara? And importantly, how do you get the maximum return to provide these? The biggest question to answer is what's the least you could do that would have the most effect to improve the long-term economic viability (LEV) of the Pilbara? Adapting Krugman's spatial economics model and Porter's clustering model, and having reviewed more than 200 documents and conducted dozens of interviews, the below diagram shows what we believe to be the key opportunities and actions to be undertaken in the Pilbara.



Long-term Economic Viability (LEV)												
Area	Energy		Tourism		Industry		Agriculture	Supply Base		Cost of Living & Doing Business		
Objectives	Electrify Rail and Mines	Fully Inter-connected Grid	Online Tourism Market Info	Branding & Market Campaign	Infrastructure Delivery e.g. Roads	Special Economic Zones	R&D Biz Incubation	Agricultural Diversification and Export Plan		Strategic Supply Base & Military Presence	Affordable Housing & Commercial Space	Cost Competitive Logistics
	Renewable Energy & Plan for De-Dieseling the Pilbara	Regional Energy Masterplan	Quantified Business Plan			Technology & Innovation Strategy	Local Enterprise Strategy, Mentors & Boards	Irrigation Systems and Logistics	Local Food Production	Economic Plan for Construction & Land Cost Reduction	Port & Rail Logistics	Pacific Rim Export Market Plan

Figure 42: Long term Economic Viability (LEV)

Pilbara 2050: Ensuring the long-term viability of the Pilbara

Dimensions of Strategy

Process, Content, Context

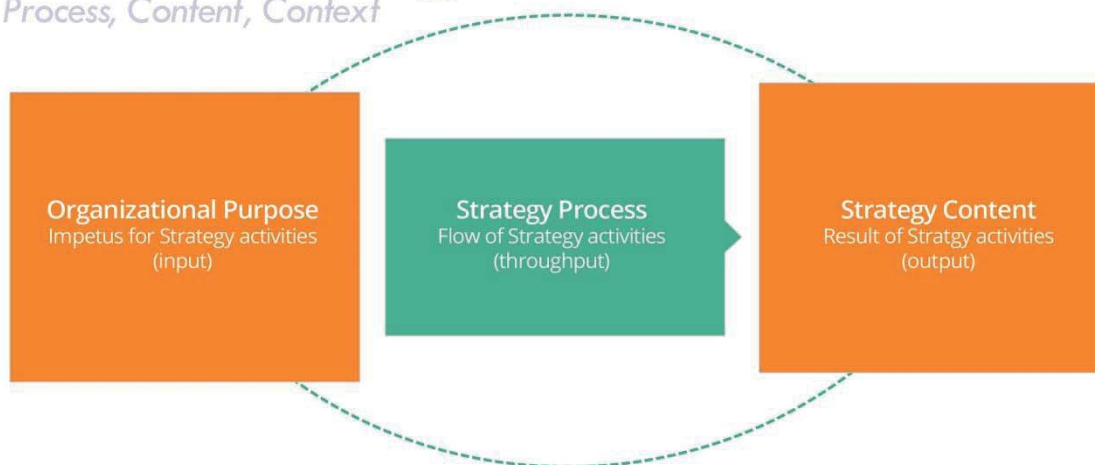


Figure 43: Dimensions of strategy (de Wit & Meyer, 2010)

A coherent strategy has pieces that form a coherent whole. An LEV strategy would need to contain critical components, such as purpose, process and content, shown in Figure 43 below.

The Pilbara Development Commission's Pilbara Cities vision has enabled the first steps towards a future diversification of the Pilbara. However in terms of a long term plans it is currently nebulous (see Figure 44), lacking a clear direction of what will be the economic vehicle to deliver upon the vision and how it will get there. London, for example, utilized its shipping industry to create the shipping insurance and other insurance industries, which later led to it being one of the financial centres of the world. Could the Pilbara define a coherent vision, develop and execute a comprehensive economic diversification plan and secure its place as a powerhouse, long after the natural resource bounty is extracted?

Pilbara Cities Vision

Vision

The Pilbara Australia's Global Economic Hub

Mission

The Catalyst for Regional Growth and Development

Our Roles

- Leader
- Advocate
- Broker
- Innovator

Objectives


1. Diversity - Economic, Community & Social Development
2. Development - Land Supply, Accommodation & key Infrastructure

Figure 44: Pilbara Cities vision (see: www.pdc.gov.au/about/)

We believe that the LEV framework we outline in this report would provide an initial pathway to creating an economically and socially resilient Pilbara for the future.

In order to define and work towards a comprehensive long-term vision for the Pilbara, it will be imperative that the government play a direct and ongoing role. It must be recognized that the private sector (particularly the resource industry) is not necessarily going to act in the long-term interests of the Pilbara on their own accord. Therefore, the government needs to steer infrastructure development in the region and to ensure that private sector-led developments favour infrastructure, which represent the best interests of the region, rather than those that have the most political appeal.

For this to occur greater coordination between government entities is required. An operational environment must be developed in which the various regional, state and federal agencies work towards the same goals, and do not need to compete for funds and prioritization. The most recent Global Competitiveness Index 2013/2014 ranks Australia 128th poorest in the world for the burden of bureaucracy on the economy (World Economic Forum, 2013). This level of red tape creates barriers to economic diversification. The Pilbara, like Australia as a whole, requires a more holistic approach to government planning and implementation. In addition, distinct, rather than competing identities need to be developed

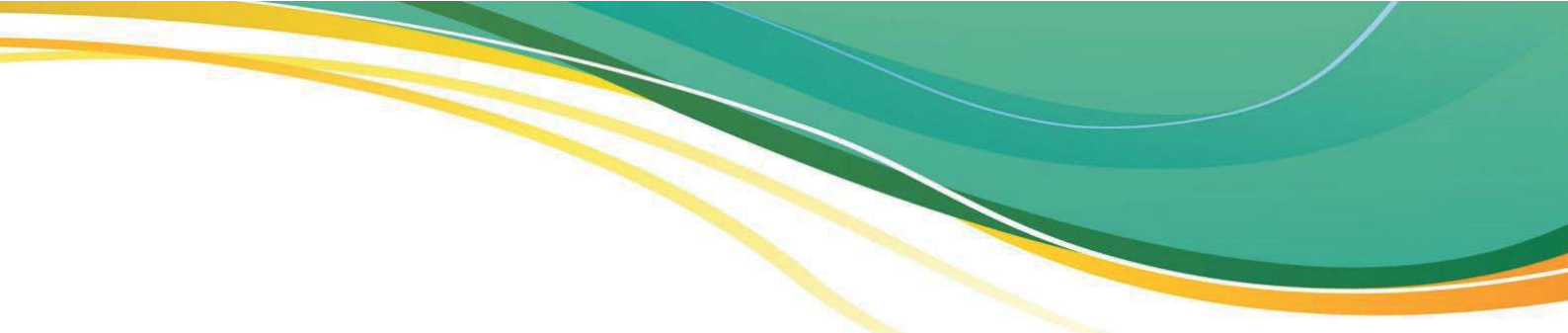


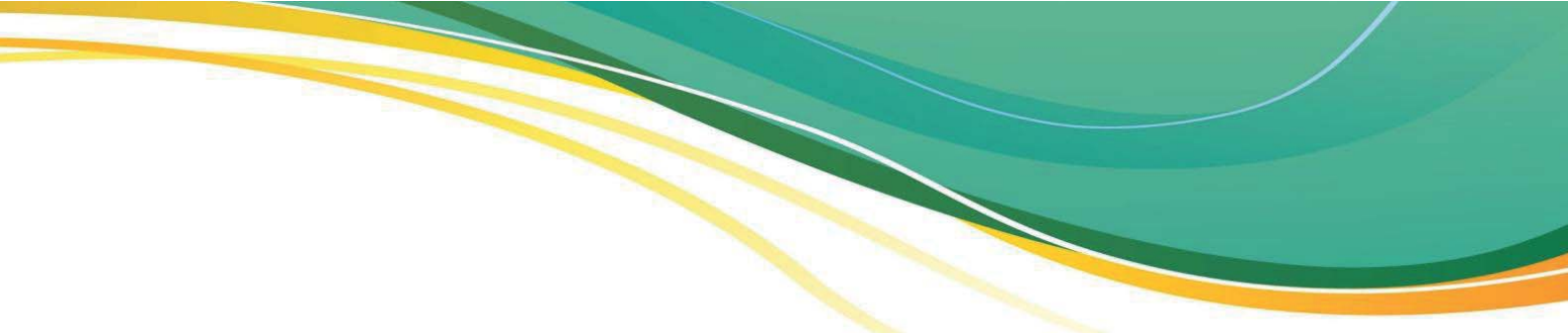
for Karratha and Port Hedland that reflect the differing strengths of each city. This report has set out the basis of a framework Long-term Economic Viability in the Pilbara. It suggests that the first step in achieving this is a vision and economic diversification plan. There are a number of substantive economic opportunities in the Pilbara, which have been highlighted in this document. Potential base and driver industries to be assessed further include: tourism, agriculture and renewable energy. Additionally, economic benefits exist in opportunities for interconnected transport and energy grids in the Pilbara, and in new partnership approaches for engaging with Indigenous people. An economic diversification plan could build on the LEV framework in this report but will need detailed economic modeling and assessment of various industries and sectors. A commitment to supporting promising base driver industries and improving the efficiency of infrastructure would in itself be a major step towards creating the LEV of the region. The Pilbara has the potential to become a resilient economy and community; however this greatly will depend on whether the political will exists to do so.



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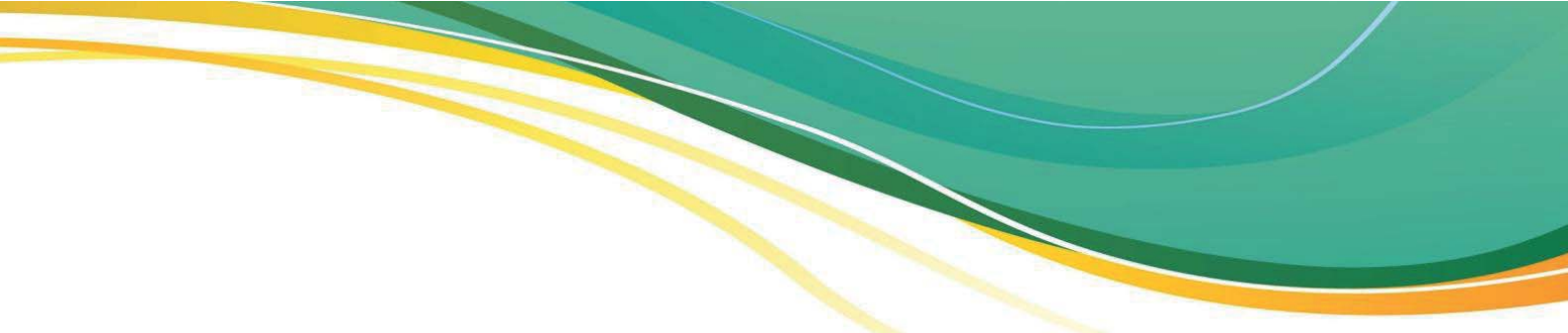
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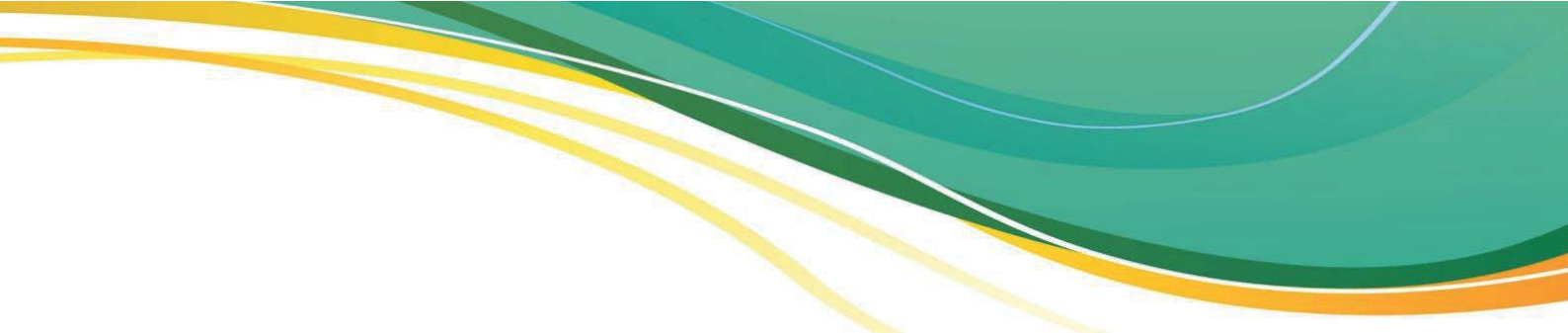
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