

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/328176136>

Climate Change and the Adaptive Economy: Discussion Paper

Technical Report · October 2016

DOI: 10.13140/RG.2.2.31437.69607

CITATIONS

0

READS

40

3 authors, including:



[Sarah Crossman](#)

Flinders University

12 PUBLICATIONS 7 CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:



Paper from my PhD research [View project](#)



Regional Development Adelaide commissioned report [View project](#)



Discussion Paper

Sarah Crossman, John Spoehr and Mark Siebentritt

Australian Industrial Transformation Institute

2016



**Climate Change and
the Adaptive
Economy:
Discussion Paper**

Australian Industrial Transformation Institute

Flinders Business School
Faculty of Social & Behavioural Sciences
Flinders University of South Australia

1284 South Road
Clovelly Park
South Australia 5042

www.flinders.edu.au/aiti

Published 2016.

ISBN: 978-0-9945741-1-4

URL: <http://www.flinders.edu.au/aiti/>

CAT: AIT1201608

Suggested citation:

Crossman, S, Spoehr, J, and Siebentritt, M. 2016. *Climate Change and the Adaptive Economy: Discussion Paper*. Adelaide: Australian Industrial Transformation Institute, Flinders University of South Australia.

This research was supported by a grant from the City of Salisbury and City of Playford through the Adapting Northern Adelaide – Regional Climate Change Adaptation Plan partnership..

AITI would also like to acknowledge the contributions and support from Mark Siebentritt at Seed Consulting Services.

The Australian Industrial Transformation Institute (AITI) has taken care to ensure the material presented in this report is accurate and correct. However, AITI does not guarantee and accepts no legal liability or responsibility connected to the use or interpretation of data or material contained in this report.

Contents

KEY POINTS	V
1 INTRODUCTION	1
1.1 ADAPTING NORTHERN ADELAIDE.....	1
1.2 TOWARDS AN ADAPTIVE ECONOMY	1
1.3 OUR CHANGING CLIMATE	2
1.4 WHAT IS AN ADAPTIVE ECONOMY?.....	3
1.4.1 Green Economy	3
1.4.2 Low-Carbon Economy.....	3
1.4.3 Circular Economy.....	4
1.4.4 Clean Tech.....	4
1.4.5 Adaptive Economy	4
1.5 ECONOMIC OPPORTUNITIES AND RISKS IN AN ADAPTIVE ECONOMY	5
2 GLOBAL AND NATIONAL CONTEXT OF AN ADAPTIVE ECONOMY	7
2.1 INTERNATIONAL CONTEXT	7
2.1.1 <i>Employment impacts in the European Union</i>	7
2.2 AUSTRALIAN INITIATIVES	9
2.2.1 <i>National Innovation and Science Agenda</i>	9
2.2.2 <i>Climate change policies, adaptation and employment</i>	10
2.3 SOUTH AUSTRALIAN CONTEXT	13
3 OPPORTUNITIES IN NORTHERN ADELAIDE.....	15
3.1 ESSENTIAL SERVICES.....	15
3.1.1 <i>Water and waste management</i>	15
3.1.2 <i>Energy</i>	16
3.2 SECTORAL OPPORTUNITIES	17
3.2.1 <i>Advanced manufacturing</i>	17
3.2.2 <i>Construction and urban renewal</i>	18
3.2.3 <i>Health, Ageing and Disability</i>	19
3.2.4 <i>Horticulture and food production</i>	19
3.2.5 <i>Defence</i>	20
3.2.6 <i>Mining equipment and technology services</i>	20
3.2.7 <i>Tourism, recreation and culture</i>	21
4 NEXT STEPS	21
REFERENCES.....	23



List of Case Studies

CASE STUDY 1:	8
CASE STUDY 2:	13
CASE STUDY 3:	14
CASE STUDY 4:	16

List of Figures

FIGURE 1: ADAPTIVE ECONOMY	5
----------------------------------	---



Key Points

- An Adaptive Economy is one that recognises that climate change mitigation and adaptation imperatives can be a catalyst for innovation and a generator of a wide range of high value industry and employment opportunities.
- Climate change mitigation and adaptation responses will have positive employment impacts in some sectors and negative results in other sectors. Some of these employment implications will be short term, and others long term.
- Opportunities exist for Australia to further develop precision agriculture to continue the transformation of agricultural management in Australia and overseas.
- Infrastructure investments in the Australian construction sector may lead to the creation of new jobs in areas such as the building of coastal defences, flood protection, road adaptation and drainage management.
- Energy efficient housing and buildings that are better adapted to climate change will also have the potential to generate jobs in the Australian construction sector.
- In South Australia the renewables industry has experienced jobs growth and expects further increases on the back of continued support for the development of the industry in SA.
- The storage of renewable energy in battery systems is emerging as a new technology that can offer significant economic potential for South Australia.
- In Northern Adelaide, the construction and urban renewal sector has potential to grasp opportunities in energy efficient housing construction and the design of new goods and services.
- The closure of the auto-manufacturing industry in Northern Adelaide presents major challenges to business and workers dependent on the sector.
- The health, ageing and disability sectors have also been identified as having significant potential for industry and employment growth. There is potential for local manufacturers to diversify into producing new tools, components or products for medical devices and assistive technologies that support healthy ageing.
- Further considerations for the region include:
 - ◆ What sustainability, industry and employment development benefits might flow from pursuing specific opportunities?
 - ◇ What is the existing expertise and capability in the region to pursue these opportunities?
 - ◇ What issues need to be solved in the region and have potential for global application?



- ◇ What are the tradeoffs and potential benefits?
- ◇ How can industry grow but pollute less?
- ◆ How do we better promote the region and what branding and marketing would accelerate growth for sustainable energy management, low carbon and green industries?
- ◆ What links to funding and finance need to be explored?
- ◆ What changes may need to occur to realise these opportunities and what barriers should be addressed?
- ◆ What links to funding and finance need to be explored?
- ◆ What policies, incentives and structures are needed to drive collaboration?



1 Introduction

1.1 Adapting Northern Adelaide

Adapting Northern Adelaide is a climate change adaptation project covering the Cities of Salisbury and Playford in South Australia. Its aim is to identify ways that the community, government and business in the region can respond to changes in future climate and associated impacts.

The region has many unique features: it is one of the most rapidly growing urban areas in Australia; it has significant environmental assets along the coast and in the Mt Lofty Ranges; it is recognised internationally for its innovative approach to stormwater management; and it has an economy that is under transition from its traditional manufacturing base.

The transition in the region's economy presents both challenges and opportunities for employment and local businesses. While traditional forms of business activity are changing, new opportunities are arising as the demand for goods and services increases in domestic and international markets. A major priority of Adapting Northern Adelaide is to build the region's capacity to harness the economic opportunities that arise out of responding to a changing climate.

1.2 Towards an adaptive economy

This *Adaptive Economy* discussion paper is designed to increase awareness of the wide range of economic and employment opportunities that arise from action to respond to climate change. While much attention has been paid to the science of climate change, our understanding of the industry and employment opportunities associated with mitigating and adapting to climate change is relatively limited in Australia. This paper makes a contribution to filling this gap, suggesting that the scale of the challenge requires us to think about transformative change, creating what might be described as an 'Adaptive Economy'.

An Adaptive Economy is one that recognises that climate change mitigation and adaptation imperatives can be a catalyst for innovation and a generator of a wide range of high value industry and employment opportunities. The need for radical innovation and accelerated uptake of solutions to climate change is already giving rise to a wide range of new business and employment opportunities. These are likely to grow rapidly as governments face the need for bolder action on climate change. While considerable uncertainty remains about how this will unfold across the globe, there is little doubt that the momentum for action will be considerable. First movers will not only contribute to meeting the challenge but will be rewarded for doing so.

There has been much written on the negative potential impacts of climate change on employment and businesses. Some reports predict climate change mitigation processes will create jobs, while others believe there will be no net job increases (Markey, McIvor, & Wright, 2014). Impacts will vary between sectors with potential employment decline in industries which pollute heavily or rely on finite resources, such as the coal mining industry (Markey et al., 2014).

The impact of climate change adaptation on employment will have temporal variation. There may be short term increases in employment due to additional investments in more labour-intensive low-carbon technologies (Fankhauser, Sehleier, & Stern, 2008). The positive increase in jobs will diminish as technologies become more efficient however overall, short-term



employment growth is expected to be positive. In the long term, climate change adaptation investments may lead to a reduction in climate change damage, reducing job losses in the sectors vulnerable to climate change impacts (European Commission, 2014). However, adaptation measures may also reduce demand for some services, such as reconstruction services after an extreme weather event, and therefore adversely affect employment in these sectors (European Commission, 2014).

In the broader economy, long term employment impacts are expected to be the most significant with the potential for technical change and innovation to trigger a fundamental overhaul of the economic system (Fankhauser et al., 2008). Earlier occurrences of innovation-led change has demonstrated that it can be a powerful driver of job creation, productivity improvements and growth. An example of this is the skill-biased technological change of the previous few decades that has contributed much of the developed world's wealth (Fankhauser et al., 2008).

The potential negative impacts of climate change on Northern Adelaide employment and businesses was addressed in the vulnerability assessment conducted as part of developing the Adapting Northern Adelaide Adaptation Plan. This paper will therefore focus more on emerging opportunities.

1.3 Our changing climate

The starting point for realising business and employment opportunities from the Adaptive Economy is an appreciation of the science that underlies the conclusion that industrialisation has fuelled climate change, evidenced by the fact that greenhouse gas emissions are the highest on record (IPCC, 2014b). Since the pre-industrial era, greenhouse gas emissions have increased at extraordinary rates. Atmospheric and ocean temperatures have increased, rainfall patterns have changed, and sea levels have risen. There have been many observed changes in extreme weather and climate events since the 1950s. These have included increases in warm temperature extremes, decreases in cold temperature extremes, rising sea levels, and an increase in the number of heavy precipitation events in many regions (IPCC, 2014b).

These climate changes have widespread impacts on both human and natural systems (IPCC, 2014b). Further increases in greenhouse gas emissions will contribute to the scale of global warming and increase the probability of severe and permanent consequences for people, businesses and the environment.

Responses to climate change impacts can take two approaches; 1) mitigation activities, and 2) adaptation measures. Mitigation of climate change is defined by the IPCC (2014a) as “human intervention to reduce the sources or enhance the sinks of greenhouse gases”. Adaptation to climate change describes how we will respond to actual or expected climate and its effects (IPCC, 2014a). In other words, mitigation aims to reduce carbon emissions from a given activity, while adaptation describes how we will respond to a different future climate.

Mitigation and adaptation are not mutually exclusive and are often undertaken together in response to climate change. Mitigation activities are vital for reducing further growth of greenhouse gas emissions in the coming decades, and therefore reducing the severity of the impacts. At the same time, it is critical that we adequately adapt to these anticipated climate changes given the world is already on a path to further global warming as a result of previous greenhouse gas emissions (IPCC, 2014b).



In this discussion paper, climate change mitigation and adaptation activities will be considered together to explore the potential opportunities that might arise from building an adaptive economy in Northern Adelaide.

1.4 What is an adaptive economy?

There is growing interest in the potential economic and employment benefits that may arise from climate change mitigation and adaptation actions. The European Commission (2014) define an effective adaptation measure as “where the adaptation activity contributes to the economy and employment, therefore reducing or preventing the social, environmental and economic costs of climate change”.

The idea of an adaptive economy has parallels with sustainable development strategies like the green economy, low-carbon economy and the circular economy.

1.4.1 Green Economy

The term ‘green economy’ is often used as a broad descriptor of sustainable activities that contribute to economic development and prosperity. It is defined by the UNEP (2010) as an activity “*that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities*”. Opportunities and innovations undertaken within an adaptive economy framework align with the ideologies of a ‘green economy’ and the sustainable activities that occur within it.

The green economy encompasses ‘green jobs’, ‘green industries’, ‘low-carbon economy’ and the ‘circular economy’. Green jobs (and green industries) are typically those in the agricultural, manufacturing, research and development, administrative and service sectors that contribute substantially to preserving or restoring environmental quality (United Nations Environment Programme (UNEP), 2008). This includes, but is not limited to, jobs that help to protect ecosystems and biodiversity, to reduce consumption of energy, materials and water, to reduce carbon emissions, and to minimise or avoid generation of waste and pollution (United Nations Environment Programme (UNEP), 2008).

The green economy includes sectors that are able to *provide solutions* to the needs of businesses such as environmental, adaptation and low carbon challenges. This can be in the form of manufacturing components or systems, providing services, logistics, research, development and innovation skills.

However, any business, including those not typically identifiable as green, can play an important role as *customers* in seeking solutions for climate resilience, energy efficiency, renewable energy and other greening activities, particularly where local and state businesses are supported through such procurement.

1.4.2 Low-Carbon Economy

Similarly, a low-carbon economy is characterised by activities which emit low levels of carbon dioxide into the atmosphere (Levy, 2010). It encompasses a diverse range of sectors and increases the demand for activities which promote more efficient use of fossil fuels and limit carbon dioxide emissions (Levy, 2010). While the low carbon agenda will place employment in the most carbon intensive industries at risk it presents opportunities in innovative, more



sustainable industries (Levy, 2010). Moving toward a low carbon economy is central to *South Australia's Climate Change Strategy 2015-2050*.

1.4.3 Circular Economy

The concept of a circular economy was originally coined by environmental economists Pearce and Turner in 1990. It goes beyond the concept of a low-carbon economy to describe an industrial economy that promotes resource minimisation, the adoption of cleaner technologies, and one that produces no waste or pollution (Andersen, 2007). Confronted by existing environmental problems and resource scarcity, the concept of a circular economy arose, proposing that the economy and the environment are managed as an interrelated, circular relationship (Su, Heshmati, Geng, & Yu, 2013).

1.4.4 Clean Tech

In recent times the concept of 'clean technology', or cleantech, has appeared in modern nomenclature. Cleantech refers to economically viable products, services and processes that harness renewable materials and energy sources, dramatically reduce the use of natural resources and cut or eliminate emissions and wastes (Australian Cleantech & Bridge8, 2010).

1.4.5 Adaptive Economy

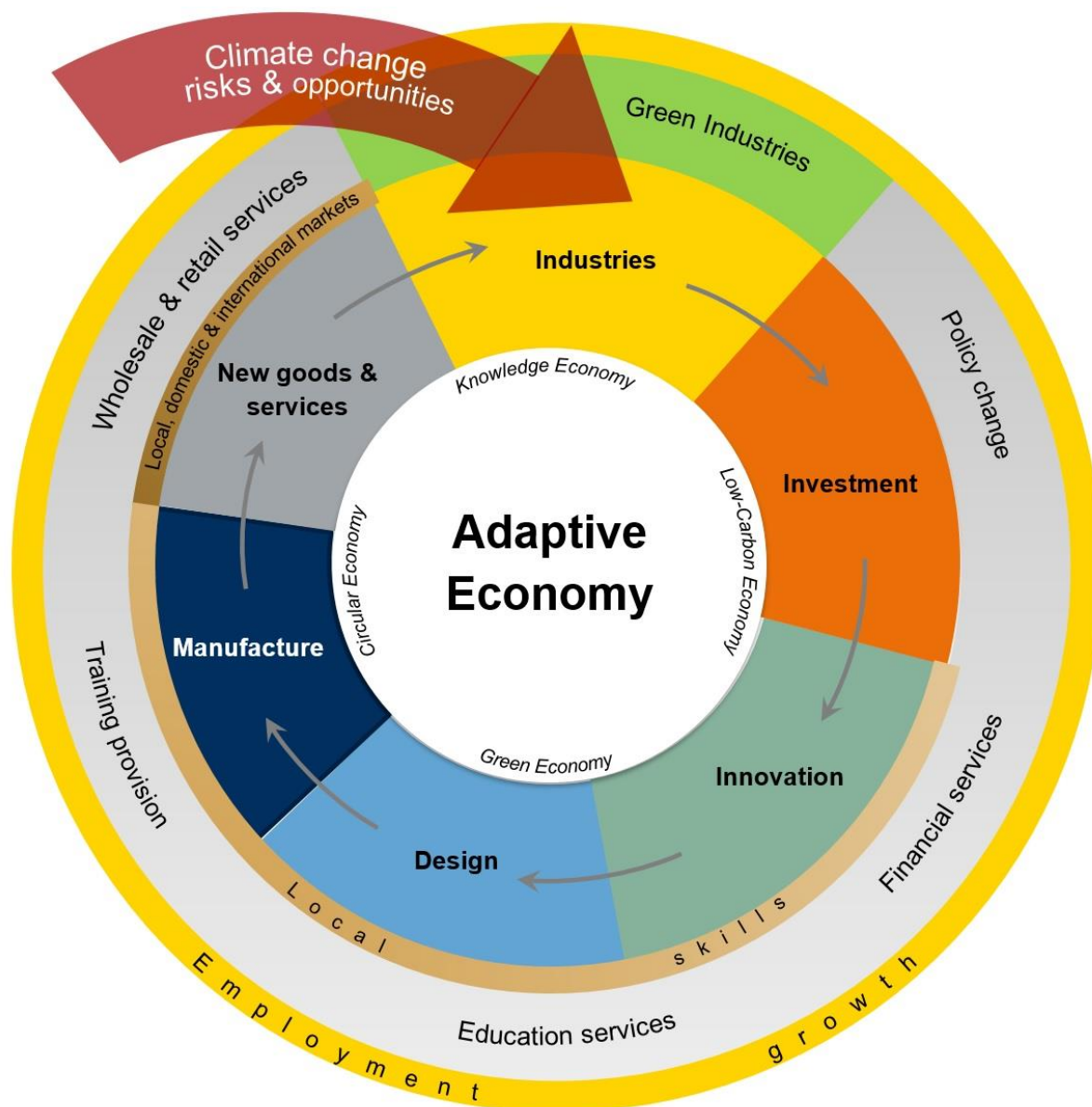
For the purpose of this discussion paper, the term 'adaptive economy' means an economy that is highly responsive to climate change mitigation and adaptation imperatives. An adaptive economy is one that fosters the development of solutions to climate change that underpin the growth of sustainable industries and jobs. It encompasses many of the ideas behind the low-carbon economy and green economy, and includes, but is not limited to, employment and potential growth in green jobs and green industries. A successful adaptive economy will be characterised by knowledge intensive industry development involving the generation and application of creative transdisciplinary solutions.

In the context of responding to climate change, an adaptive economy is one in which local skills and services respond to meet emerging climate change related risks and opportunities and in so doing meet local, but more importantly, domestic or international market demand. Such goods and/or services will present opportunities for employment and business growth. In this sense an adaptive economy is broader than traditional thinking about what might constitute green or sustainable jobs and applies across the wider economy.

Figure 1 further explains an Adaptive Economy. The figure demonstrates that industries are continuously impacted by climate change and presented with risks and opportunities associated with these impacts. These risks and opportunities are supported by providers and consumers of green industries, and ultimately lead to an investment response, requiring the utilisation of local skills in innovation, design and manufacturing, with the new goods and services having market potential locally, domestically and internationally. This adaptation cycle may impact policy through new policy development or change to existing policy, and is supported by financial services through accounting and financial advice, education and training services, and the wholesale and retail service industry. A successful adaptive economy will have an overall positive employment impact in a range of sectors and across skill levels.



Figure 1: Adaptive Economy



1.5 Economic opportunities and risks in an adaptive economy

This section of the discussion paper explores the potential economic opportunities and costs associated with adaptive responses, and considers the implications for investment on employment.

If global warming continues to rise at current levels, it is estimated that the total cost of climate change will equate to an average reduction in global per-capita consumption of a minimum of 5%, possibly as much as 20% (Stern, 2007). Climate change will influence the availability of commodities essential for economic growth, such as water, food and energy, impacting populations across the globe (Stern, 2007).



There are also costs associated with climate change mitigation and adaptation responses. The establishment of new industries and the transition of entire sectors to new production methods, requires significant upfront investment. Climate-proofing existing infrastructure is costly and it is estimated that the additional expense of making new infrastructure and buildings more resilient to climate change in OECD countries could range from \$15 – 150 billion each year (0.05-0.5% of GDP), with higher costs possible with the prospect of higher temperatures in the future (Stern, 2007).

In 2008, economist Ross Garnaut was commissioned by the Australian Commonwealth and State Governments to review the potential costs and benefits of Australia's efforts to mitigate the harmful effects of climate change. This review concluded that the costs of inaction were greater than the costs of intervention and 'that it was in Australia's national interest to do its fair share in a strong global effort to mitigate climate change' (Garnaut, 2011). Adaptation presents an opportunity to adjust economic activity in vulnerable sectors and support innovative and climate-resilient sustainable development (IPCC, 2014b; Stern, 2007).

While the impact of climate change and associated mitigation and adaptation activities on employment has been considered by researchers internationally, a review of adaptation strategies and actions plans undertaken by the European Commission (2014), determined that very few countries in the European Union had explicitly considered the employment impact of adaptation actions. It is anticipated however, that the transition to a low-carbon economy could impact employment in four different ways (Markey et al., 2014; United Nations Environment Programme (UNEP), 2008):

1. Job creation
2. Job substitution
3. Job elimination
4. Job transformation to greener industries.

New jobs may be generated by carbon mitigation activities, for example the increased demand for the manufacture of carbon-reduction technologies. Job substitution may occur through the shift from high emissions forms of energy production to renewable technologies. The elimination, or loss, of jobs without replacement may occur if entire industries need to cease operation. The transformation of jobs is likely to occur within many sectors, for example, trades may be transformed and redefined to more ecologically sustainable skills sets and work methods (Markey et al., 2014).

Investments in response to climate change will have impacts both within and beyond the sector of origin, making it challenging to quantify overall effects on the economy and employment (European Commission, 2014). Impacts will vary between sectors with potential employment benefits in the construction and manufacture of carbon-reduction technologies industries, with the opposite occurring in the coal mining sector for example (Markey et al., 2014).

Opportunities exist in the technology sector for the development of innovative responses to climate change. In many cases, technology has driven change in numerous aspects of our lives; telecommunications, finance, transport, even in how we interact with our social groups. Climate change adaptation presents a major opportunity to generate demand for novel technologies that drive economic activity in low-carbon sectors (Levy, 2010). In this case, climate change can be seen as an enabler of change, a driver of new technological solutions and industry transformations, and an area for significant employment growth. Employment opportunities may



cross a range of skill levels from low-skilled installation and construction workers, to high-level technical and innovative roles, as well as senior management and product development positions (Levy, 2010).

It is evident from the literature that climate change mitigation and adaptation responses will have positive employment impacts in some sectors and negative results in other sectors. Some of these employment implications will be short term, and others long term. To ensure that the net effect is positive, a dedicated strategy that addresses the combined effects of climate change and economic development is required.

Further analysis of research into specific employment impacts of climate change adaptation within Australia and internationally is presented in Section 2.

2 Global and national context of an adaptive economy

2.1 International context

The impacts of climate change across the globe will be highly variable, with the most serious impacts occurring in the poorest, most vulnerable countries (Stern, 2007). Globally, losses from extreme weather events have increased from around \$83 billion in the 1970s to around \$440 billion in the 1990s. Developed countries are less vulnerable to these climate change impacts for a number of reasons, one of which is due to their greater adaptive capacity. More wealthy countries are better equipped to invest in adaptation measures and have more flexible economies (Stern, 2007). This is evident by the fact that the proportion of GDP loss as a result of these weather-related events was much greater in developing countries than in developed countries.

2.1.1 Employment impacts in the European Union

Research on the impact of climate change on employment is largely focused on jobs losses associated with climate change impacts rather than job gains generated by measures designed to mitigate and adapt to climate change. For example, the European Commission (2014) attempted to quantify the impacts of climate change adaptation on employment. Assuming no new adaptation activities commenced beyond 2011, this study determined that from 2015, climate change will result in the loss of approximately 410,000 jobs by 2050 in the European Union (EU) (European Commission, 2014). This would increase the EU unemployment rate by two percent due to climate change.

Analysis of the potential employment impacts of climate change adaptation expenditure in the EU presents economic and employment opportunities for some sectors (European Commission, 2014). Climate change adaptation expenditure is predicted to be significant in transport, built environment, health and agriculture, resulting in an increased demand for goods and services from the construction sector predominantly (European Commission, 2014). Assuming expenditure on climate change adaptation equates to 0.5% of GDP in 2050, the employment impact is estimated to be an additional 50,000 jobs in the EU by 2020, increasing to 500,000 by 2050 (European Commission, 2014). In the scenario where climate change adaptation expenditure increases to 1% of GDP in 2050, the employment impact is significantly larger, with 200,000 new jobs predicted in 2020 (European Commission, 2014).



The European Commission (2014) also analysed the types of jobs created by adaptation investments and examined skills and education requirements from a future workforce. The types of occupations predicted to be in highest demand include:

- Statisticians/mathematicians,
- Insurers,
- Real estate agents,
- Environment and conservation professionals,
- Researchers,
- Engineers (planning, building and civil),
- Fire-fighters,
- Medical assistance professionals,
- Office clerks, and
- Building maintenance and repairs workers (European Commission, 2014).

These occupations present opportunities for individuals with a range of educational level requirements. As a percentage of the working population, it is predicted that adaptation expenditure will create the greatest number of jobs for people with higher qualifications and skills (European Commission, 2014). In light of these findings, it is important that South Australia and Northern Adelaide embrace and utilise the high-quality university sector present in the region, and prepare the local workforce for the types of occupations and skills that will be highly sought after in a climate-adapted economy.

In an effort to adapt to rising sea levels, the City of Rotterdam undertook an innovative pilot project. Case Study 1 describes the mixed-use floating pavilion built to demonstrate the potential for a floating urban district development to adapt to rising sea levels in the Rhine-Meuse-Scheldt delta. The City of Rotterdam plans to build floating urban districts, with 1,200 floating homes within a 13,000 home village by 2040. This case study demonstrates innovation in design and construction and in the creation and manufacture of a new building material. It also has the potential to develop an international

CASE STUDY 1: Rotterdam floating pavilion

Rotterdam is located on the Rhine–Meuse–Scheldt delta and is therefore vulnerable to climate change impacts.

In an effort to adapt to rising sea levels in Rotterdam Harbor, a pilot project was undertaken to design and construct a floating pavilion. The mixed-use pavilion utilises solar energy and surface water for heating and cooling, and purifies water for use in the toilets, discharging treated water safely back into the river system.

Economic and Environmental Benefits:

- ❖ The design phase of the floating pavilion **employed approximately 20 highly educated people** (physical sciences, mathematical sciences and engineers).
- ❖ During the eight month construction phase, the **labour force was comprised of workers from the mining, construction, manufacturing, transport, and building trades sectors.**
- ❖ This **labour was short-term**, continuing only during the design and construction period.

The City of Rotterdam plans to build floating urban districts, with 1,200 floating homes within a 13,000 home village by 2040.

Source: (European Commission, 2014)



Rotterdam floating pavilion (Source: <http://goo.gl/zM1rnP>)



market for the concept as many other regions across the globe are facing similar challenges from rising sea levels.

2.2 Australian initiatives

Across the world, efforts to mitigate climate change are mediated by prevailing policy commitments. The employment and economic effects of climate change and of mitigation and adaptation policies have influenced political debates on climate change in Australia and internationally (Markey et al., 2014).

An important factor in the debate around effective climate change policies is the consideration of the role of innovation. Innovative solutions to climate change adaptation are critical, requiring policy leadership, system stability and consistency in approach to support Australian businesses in their response to climate change.

2.2.1 National Innovation and Science Agenda

In December 2015 Prime Minister Malcolm Turnbull launched a signature innovation statement entitled the 'National Innovation and Science Agenda'. Valued at \$1.1 billion over four years, the Agenda is organized under four main headings:

1. Culture and capital

- This comprises various tax breaks for venture capitalists and other investors to improve flow of funds to early stage companies, together with more favourable tax treatment of investment in intangibles (such as patents).
- For example, venture capitalists and other investors that have invested in a start-up for more than three years will be exempt from the capital gains tax for 10 years and receive a 20% non-refundable tax offset on investments capped at \$200,000 per year.
- In addition, a 10% tax offset for capital invested in Early Stage Venture Capital Limited Partnerships will be introduced and the government will “relax” the same business test that denies tax losses if a company changes its business activities.
- \$8 million in support for accelerators and incubators through an expansion of the Entrepreneurs Programme.
- A CSIRO Innovation Fund of \$200 million to support spin-off start-ups (largely funded by commercialisation of CSIRO IP).
- A \$250 million Biomedical Translation Fund to commercialise Australian research in partnership with the private sector (government contribution \$10 million)
- Extra funding to the CSIRO’s data research arm, Data 61 (\$75 million), and
- \$30 million to a Cyber Security Growth Centre.

In addition, the Culture and Capital component comprises initiatives concerning tax losses, insolvency, and period of bankruptcy to take account of inherently higher failure rates of innovative start-ups and reduce risk-aversion.

Under the changes to bankruptcy laws, investors in a failed venture will only have to wait one year, instead of three, before creating a new start up and a “safe harbour” for directors will be introduced from personal liability for insolvent trading.



2. Collaboration

- Aimed at improving co-production by and between industry and researchers, this involves \$127 million in block grant funding for collaboration between universities and industry, together with metrics on non-academic impacts and industry engagement of universities.

3. Talent and skills

- This includes a boost to STEM funding in schools, digital education, an entrepreneurs' visa category and changes to the 457 category of visa to encourage international talent in to Australia and encourage exchange students to stay after completion of their courses, and the establishment of offshore launching pads to assist with the overseas expansion of entrepreneurial activities.

4. Government as an exemplar

- This involves changes to government procurement processes to be friendlier to start-ups and small businesses, including a 'digital marketplace' for government procurement to increase opportunities for start-ups to supply, competitively awarded grants to test innovative ideas, and creation of a new innovation and science committee of Cabinet and a new board within the Industry Department, 'Innovation and Science Australia'.

The policy is of modest scale and scope, having often been described as 'a good start' by many commentators. In addition, it can be observed that its emphasis lays with start-ups and SMEs, with less attention to the innovative potential of larger companies. In this respect and the fact that its strongest emphasis is on ICT and medical technologies, the statement appears to draw inspiration from US models and practice. This reinforces the current imbalance in provision of early stage capital in Australia. As one authority has noted: *"Most of the seed, early stage and expansion capital is going to biotech and Med Pharma, software, the internet of things, ICT, fintech and social media. Virtually no money is going to new energy and environment technologies or advanced manufacturing and engineering services. Policy is not helping deal with this situation"* (Nixon Apple, 2015).

From Western Europe a broader approach to industrial transformation is observable. It emphasizes the demand-side drivers from addressing societal challenges that will drive the advent of new products and services, such as environmental sustainability and population health and ageing. The focus is not on start-ups and small companies alone, but also on complex value chains and lead customer relationships linking large, medium and small firms, and transforming existing businesses. It emphasizes the full range of key enabling technologies, not only digital ones, and their broad and rapid diffusion, not just origination or invention. It also emphasizes innovation in business models and firm organization alongside the new technology platforms.

Expansion and elaboration of the Australian innovation agenda to encompass elements of this approach would be highly desirable.

2.2.2 Climate change policies, adaptation and employment

Climate change policy in Australia, particularly how to achieve a sustained reduction in carbon emissions has been subject to uncertainty since 2007 (Markey et al., 2014). Disagreement between the major political parties on how to achieve emissions reductions is ongoing, with various policy options being canvassed. This has included a carbon tax, an emissions trading scheme, a fixed price on carbon emissions, and most recently, a direct action plan which aims to



provide incentives for businesses to reduce carbon emissions and increase their use of renewable energies (Markey et al., 2014).

This uncertainty in Australian climate change policy has implications for how businesses and workers respond to climate change. Rafferty & Yu (2010) state that a stable market for climate-adapted jobs, skills and industries will only emerge where there is certainty and stability around regulation, policy setting and government support for a low-carbon economy. Given this view, there may be a role for Northern Adelaide in advocating for climate change policy and government regulation to further support advancements in and commitments to climate adaptation.

In 2014, the Australian Government passes legislation to implement the Emissions Reduction Fund. This fund provides incentives for emissions reduction activities across the Australian economy. The Government have provided \$2.55 billion to establish the Emissions Reduction Fund to help achieve Australia's 2020 emissions reduction target of five percent below 2000 levels by 2020. The Fund provides incentives for development of new products and services, thereby supporting innovation in low carbon activities across all sectors of the economy.

A significant body of research into the longer-term impacts of climate change mitigation policies argues that a shift to a low-carbon economy is likely to have a positive impact on employment (Bowen, 2012; OECD/Martinez-Fernandez, Hinojosa, & Miranda, 2010; Organisation for Economic Cooperation and Development (OECD), 2012; Rosemberg, 2010; United Nations Environment Programme (UNEP), 2008). It is argued that the renewable energy industry is likely to have a greater labour intensity and therefore higher job growth potential than more carbon intensive sources of energy production. A joint report by the Australian Council of Trade Unions (ACTU) and the Australian Conservation Foundation (ACF) found that a transition to a green economy would substantially benefit employment. They concluded that there was potential for up to 500,000 new jobs by 2030 in renewable industries such as energy efficiency, sustainable water systems, biomaterial, green buildings and waste recycling. Growth in these areas, however, was conditional on an unimplemented comprehensive government policy package, rather than based on existing policies. The report also gave little consideration to the employment impact of the decline or transition of high carbon industries to a green economy (Australian Conservation Foundation & Australian Council of Trade Unions, 2008; Markey et al., 2014).

Climate change is expected to significantly impact Australian agriculture through reduced yields, damage to crops and an increase in livestock deaths (Rosemberg, 2010). The dependence of the agricultural industry on weather and natural resources has meant that it has had to continuously adapt to change for hundreds of years. The extreme drought conditions experienced throughout the 1990s and early 2000s coincided with the rapid growth of precision agriculture techniques as a means of coping with the lack of available water (Whelan, 2011). Precision agriculture is a philosophy aimed at increasing long term, site-specific and whole farm production efficiency, productivity and profitability while minimising unintended impacts on the environment (Whelan, 2011). Australia has a long history of innovation in agricultural management and remains at the forefront of precision agriculture tool development and application, not least because of the country's unique range of production conditions (Whelan, 2011). Significant technological developments, including software and hardware improvements, farming equipment modifications, and major improvements in GPS accuracy, saw increased uptake of precision agriculture techniques throughout this drought period.



A study into the economic benefits of precision agriculture evaluated the potential profitability for Australian grain growers from adopting precision agriculture techniques (Robertson, Carberry, & Brennan, 2007). The study found that precision agriculture systems were profitable, initial capital investment was able to be recovered within a few years, and brought intangible benefits to overall farm management (Robertson et al., 2007). Farmers reported less fuel use, less soil compaction and more accurate sowing times. It was also reported that less hired manual labour was required as a result of adopting precision agriculture techniques. However, demand for high-skilled agricultural consultants to assist with on-farm management practices increased in some cases (Robertson et al., 2007).

Opportunities exist to further develop precision agriculture to continue the transformation of agricultural management in Australia and overseas. Sensing systems, software development, robotics and agronomic research present opportunities for further innovation to support the agricultural sector to adapt to climate change.

Aligned with the growth of precision agriculture are the major infrastructure upgrades occurring across the Murray-Darling Basin to improve efficiency of off-farm water delivery systems. Many open channels are being replaced with pressurised-pipe delivery systems, lining of other open channels to reduce water loss, and upgrading of pump stations are some of the investments aimed at improving water resource management. On-farm irrigation system upgrades to assist with water use efficiency have also occurred, including converting flood irrigation to drip or spray systems, modernisation of pipes and pumps, and monitoring of soil moisture. These investments have brought widespread industry benefits such as increased farm productivity with higher yields from reduced water usage, improved business opportunities such as crop diversification and multiple cropping, reduction in soil salinity and reduced water usage.

The adaptation activities around precision agriculture and water use efficiency are examples of where Australia has taken steps to safeguard a vital economic industry from the adverse effects of climate change.

Infrastructure investments in the construction sector may lead to the creation of new jobs in areas such as the building of coastal defences, flood protection, road adaptation and drainage management (Rosemberg, 2010). Energy efficient housing and buildings that are better adapted to climate change will also have the potential to generate jobs in this sector (Rosemberg, 2010). Australia has a relatively mature green construction sector. The green building industry has evolved from a niche sector focusing on single dwellings to an established industry centred on large scale projects, communities and cities. The sector is supported by clear and accurate guidelines on environmentally sustainable construction and is buoyed by the direction from the not-for-profit Green Building Council of Australia. The Green Building Council of Australia's key objectives are to drive the transition of the Australian property industry towards sustainability (Green Building Council Australia, 2016). They are strongly supported by both industry and government to drive the adoption of green building practices through market-based solutions, ultimately integrating these into mainstream design, construction and building operations. The Green Star rating system developed by the Green Building Council of Australia has been widely adopted with over 550 projects across Australia receiving Green Star Certification (Australian Government, 2016). Benefits from these green buildings include lower operating costs, increased building values and improved return on investment, providing further demand for similar investments.



Case Study 2 demonstrates a Greenfields community development project in Alkimos Beach Western Australia that received a 6 Green Star rating for sustainable and innovative design.

There is, however, evidence that for some types of infrastructure the employment potential from construction may not have been fully realised (International Labour Organization, 2011). Constraints in the planning processes and procurement policies may limit the potential of this sector. Additionally, the interdependency of the construction and manufacturing industries, and their ability to respond to demand for 'green' building materials, may have implications for the growth of employment in the construction sector.

2.3 South Australian context

South Australia has an ambition to achieve zero net emissions by 2050, with a commitment to make Adelaide the world's first carbon neutral city by 2020 (Government of South Australia, 2015). South Australia has demonstrated leadership in climate change action and was the first Australian jurisdiction to introduce climate change legislation in 2007. The *Climate Change and Greenhouse Emissions Reduction Act 2007* set a target for the state to reduce greenhouse gas emissions by 60% of 1990 levels by 2050. By 2012, the State's net emissions were 9 per cent below 1990 levels. During this time, the State's economy grew by 60% demonstrating that economic growth can be independent from growth in greenhouse gas emissions (Government of South Australia, 2015).

Further demonstrating South Australia's commitment to a low carbon economy, the State Government established the Office of Green Industries SA in 2015. Green Industries SA will support efforts in waste management, resource efficiency and recycling, and importantly, encourage innovation and economic growth through development of the Green Economy. Through the implementation of South Australia's Waste Strategy 2015-2020 (Office of Green Industries SA, 2015), the Government aims to, among other priorities, work with businesses, governments and the environmental sector to build the Green Economy in SA, and to help businesses find new overseas markets for their waste management knowledge and skills.

Leveraging from the Federal Government Renewable Energy Target, South Australia has embraced the renewable energy industry. By 2014, renewable energy supplied 41 per cent of South Australia's electricity, including 34% generated from wind energy (Government of South Australia, 2015). The state has one of the highest rates of rooftop solar panel installation, with one in four households generating their own power. As a result, the renewables industry has

CASE STUDY 2: Alkimos Beach Community development

Australia's first 6 Star Green Star rated community development is at Alkimos Beach in Western Australia (Green Building Council Australia, 2016). The master planned community includes 2,000 homes, parks, trails, schools and community facilities as part of its development. Homes within the precinct are powered by renewable energy and connected to a solar energy storage system, reducing emissions and significantly lowering household energy expenses. Smart water initiatives further contribute to its 6 Green Star rating with stormwater retention, bore water irrigation and water-efficient household appliances integrated into the design.

Economic and Environmental Benefits:

- ❖ **Community-oriented sustainable design**
- ❖ **Reduced emissions** from household energy production
- ❖ **Lower household energy expenditure**
- ❖ Integration of **smart water initiatives**
- ❖ **Potential to replicate** in other Greenfields sites

Source: (Green Building Council Australia, 2016)



experienced jobs growth and expects further increases on the back of continued support for the development of the industry in South Australia (Government of South Australia, 2015).

The majority of South Australia's greenhouse gas emissions are from energy production, comprising 75% of the state's total emissions. Case study 3 presents an example of innovation in the renewable energy sector by Heliostat SA, where local skills and collaborative innovation has led to the establishment of an international market and the creation of local jobs.

The storage of renewable energy in battery systems is emerging as a new technology that can offer significant economic potential. Battery storage technology investment provides opportunity in two ways; 1) to reap regional benefits from the establishment of backup power and generators for local businesses and key infrastructure, and 2) to position South Australia as a major international force in the advancement of this sector. On the back of South Australia's strong performance in the development of renewable energy generation, involvement in battery storage technology aligns well with the State's economic and environmental policy directions.

One tangible illustration of this is the transformation of the former Mitsubishi manufacturing site at Tonsley in Adelaide's southern suburbs. The site is recognised as Australia's only urban renewal project to receive 6 Star Green Star Communities certification by the Green Building Council of Australia (Government of South Australia, 2015). The precinct brings high-value manufacturing and technology-based businesses together with the education, training and research sectors, to facilitate innovation and collaboration focussing on green design and sustainable building practices. New development manuals and site-specific design protocols were created for future buildings on the Tonsley site, setting benchmarks for sustainable and liveable urban renewal projects across the country.

The benefits of urban renewal involving reuse of infrastructure are significant. For example, the choice to retain the large assembly building at Tonsley saved around 90,000 tonnes of embodied carbon emissions (Green Building Council Australia, 2016). Key features of the site include integration of residential, transport, leisure and businesses on the one site, water-sensitive urban design, and in the future a 3MW photovoltaic array.

CASE STUDY 3: Heliostat SA Large scale solar technology

Heliostat SA develops, manufactures and constructs large scale solar technology projects, using concentrated solar power (CSP) and concentrated solar photo voltaic (CSPV) to produce greater energy output per square metre than conventional solar power plants.

Four South Australian organisations (Precision Components, the University of South Australia, May Brothers and Enersalt) came together to develop this innovative product.

Heliostat SA have established agreements with India, Japan and the Asia Pacific to deploy three gigawatts of capacity to support their growing energy demands.

Economic and Environmental Benefits:

- ❖ **Creation of hundreds of jobs** over the next two years.
- ❖ **Zero emissions** from production
- ❖ **Low cost** of production
- ❖ **Production of energy day and night**
- ❖ Establishment of an **international market**

Source: <http://www.heliostat.com.au>



3 Opportunities in Northern Adelaide

There is a need to focus attention on the potential contribution that development of an adaptive economy might make to industry diversification and jobs growth in Northern Adelaide. An important starting point is to develop a better understanding of what industry and employment growth opportunities are likely to flow from various mitigation and adaptation measures and link this to the economic priorities in the region.

3.1 Essential Services

The Northern Adelaide region is underpinned by the essential environmental services of water, waste management and energy. These services are well managed and developed in the region, supporting opportunities for sectoral climate change adaptation.

3.1.1 Water and waste management

The water sector is well advanced in the Northern Adelaide region and significant capability in water services delivery exists. The City of Salisbury in Northern Adelaide has pioneered the construction of large-scale urban wetlands in Australia. The Council proposed and developed an area of low-lying saline land into a storm water detention basin and wetlands habitat. Greenfields Wetlands, completed in 1995, covers 114 hectares and acts as a flood protection and retention basin, improving water quality and aquifer storage capacity in the area (City of Salisbury, 2016).

As well as enhancing the amenity of the site, it has provided flood mitigation services and now provides a source of water for local parks and gardens and industry through Salisbury Water. Greenfields Wetlands demonstrates a local community's success in developing an innovative solution to a local issue that has potential to appeal to regions facing similar challenges across the globe.

The Bolivar Waste Water Treatment Plant in Adelaide's north is one of three waste water treatment facilities in Adelaide. In addition to recycling water, the site captures methane and converts it into electricity to power the plant, and organic material is converted to biosolids for soil enhancement (Department of State Development, 2016).

Recycled water from the Bolivar Waste Water Treatment Plant is also used widely in the Northern Adelaide Plains, with 20 GL of recycled water available to horticulturalists from the Virginia Pipeline Scheme.

The innovative approaches to water management in the region are internationally recognised. They also present export opportunities for firms that have developed and applied water management approaches in the region or elsewhere in South Australia which can now be exported overseas. One such example of exporting water management expertise is the Sponge Cities Construction Program in Jinan¹, China, where a MOU with Shandong Ronghui Guantong Pty Ltd and the South Australia Water Industry Alliance identifies opportunities to collaborate, share knowledge and the transfer of intellectual property in relation to water sustainability

¹ The Jinan Sponge Cities project involves the City of Onkaparinga, although the City of Playford is part of a broader local government consortium with cities in Shandong Province.



including development, utilisation, rainwater collection, sewage treatment and sea water desalination with the intent to continue to develop advantages for all parties and their respective provinces and states.

3.1.2 Energy

The renewable energy sector is well developed within the Northern Adelaide region with widespread adoption of particularly solar power generation. The region has the capacity to expand uptake of renewable energy given the diversity of industries and sectors present in the region. The construction and urban renewal, agriculture, defence, mining and tourism sectors would all benefit from investment in renewable energy.

Case Study 4 provides a local example of climate change adaptation in the horticultural sector involving the construction of a major solar thermal electricity generation by Sundrop Farms. The economic and environmental benefits to the local community of this investment are demonstrative of the potential gains from adaptation initiatives. Local jobs were created, operating costs were reduced and agricultural output increased as a result of this investment.

It is noteworthy that Australia's only solar panel manufacturer, Tindo Solar, is located in Northern Adelaide. Tindo is a wholly Australian owned company that designs and manufactures solar panels for Australian and worldwide markets (Tindo Solar, 2016). It has used advanced manufacturing technologies and automation to maintain a strong position in a very competitive global market.

The necessity for countries across the globe to reduce carbon dioxide emissions and adopt cleaner forms of energy production reflects the worldwide demand for renewable energy production and therefore the potential for a national and international market.

CASE STUDY 4: Sundrop Farms Sustainable Horticulture

Sundrop Farms Pty Ltd is a horticultural company near Port Augusta in South Australia's north. It has expanded and adapted its operations to showcase sustainable horticultural production in an arid environment.

Sundrop has constructed a solar thermal facility to generate electricity, desalinate seawater for irrigation and warm and cool the greenhouse.

The ventilation system also uses seawater to clean and sterilise the air as a natural pest management system.

Economic and Environmental Benefits:

- ❖ **Lower operating costs** due to protection from fluctuating water and energy prices
- ❖ **Reduced pesticide use**
- ❖ **Reduced fossil fuel demand**
- ❖ **Efficient use of marginal land**
- ❖ **Creation of around 175 jobs**

Source: (Department of State Development, 2015)



Sundrop Farms. Source: <http://www.sundropfarms.com>



3.2 Sectoral Opportunities

Supported by the essential services discussed above, there are several sectors in Northern Adelaide with relatively strong growth potential. These are:

- Advanced manufacturing
- Construction and urban renewal;
- Health, ageing and disability;
- Horticulture and food production;
- Defence;
- Mining equipment and technology services, and;
- Tourism, recreation and culture.

As a cross cutting theme, Northern Adelaide Green Industries can influence each of these sectors to provide optimum benefits by integrating climate change adaptation and economic development opportunities. In this way, the economic development and employment opportunities can be enhanced, particularly where there is leadership and exemplars able to demonstrate solutions in technology and climate response.

3.2.1 Advanced manufacturing

Rather than being a discrete industry, advanced manufacturing is a dynamic, ever-expanding set of enterprise, sector, and society-wide capabilities spanning technology, innovative business organisation, new materials, increasingly complex global value chains, high performing workplaces, innovative enterprise culture, bundling of products with unique service offerings, etc. Advanced manufacturing changes (indeed transforms) other sectors of the economy and is critical to those surveyed here: water, energy, clean technology, waste management, construction and urban renewal, health, ageing and disability, food and beverages, defence technologies and resources equipment and technology services.

Advanced manufacturing refers to firms and clusters of firms competing on the basis of unique knowledge and expertise, and the application of new knowledge (innovation) to achieve efficiencies in their own production processes, and typically to address environmental, technological or social challenges. They build value through innovation and product and service differentiation, and so avoid having to compete directly on cost against low wage countries or regions. Advanced manufacturing includes high tech, but is not synonymous with it, and is defined by a set of capabilities and characteristics rather than being a particular industry.

It is applied knowledge-intensive and desirable 'economic complexity' par excellence.

The potential contributions of advanced manufacturing to climate change mitigation and adaptation are of two broad types:

- Technological inputs that reduce the climate/environmental impact of the activity (both production and through-life operation), across the board from food production to submarines to mining
- Technologies with an overriding and explicit climate/environmental purpose from clean technologies to climate mitigating and adaptive building construction to water saving technology, etc.



As noted in this report's survey, Northern Adelaide has existing capabilities in climate mitigating and adaptive technologies, such as Tindo Solar, water management, horticulture, and other areas. The potential to augment advanced manufacturing technological inputs to these and other areas should be promoted through a process of 'entrepreneurial discovery' – focused scanning of demographic, technological and other trends to discover opportunities for new products and services. This means public authorities playing a key role in helping capture information, including mapping current industry capacity and capability, workforce requirements, future demand, gap analysis and R&D and technology forecasting.

An area of promise for the North is advanced prefabricated/manufactured building and construction. Existing capabilities and capacity could be augmented for industry growth with major environmental benefits. An existing program, the Advanced Modular Construction Industry Alliance, focusses on applications in remote mining sites. There is a strong case to broaden the focus to take account of the growing sophistication and diversity of prefab and modular housing and construction products.

The attractiveness of prefab as an industry diversification opportunity and a growth opportunity is as follows:

- Adjacency to existing capabilities otherwise being lost (automotive):
 - Almost ready-made workforce
 - Almost ready-made SME capabilities: highly competent tier 2 and 3 component suppliers
 - Opportunity to build efficient, innovative local value chain
 - Build on synergies between automotive manufacturing and industrialized building and construction
- Prefab is a new sector responding to multiple complex problems through greater innovation, specialization and a growing, diverse array of products and services, with implications for diversification of industry:
 - Affordability
 - Lower waste in construction
 - Production efficiencies
 - Time- and cost-reduction
 - Supply chain optimization
 - Higher density/new urban development
 - Environmental performance/carbon footprint
 - New materials, new engineering practice
 - Population ageing/smart homes/assistive technologies
 - Home automation/systems integration
 - New product and service opportunities, with greater complexity and sophistication.

This list makes clear that a focus on this sector could stimulate local advanced, niche manufacturing, with climate mitigation and adaptation a major driver. The national industry peak body, PrefabAUS, leads the drive to innovate in new prefabricated design and building, with the target of trebling the size of the industry by 2020.

3.2.2 Construction and urban renewal



The construction and urban renewal sector is already strong in Northern Adelaide with the presence of more than 3,000 construction-related small businesses (Department of State Development, 2016). Opportunity for further growth of this sector is predicted, with the 'Look North' plan identifying that major construction projects are planned for Northern Adelaide, generating around 1,500 new jobs (Department of State Development, 2016).

The planned residential developments, urban renewal projects, local school and city centre upgrades, and social housing construction present opportunities for the construction sector to develop innovative, climate change-adapted buildings. The Weeks Group in Adelaide's north is an example of a construction company that has developed an innovative product for the construction of energy efficient, affordable housing to meet demand in this sector (Department of State Development, 2016). They designed a steel framing system that has high thermal insulation properties enabling a reduction in household heating and cooling costs. This type of innovative product development could be eligible to benefit from participation in the Australian governments Emissions Reduction Fund, providing additional financial support to a local business.

There is likely to be widespread demand for these types of novel construction and design systems, providing domestic and international export potential for the region.

3.2.3 Health, Ageing and Disability

The health, ageing and disability sectors have also been identified as having significant potential industry and employment growth. Populations are ageing globally, forcing innovators to develop new products and services to meet the needs of ageing communities.

There is potential for local manufacturers to diversify into producing new tools, components or products for medical devices and assistive technologies that support healthy ageing (Department of State Development, 2016). This will be aided by a commitment in the 'Look North' plan to the formation of an industry network to foster innovation and collaboration in the assistive technology sector in northern Adelaide.

Support services and assistive technologies will be in increasing demand as population's age in Australia and throughout the OECD. Opportunities exist for Northern Adelaide to respond to this demand and establish a national and international market for these innovative products.

3.2.4 Horticulture and food production

Northern Adelaide possesses significant strength in food production, processing and distribution. The Virginia horticultural area is one of Australia's premier horticultural districts, with annual farm gate production of \$250 million, and potential for growth (WISeR, 2014). Within the region major food processors are clustered in Salisbury South, Pooraka and Edinburgh North, while Pooraka is home to South Australia's largest wholesale produce market, and significant cold store and distribution facilities exist in Pooraka, Direk and Penfield.

While warmer and drier conditions and an increased risk of extreme weather events could impact the sector under climate change, the region's efforts in water infrastructure improvement, through creating wetlands, aquifer storage and recovery schemes, and in wastewater recycling, provide climate resilience and continued economic opportunities. For example, during the summer and in prolonged droughts, the region's use of multiple sources of water provide for continuous growing and harvesting of farm produce. This will be further enhanced by an additional 20 GL of



recycled water from the Bolivar wastewater treatment plant that will become available for food production in the next 5-10 years.

The *Strength in Diversity* report (WISeR, 2014), discusses establishing a Horticultural Innovation Centre in the region. This centre would link producers with training and R&D and business improvement, taking a whole of value chain approach involving sorting and packing, quality control, marketing and branding, collaboration and relationship building with buyers and markets (WISeR, 2014). Innovations in climate change adaptation could be driven by support from such a centre, identifying and using the opportunities provided by the sector's growth to expand value adding by the industry, and to develop locally manufactured inputs and services to manage climate change impacts.

The report indicates that the Horticulture Innovation Centre has strong institutional support from the Wakefield Group, which is a collaboration comprising all councils or council areas making up the federal seat of Wakefield, and which is well-positioned to lead and oversee the advancement of many of these projects, in collaboration with the Stretton Centre (WISeR, 2014).

Communities outside the region, including overseas, are also faced with extreme weather events and warmer, drier conditions, providing Northern Adelaide with a potential international market for its innovative climate change adaptation solutions for this sector.

3.2.5 Defence

South Australia's defence technology and manufacturing industry is largely concentrated in Northern Adelaide. The region supports more than 85% of Adelaide's defence industry activity, with about 5,000 highly skilled defence industry workers employed in the region (Department of State Development, 2016).

Recent commitment to naval ship building in Adelaide's north presents a significant opportunity for defence sector knowledge and technology transfer to support the growth of the adaptive economy, particularly through the development and application of advanced energy storage systems and smart materials utilising nanotechnologies. The region's expertise in stormwater management, biodiversity enhancement and renewable energy production can service defence sector site and operational requirements. Defence industries can also be an important customer for the region's businesses that provide specialist manufacturing and technology services as well as businesses providing green, low carbon and cost saving solutions in energy management, resource efficiency and waste to recycling technologies.

The innovative products and solutions applied locally to the defence sector will have national and international appeal and therefore potential for establishment of external markets in this sector.

3.2.6 Mining equipment and technology services

Northern Adelaide is well-positioned to service the global mining equipment and technology sector. The challenge is to develop more sustainable mining processes utilising more efficient methods of extraction and renewable energy sources. The University of South Australia, based in Mawson Lakes, specialises in research in this area, and many local companies have emerged as important players in the innovation and development of these services. The Ian Wark Institute is a leading centre of expertise in mineral processing; firms like Ausco Modular, Osmoflo and Jumbo Vision are supplying products as diverse as temporary accommodation, desalination plants and control rooms into resource major projects (WISeR, 2014).



South Australia has a portfolio of diverse high value resource and energy projects that could provide diversification opportunities for manufacturers in Northern Adelaide, with climate change adaptation at the forefront of innovation.

Additionally, assistance to link local businesses in the north of Adelaide to global mining equipment and technology opportunities is provided by the Mining and Petroleum Services Centres of Excellence and Industry Capability Network SA, driving significant export potential for this sector.

3.2.7 Tourism, recreation and culture

Northern Adelaide currently has an increasing number of visitors to the region with recent improvements to the St Kilda Playground, waterfront areas and wetlands and new opportunities associated with the creation of the Adelaide International Bird Sanctuary. These developments are building the region's attractions with hosting of community events, and food-related tourism also contributing to this trend (Department of State Development, 2016).

There is potential for further increase in tourism, recreation and culture through expansion of sporting facilities, promotion of wineries and restaurants, and expansion of community events programs. One example is the planned development City of Playford Sports Precinct which will create facilities of excellence for sporting activities. This growth potential, coupled with the well-developed essential services of energy, water and waste management in the region, has the capacity to drive climate change-adapted initiatives in this sector. Demand for carbon-neutral events and innovative waste and water management solutions locally and globally, positions Northern Adelaide well for meeting this sector's needs.

An additional consideration for capacity in all of these sectors is the potential opportunity that may surface from the closure of the auto-manufacturing industry in Northern Adelaide. This closure presents major challenges to business and workers dependent on the auto-manufacturing sector. An Adaptive Economy strategy needs to consider the reskilling of automotive workers and re-use of car manufacturing facilities to service growing demand for products and services that are responsive to climate change imperatives. The potential opportunities identified within the seven sectors described in the above sections may assist to support the transition of the automotive workers and to utilise the large-scale facilities in the region.

4 Next Steps

The City of Playford and City of Salisbury have committed to supporting the development of a Northern Adelaide Green Industries Region based around collaborating with industry and governments and other South Australian regions. The initiative seeks to optimise green industries networking, promote Northern Adelaide's business capabilities and services and develop pathways to access procurement supply chains to provide solutions for climate adaptation, low carbon and green customer needs.

This discussion paper outlines a broad range of climate change adaptation opportunities across seven sectors and considers the complementary role of the essential services present in the Northern Adelaide region. To further define the benefits and costs of these opportunities, it may



assist to undertake detailed analysis of selected options to identify the potential contribution they might make to a more sustainable and prosperous future for the region.

Given the importance of engaging with stakeholders on potential actions and strategies, it is proposed that an Adaptive Economy Forum explore the following questions for the Northern Adelaide Region: :

- ◆ What sustainability, industry and employment development benefits might flow from pursuing specific opportunities?
 - ◇ What is the existing expertise and capability in the region to pursue these opportunities?
 - ◇ What issues need to be solved in the region and have potential for global application?
 - ◇ What are the tradeoffs and potential benefits?
 - ◇ How can industry grow but pollute less?
- ◆ How do we better promote the region and what branding and marketing would accelerate growth for sustainable energy management, low carbon and green industries?
- ◆ What links to funding and finance need to be explored?
- ◆ What changes may need to occur to realise these opportunities and what barriers should be addressed?
- ◆ What links to funding and finance need to be explored?
- ◆ What policies, incentives and structures are needed to drive collaboration?



References

- Andersen, M. S. (2007). An introductory note on the environmental economics of the circular economy. *Sustain Sci*, 2, 133-140.
- Australian Cleantech, & Bridge8. (2010). *South Australian Cleantech Capacity and Capability Final Report*. Retrieved from
- Australian Conservation Foundation, & Australian Council of Trade Unions. (2008). *Green Gold Rush: How ambitious environmental policy can make Australia a leader in the global race for green jobs*. Retrieved from https://www.acfonline.org.au/sites/default/files/resources/Green_Gold_Rush.pdf
- Australian Government. (2016). Australian Trade Commission. Green and Sustainable Building. Retrieved from <https://www.austrade.gov.au/greenbuildings/>
- Bowen, A. (2012). 'Green' Growth, 'Green' Jobs and Labor Markets. Retrieved from London: <http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/02/WP76-green-growth-green-jobs-labour-markets.pdf>
- City of Salisbury. (2016). Greenfields Wetlands. Retrieved from http://www.salisbury.sa.gov.au/Live/Environment_and_Sustainability/Wetlands_and_Water/Wetlands/Wetlands_Locations/Greenfields_Wetlands
- Department of State Development. (2015). *Low carbon investment plan for South Australia: Strategy Paper*. Retrieved from http://www.renewablessa.sa.gov.au/files/dsd_2015-low-carbon-investment-plan_web.pdf
- Department of State Development. (2016). *Northern Economic Plan*. Retrieved from Adelaide:
- European Commission. (2014). *Assessing the Implication of Climate Change Adaptation on Employment in the EU: Final Report and Annexes*. Retrieved from Rotterdam:
- Fankhauser, S., Sehleier, F., & Stern, N. (2008). Climate change, innovation and jobs. *Climate Policy*, 8, 421-429.
- Garnaut, R. (2011). *The Garnaut Review 2011. Australia in the Global Response to Climate Change*. Retrieved from <http://www.garnautreview.org.au/update-2011/garnaut-review-2011/garnaut-review-2011.pdf>
- Government of South Australia. (2015). *South Australia's Climate Change Strategy 2015-2050: Towards a low carbon economy*. Retrieved from Adelaide: http://www.environment.sa.gov.au/Science/Science_research/climate-change/climate-change-initiatives-in-south-australia/sa-climate-change-strategy
- Green Building Council Australia. (2016). Green Building Council Australia. Retrieved from <http://www.gbca.org.au/>
- International Labour Organization. (2011). *Promoting Decent Work in a Green Economy*. Retrieved from ILO Background note to "Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication". UNEP:
- IPCC. (2014a). Climate Change 2014: Mitigation of Climate Change. . In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlomer, C. von Stechow, T. Zwickel, & J. Minx (Eds.), *Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- IPCC. (2014b). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Retrieved from Geneva, Switzerland:
- Levy, C. (2010). *A 2020 Low Carbon Economy. A Knowledge Economy Programme Report*. Retrieved from The Work Foundation, Lancaster University: http://www.theworkfoundation.com/downloadpublication/report/243_lowcarbonfinal_corrected.pdf
- Markey, R., McIvor, J., & Wright, C. (2014). *Climate Change and the Australian Workplace*. Retrieved from Sydney: http://www.businessand economics.mq.edu.au/_data/assets/pdf_file/0014/336101/Climate_C_hange_and_The_Australian_Workplace_2014.pdf



- Nixon Apple. (2015). *Financing and Building a New Generation of Fast Growing Start-ups, Gazelles and Unicorns: Some Personal Observations*. Retrieved from
- OECD/Martinez-Fernandez, C., Hinojosa, C., & Miranda, G. (2010). *Green jobs and skills: the local labour market implications of addressing climate change*. Retrieved from <http://www.oecd.org/regional/leed/44683169.pdf>
- Office of Green Industries SA. (2015). *South Australia's Waste Strategy 2015-2020*. Retrieved from Adelaide:
- Organisation for Economic Cooperation and Development (OECD). (2012). *The jobs potential of a shift towards a low-carbon economy. Final Report for the European Commission (DG Employment)*. Retrieved from <http://www.oecd.org/els/emp/50503551.pdf>
- Rafferty, M., & Yu, S. (2010). *Skills for green jobs in Australia*. Retrieved from Geneva:
- Robertson, M., Carberry, P., & Brennan, L. (2007). *The economic benefits of precision agriculture: case studies from Australian grain farms*. Retrieved from <https://grdc.com.au/uploads/documents/Economics%20of%20Precision%20agriculture%20Report%20to%20GRDC%20final.pdf>
- Rosemberg, A. (2010). Building a Just Transition: The linkages between climate change and employment. *International Journal of Labour Research*, 2(2), 38.
- Stern, N. (2007). *The Economics of Climate Change: The Stern Review*. United Kingdom: Cambridge University Press.
- Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: moving from rhetoric to implementation. *Journal of Cleaner Production*, 42, 215-227.
- Tindo Solar. (2016). Tindo Solar. Retrieved from <http://www.tindosolar.com.au/>
- United Nations Environment Programme (UNEP). (2008). *Green Jobs: Towards decent work in a sustainable, low carbon world*. Retrieved from http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_158727.pdf
- United Nations Environment Programme (UNEP). (2010). *Green economy: Developing countries success stories*. Retrieved from http://web.unep.org/greeneconomy/sites/unep.org.greeneconomy/files/publications/greeneconomy_successstories.pdf
- Whelan, B. (2011). *A review of the history of Precision Agriculture in Australia and some future opportunities*. Retrieved from <http://sydney.edu.au/agriculture/pal/documents/Brief%20History%20of%20PA%20in%20Australia.pdf>
- WISer. (2014). *Strength in Diversity: Diversification, Innovation and Jobs. Commonwealth Review of SA Economy and Impact of GMH Closure*. Retrieved from Adelaide:



Australian Industrial Transformation Institute
Flinders Business School
Faculty of Social & Behavioural Sciences
Flinders University
GPO Box 2100
Adelaide SA 5001
P: 08 8201 5083
E: aiti@flinders.edu.au