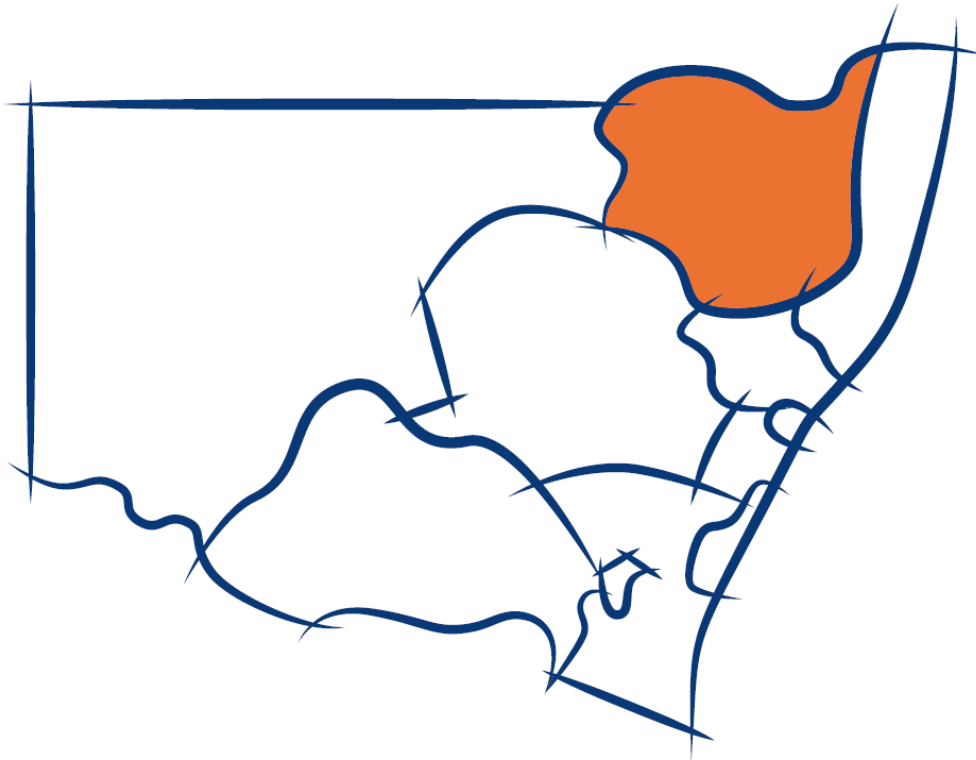




Western Enabling Regional Adaptation

New England North West region report



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1 Introduction

The climate is changing and global modelling indicates that further change is already locked in. As a result there is a growing risk of climate related impacts on our state's natural, social and economic systems. Regional administrators, businesses and communities need to identify their strengths and weaknesses in the face of climate impacts – deciding how they will act together to minimise the impact of climate change on their local economy, environment and society.

Climate affects multiple systems and so risks from climate require a systemic, coordinated response. From a practical perspective, this requires input, agreement and collaboration of multiple stakeholders, amongst whom there may be no history of cooperation. In partnership with leading researchers, the Office of Environment and Heritage (OEH) has developed and delivered processes that enable regional scale consideration of climate projections and investigation of related impacts.

The Western Enabling Regional Adaptation (WERA) project builds on local knowledge to understand climate vulnerabilities in Western NSW and identify opportunities to respond, enabling regional decision-makers to enhance government service delivery and planning at a regional and subregional scale.

The WERA project provides a structured process for participation by representatives of NSW Government agencies, local government and key regional stakeholders, using their tacit local knowledge to identify and capture opportunities to build regional resilience. By enabling participatory learning, the WERA process develops new and expanded professional networks which can be mobilised to respond to climate change. This operational knowledge of how regional systems interact informs the development of adaptation responses that are sensitive to the reality of local systems.

The WERA project has sought to:

- provide a credible evidence base for Government adaptation planning by developing a regional understanding of the impacts of projected climate change and vulnerability to the expected impacts for the New England North West region
- build on the capacity of regional decision-makers to undertake adaptation action by improved understanding of regional climate change impacts, adaptive capacity, vulnerability and adaptation options, and
- strengthen relationships between sectors across local and state government in the four western regions, with a view to capturing opportunities for regional climate change adaptation projects.

This report presents the output from a series of workshops held in the New England North West region during 2016. Workshop participants developed transition pathways for key regional systems, to build resilience to climate extremes and minimise impacts on their local communities.

The report also outlines the workshop process, and potential projects to activate the transition pathways and strengthen key regional systems in the New England North West, and support improved government service planning and delivery now and into the future. The final chapter of the report gives proactive ways to turn the report's findings into action.

2 What needs to change in the New England North West region?

2.1 Identification of vulnerable regional systems

The state's regions are subject to a broad range of drivers of change (economic, technological, social and environmental). Regions such as the New England North West are made up of many component parts (or systems) that all contribute to how the region currently functions (business-as-usual) and its trajectory of future development. A region's resilience in response to drivers of change relies on its capacity to adapt. For temporary drivers (such as fluctuations in agricultural commodity prices), basic alterations to business-as-usual may be an adequate response; however, for persistent and disruptive drivers such as climate change, more fundamental and transformative change may be required to adapt regional systems.

For the New England North West, eight regional systems were identified as particularly vulnerable and in need of change to ensure effective ongoing government service planning and delivery:

- major regional centres
- communities
- human services
- youth
- grazing (of livestock)
- agricultural production
- water
- energy.

2.2 Transition models for key regional systems

For each of the key regional systems identified, a change model was developed to describe:

1. the regional system (or set its boundaries)
2. the most important drivers acting on the system, which currently may not be climate related; however, the impacts of non-climate drivers will likely be amplified by climate change
3. business-as-usual (or the way the system currently operates)
4. a series of transition pathways that emerge from business-as-usual in response to the need for change
5. a desirable future system, transformed by progress along the transition pathways.

Major regional centres

Tamworth and Armidale are the major regional centres for the New England North West. They service a population of around 30,000–60,000 people as well as providing services to the broader region. The future development of Tamworth and Armidale is critical to supporting transformational change throughout the region. Figure 1 shows the change model for these two major centres.

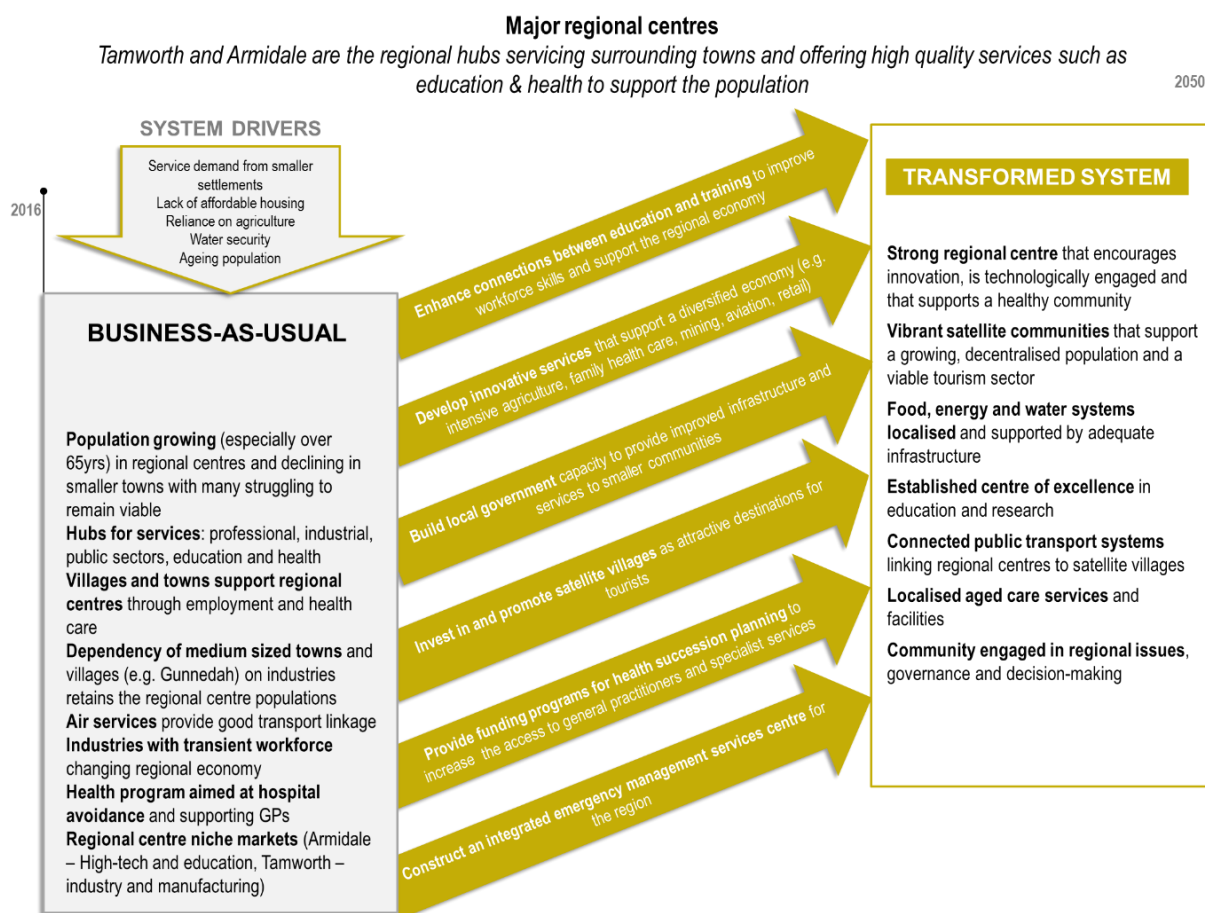


Figure 1: Change model for the major regional centres of Tamworth and Armidale

Tamworth and Armidale are influenced by a range of biophysical, economic and social drivers including demographic change (in particular ageing of the population), lack of affordable housing, reliance on agriculture as the major regional industry, the demand for services from surrounding smaller settlements and water security.

Tamworth and Armidale currently have growing populations, especially the over 65 years population. This is in contrast to some of the region’s smaller towns, with many struggling to remain viable and relying on Tamworth and Armidale niche markets for professional, industrial, education, health and public sector services. Both centres are serviced by air transport that is used by industries with transient workforces, which is driving change in the regional economy. Service provision in the health sector is responding to increasing demand by encouraging hospital avoidance and support for general practitioner (GP) services.

Pathways leading to a transformed future for Tamworth and Armidale include better connections between education and training to enhance workforce skills and drive the development of innovative regional services to support economic diversification. Building the capacity of local government to provide infrastructure and services, and investment in satellite towns would improve the viability and liveability of smaller regional towns. Funding for health succession planning to increase access to GPs and specialist services would help to relieve pressure on Tamworth’s and Armidale’s hospitals. Finally, construction of an integrated emergency management centre for all combat agencies would improve natural disaster response and assist climate adaptation.

A transformed future envisions Tamworth and Armidale as strong regional centres, innovative and technologically engaged and supporting a healthy community. Surrounding satellite towns support a growing decentralised population and a viable tourism sector. Services such as aged-care, food, energy and water are localised and transport connects satellite towns to the regional centre through establishment of modern infrastructure. Communities are actively engaged in regional decision-making. Both centres host a centre of excellence in education and research to help retain youth and provide innovative solutions to regional problems.

Communities

Under the change model, communities in the New England North West were defined around the goal of developing stronger settlements through coordinated physical and social infrastructure that is adapted to climate and community needs (Figure 2).

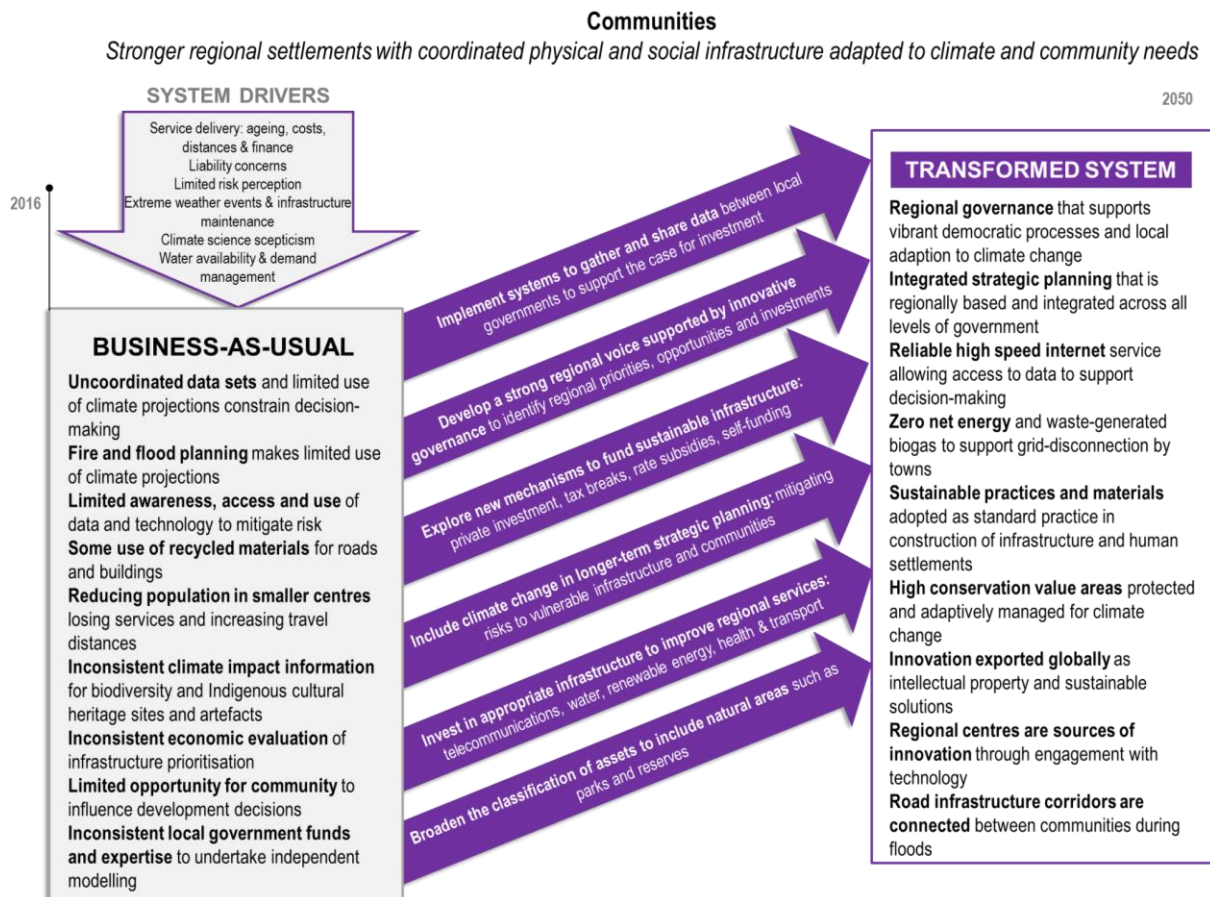


Figure 2: Change model for communities

In keeping with human settlements throughout western NSW, those in the New England North West are influenced strongly by the availability of and demand for water resources. While extreme weather events drive rising infrastructure maintenance costs, community scepticism towards climate science and limited perception of climate risk are factors that inhibit change. Local government is increasingly influenced by concerns about liability in relation to climate change. In addition, service delivery to communities is under pressure to meet the demands of an ageing population, costs of service provision, remoteness of communities, and financial viability of local government.

Communities are currently characterised as suffering from constrained decision-making on climate change because of uncoordinated data, limited use of projections in disaster planning and a lack of information about climate impacts on natural and cultural heritage. As a consequence, decision-makers have limited awareness, access to and use of data and technology that could help reduce climate risk. Sustainability is being addressed to some extent through use of recycled materials in roads and buildings. Local governments across the region are inconsistent in economic evaluation of infrastructure prioritisation, funding and expertise to independently model impacts, with limited opportunity for the community to influence development decisions.

Transition pathways for communities focus heavily on investment in infrastructure. These include collection and sharing of data among local governments to support investment, and development of a stronger regional voice in priority setting and decision-making supported by innovative governance. Greater investment in appropriate infrastructure (e.g. telecommunications, water, renewable energy, health and transport) should be linked to new funding mechanisms to encourage private investment. Broadening the classification of assets to include natural areas (parks and reserves) would help ensure environmental protection. The inclusion of climate change in longer-term strategic planning would help to mitigate risks to vulnerable infrastructure and the communities it supports.

Transformed communities are envisioned as having vibrant democratic processes that embrace local adaptation to climate change. The region's natural environment, in particular areas of high conservation value, is protected and adaptively managed for climate change. Strategic planning is regionally based and integrated across all levels of government. The region has achieved energy sustainability with towns grid-disconnected. Standard practice in construction of infrastructure and human settlements embodies the use of sustainable practices and materials. Services and infrastructure, in particular high speed internet, support decision-making through data access, and have established the region as a source of innovation and sustainable solutions that are exported globally. The region has road infrastructure corridors that link communities during floods.

Human services

Human services for the New England North West were defined as health, education emergency management and social services across the three tiers of government (Figure 3).

The demand for human services in the region is influenced by the increasing effects of climate impacts on health and mental health, an ageing population, the workforce and poor housing affordability. Service provision is constrained by limited funding under increasing costs, competitive funding models and traditional delivery of health and education services.

Currently, human services provide for a regional population that is dispersed, diverse and remote, with limited transport connectivity to major centres, making service access and delivery difficult. Access to health and social services in particular is limited, due to increasing costs, declining community health, GP retirements and limitations on specialist services from high turnover and low retention of regional doctors. Emergency management is coping with a declining volunteer base. Mental health problems and chronic illness are accentuated by climate related and economic stress. In the education sector, new partnerships have formed between the University of New England and TAFE, incorporating shared service models.

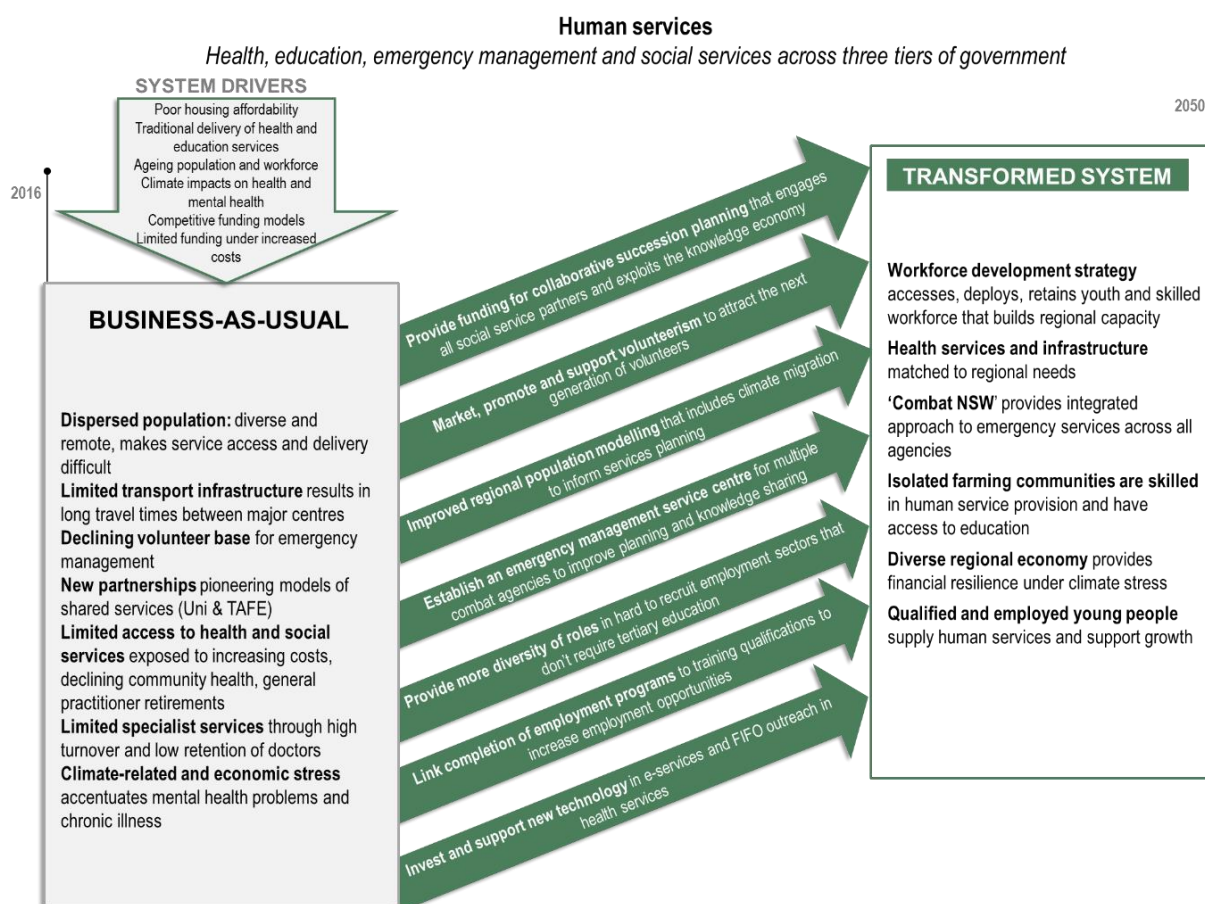


Figure 3: Change model for human services

A range of transition pathways were identified for regional human services. For example, the inclusion of scenarios for climate induced migration would improve population modelling to better inform human service planning. Establishment of an emergency management service centre for all combat agencies would improve disaster planning and knowledge sharing. Better marketing, support and promotion of volunteerism is needed to attract the next generation of volunteers. Establishment of a link between completion of employment programs and training qualifications would lead to increased employment opportunities. Provision of more diverse roles with less onerous qualification requirements would boost recruitment in sectors that struggle to attract workers. E-services, fly-in-fly-out (FIFO) outreach health services and home or community based ambulatory care services could be improved through greater investment and support in new technology.

A transformed future for health services envisions a workforce development strategy that accesses, deploys and retains youth and a skilled workforce that builds regional capacity. Services are closely matched to the needs of isolated farming communities and the ability to increase skills in human service provision. An integrated emergency services agency, 'Combat NSW', provides regional emergency management services. The regional economy is more diverse and financially resilient under climate stress and employs qualified, young human service workers to support economic growth.

Youth

Regional demographic projections suggest youth retention is needed to support transformation in the New England North West. Youth retention was defined as the retention and attraction of youth (18–35 year olds) through the remaking of communities to be healthy, creative and diverse (Figure 4).

Although recognised as a complex issue, seven drivers were identified as contributing to the loss of regional youth: declining regional services and support mechanisms, an ageing workforce, education, a lack of employment opportunities and of affordable housing for young people, limited career advancement potential, and the school leaving age is increasing and students are not taking up apprenticeships.

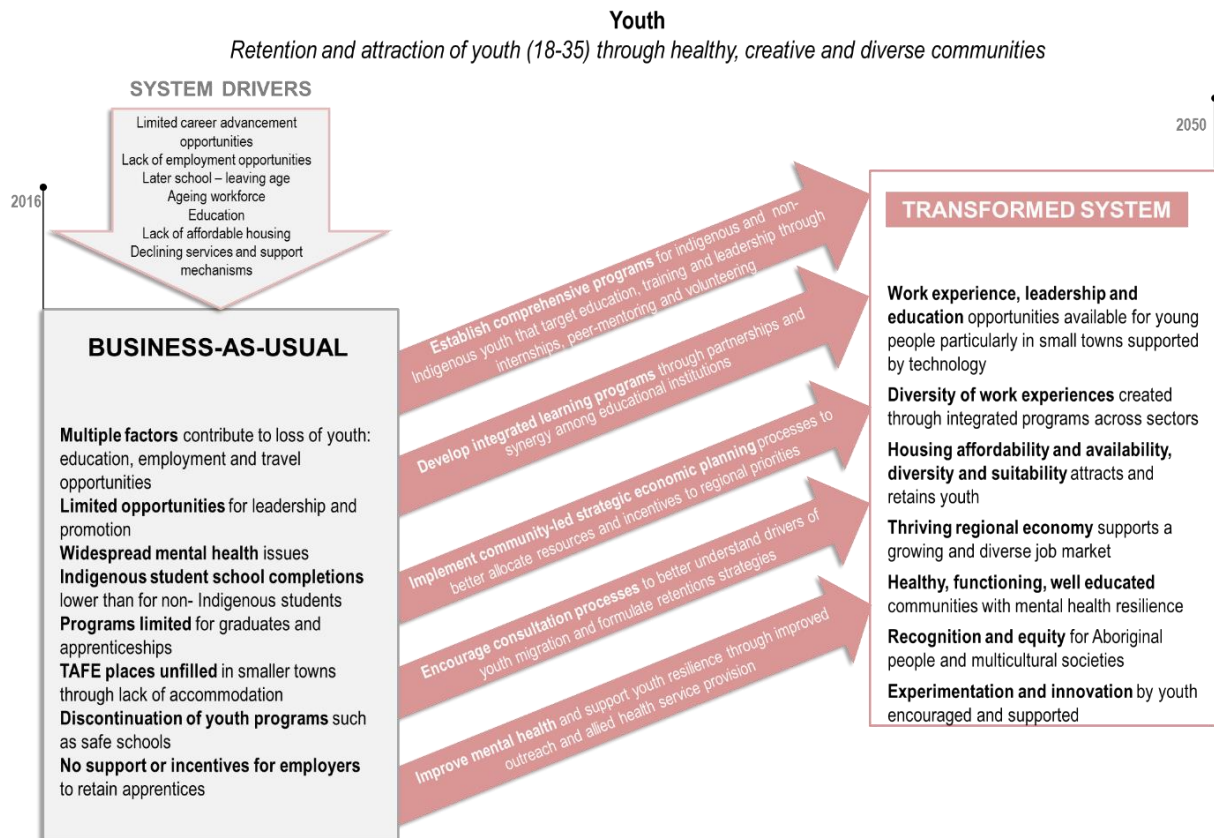


Figure 4: Change model for youth

Currently, multiple factors contribute to the loss of regional youth including the universal need to broaden experiences through travel as well as greater opportunities for education, employment, leadership and promotion outside the New England North West. In addition, youth support programs have been discontinued, school completions by Aboriginal students are comparatively low, TAFE places in some locations remain unfilled through a lack of local accommodation, no support for employers to retain apprentices and employment programs are inadequate for graduates and apprentices. These issues contribute to widespread mental health issues among regional youth.

Transition pathways towards youth retention and attraction focus on improved engagement processes, education and training opportunities, and establishment of support programs. Enhanced opportunities for internships, peer-mentoring and volunteering established through comprehensive programs (for Aboriginal and non-Aboriginal youth) would expand formal education, training and leadership skills. These opportunities would be complemented through partnerships among educational institutions to better integrate existing learning programs. Youth mental health and resilience issues could be addressed through provision

of improved outreach and allied health services. Consultation processes should be established that improve the understanding of drivers of youth migration and inform retention strategies with resources and incentives allocated to these priorities through economic planning that is community-led.

A transformation for youth in the region would see the technology-supported work experience, leadership and education opportunities established, particularly in small settlements, linked to cross-sectoral programs that diversify work experiences. Regional communities are healthy, functioning and well educated, and encourage experimentation and innovation by young people. The contribution of Aboriginal people to the region is recognised and the 'gap' between Indigenous and non-Indigenous youth has been closed. The region is attractive to youth through an economy that is thriving and supports a growing and diverse job market, and through regional housing that is affordable, available and diverse.

Grazing

The grazing system in the New England North West was defined under the change model as utilising pastures to feed livestock (Figure 5).

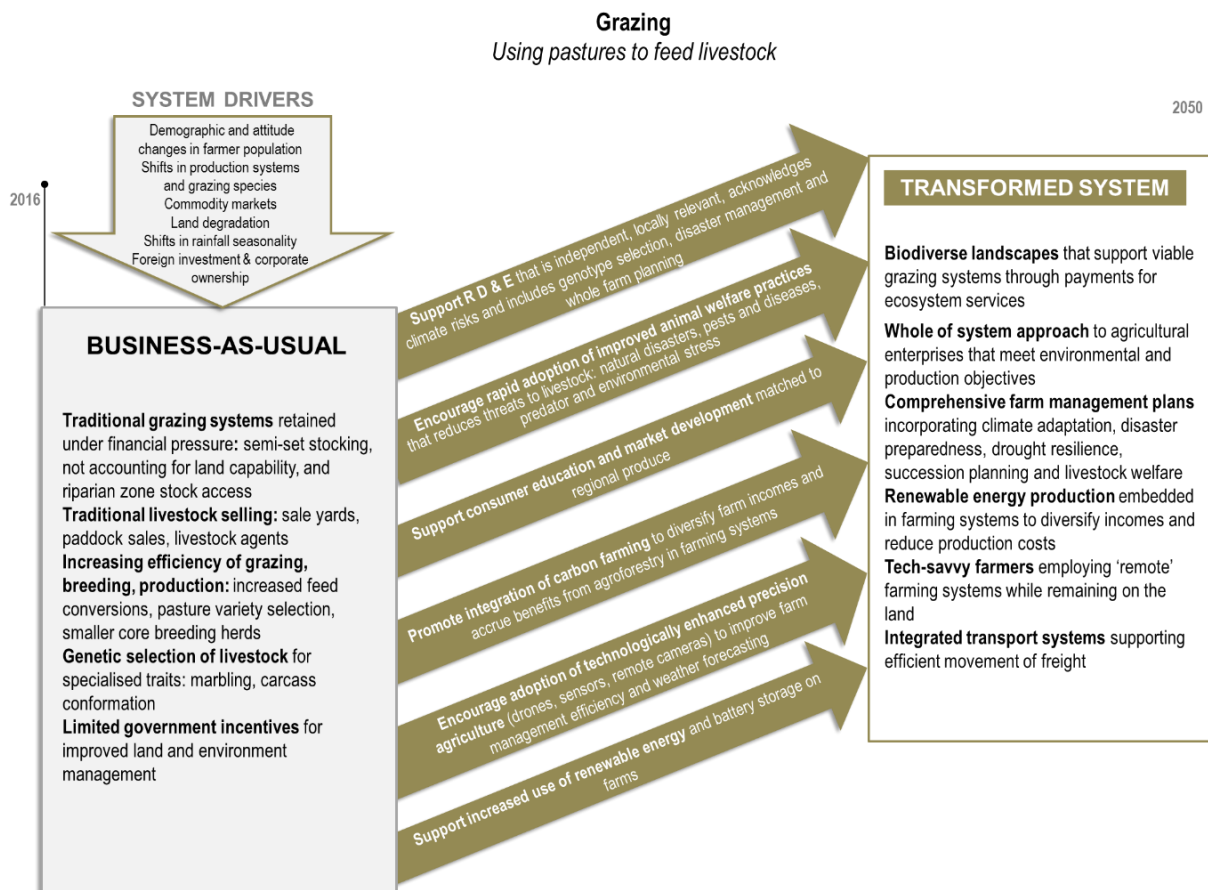


Figure 5: Change model for grazing

Major drivers on the region’s grazing system relate primarily to changes in the natural resource base, the global economy and social factors influencing farming communities. Changes in rainfall seasonality, land degradation and climate induced shifts in production systems and

species composition of the pasture-base were major natural resource drivers. The economy influences grazing systems through commodity markets, which determine the prices graziers received for their products on international markets, and foreign investment in regional agri-business. Social changes in farming communities were attributed to corporate-ownership of agricultural enterprises and demographic and attitudinal changes in farming communities.

The traditional grazing enterprises in the New England North West, characterised by semi-set stocking (rather than rotational grazing management), operationally-blind to land capability and riparian zone stock access, remain in the region but are increasingly under financial pressure. The sale of livestock is conducted mainly through traditional methods of sale yards, paddock sales and stock agents. However, newer forms of management that rely on increased efficiency of grazing, breeding and production through better feed conversion, pasture variety selection and a reduction in core breeding-herd size are now also common. Genetic selection of livestock is common to enhance specialised traits to match market requirements (e.g. marbling and carcass conformation). Government incentives that promote improved land and environmental management practices are limited.

Change in grazing systems would be promoted through transition pathways that encompass greater support for research, development and extension that is independent, locally relevant, acknowledges climate risks and includes selection of adapted genotypes (plants and livestock). In addition, rapid adoption of technologically-enhanced precision agriculture would lead to improvements in farm management efficiency and agility in response to weather forecasting. Threats of climate change to animal welfare would be mitigated through rapid adoption of improved livestock practices to deal with natural disasters, pests and diseases, predators and environmental stress. Farm incomes would be diversified and farming system sustainability improved through the integration of carbon farming (particularly agroforestry). Greater use of renewable energy on farms, particularly in relation to battery storage, would improve the viability of grazing enterprises.

Transformation in regional grazing systems envisions a holistic approach to livestock enterprises that meet production and environmental objectives and operate in biodiverse landscapes supported through payments for ecosystem services. Climate adaptation, disaster preparedness (especially for drought), succession planning and livestock welfare are integrated in comprehensive farm management plans. Renewable energy production is embedded in farming systems to diversify incomes and reduce production costs from energy consumption. Remote farming systems managed by 'tech-savvy' farmers have become established best practice. The movement of freight is efficient through the adoption of integrated transport systems that support agricultural value chains.

Agricultural production

Agricultural production systems were defined under the change model as crop and livestock systems utilising intensification to improve quality control and mitigate climate risk through increased efficiency (Figure 6).

Agricultural production is primarily driven by natural resource availability and the search for more efficient forms of marketing. Availability of water resources is critical and is affected on the supply side by changing rainfall patterns, soil moisture storage, recurring drought and proximity to resources. On the demand side, rising competition for water resources in the region and conflict over land use are increasingly important. Intensification is also influenced by the need for more efficient marketing through integration of supply chains and improved access to consumers, markets and capital. Other important drivers include proximity to other resources (e.g. waste products) and infrastructure (energy and transport).

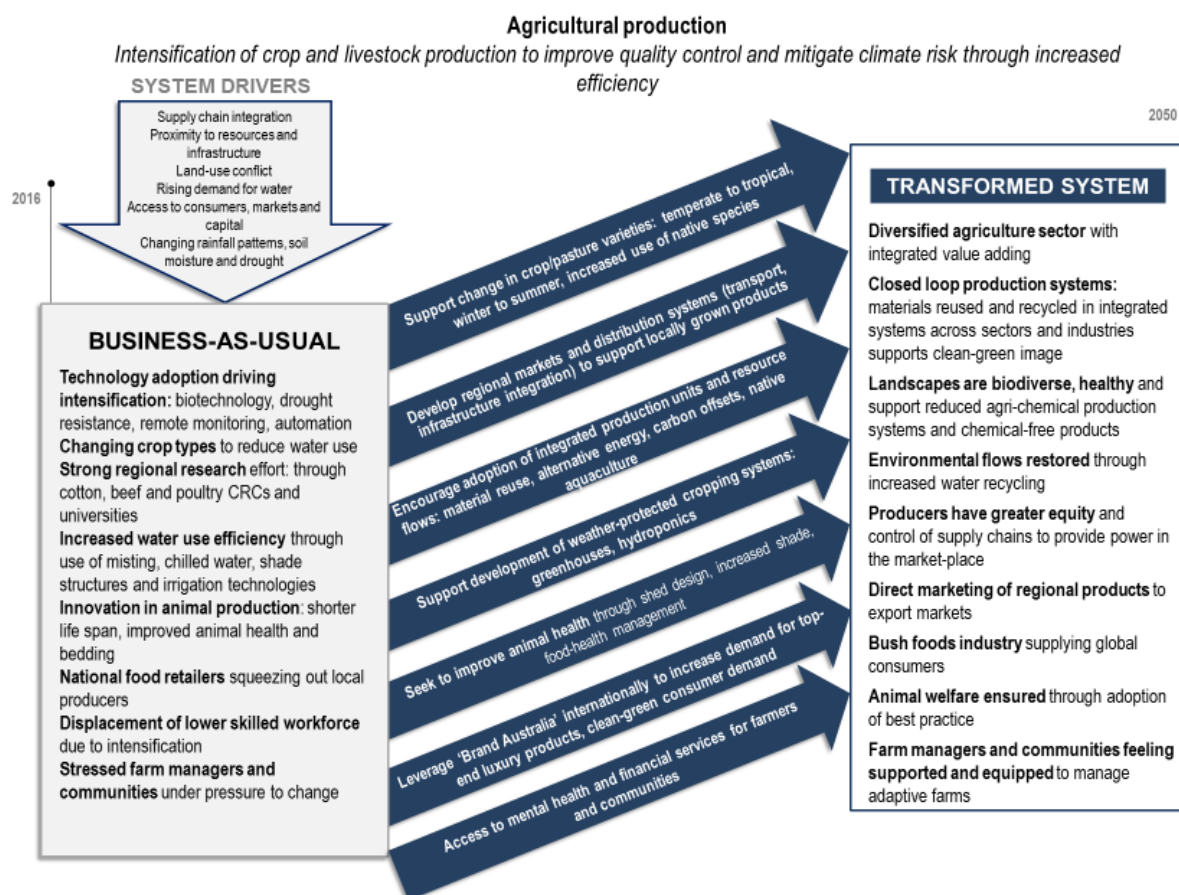


Figure 6: Change model for agricultural production

Currently, intensification is supported by a strong regional research effort through the cotton, beef and poultry sectors. Agricultural enterprises are adopting a range of technologies to intensify production including biotechnology, water efficient crop species and cultivars, remote farm monitoring and automation. However, some of these changes have led to the displacement of lower skilled workers from the workforce. Animal producers use water efficiently to mitigate heat impacts on livestock through misting, chilled water supplies, provision of shade and irrigation technologies. Innovation in animal production currently includes shorter animal life spans grown under improved animal health practices. Local food supply chains are increasingly under threat from national food retailers. The pressure for change has consequences in heightened stress levels experienced by farm managers and communities.

While rapid change is already occurring, most transition pathways called for increased support to assist with adoption of innovation including shifts to climate adapted crop and pasture species, integrated production units and resources flows on-farm and across sectors/industries, development of weather protected cropping systems (greenhouses, hydroponics), and further improvements to animal health (shed design, shade, and nutrition). Locally grown produce would be better supported by the development of regional markets and distribution systems that integrate transport with other types of infrastructure. Finally, the region should seek to leverage 'Brand Australia' internationally to increase demand for luxury products and clean-green regional produce. Farmers and communities have access to mental and financial services.

Transformation of intensive production systems envisions a diversified agriculture sector featuring local value adding. The region is seen as a leader in clean-green production through material reuse and recycling in closed loop, low-chemical production systems situated in biodiverse, healthy landscapes. Increased water recycling has allowed for the restoration of environmental flows to the region’s river systems. Producers have increased power in the marketplace through greater equity in and control of their supply chains. Direct marketing arrangements link regional producers with international buyers. A regional bush food industry supplies global consumers with a unique range of niche, high value products. The region is recognised as a leader in animal welfare through best practice production. Farm managers and communities are well equipped and supported to manage adaptive farms.

Water

The water system in the New England North West was defined as one that provides water efficiently and securely for current and future generations and where the supply from natural ecosystems is enhanced by improved recycling efficiency (Figure 7).

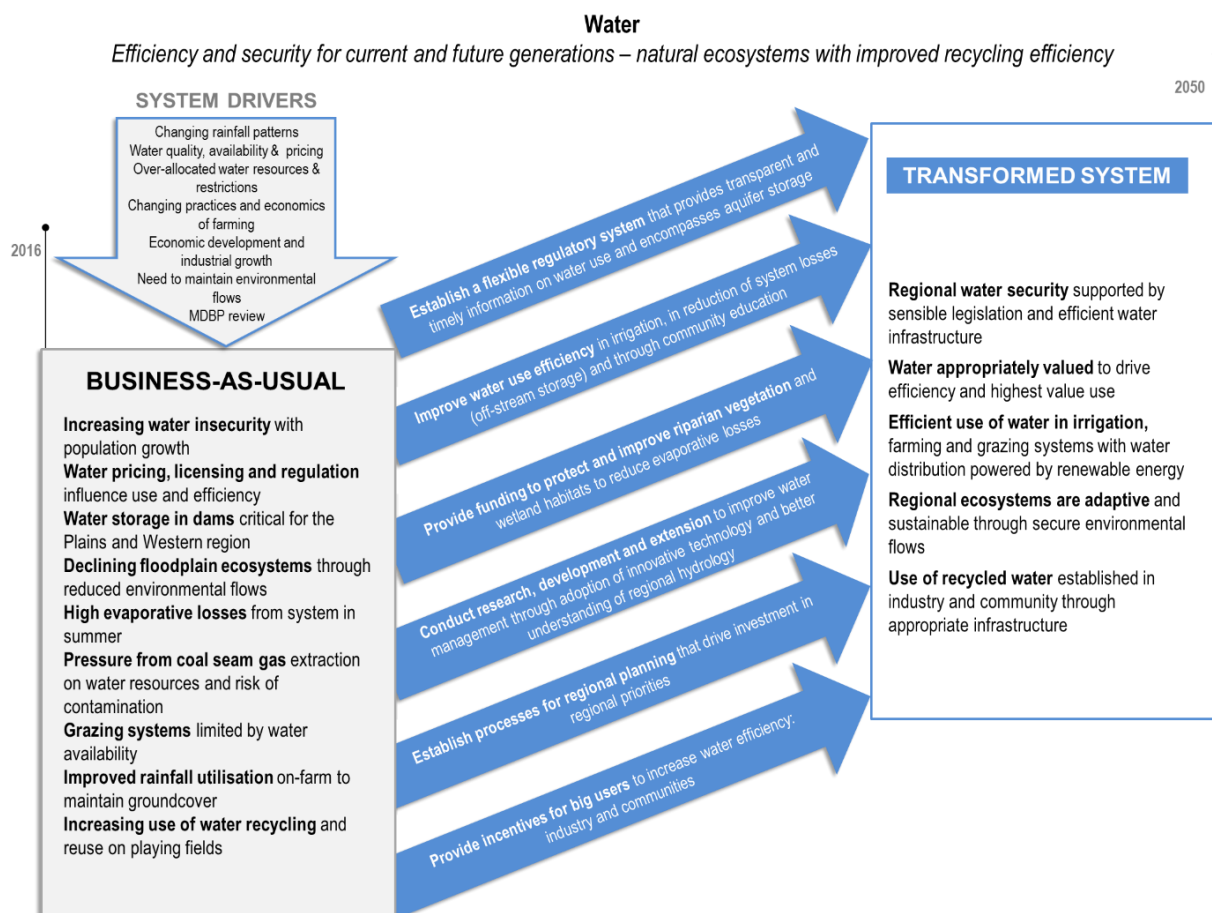


Figure 7: Change model for water

Major drivers of the water system include climate, water governance and environmental flows. Changing rainfall patterns drive the seasonal capture and demand for water. The over-allocation of resources and the use of water restrictions, the changing practices and economics of farming and regional economic development, in particular industrial water use, strongly influence the water system. Further influences include water quality, pricing and the

need to maintain environmental flows. The review of the Murray–Darling Basin Plan is also expected to drive system changes.

The water system is characterised by increasing water insecurity linked to population growth. Water pricing, licensing and regulation influence use and efficiency, with dam storage critical to supply the Plains and Western parts of the region. Water distribution suffers from high evaporative losses in summer with floodplain ecosystems in ecological decline as a consequence of reduced environmental flows. Water resources are placed at risk from an expansion of coal seam gas extraction. Farms have improved utilisation of rainfall, optimising the capture and distribution of water in the landscape to help maintain groundcover. Grazing systems in the region are limited by water availability. In urban areas, recycled water is used commonly to maintain playing fields.

Transition pathways for the water system include the establishment of a more flexible regulatory system that provides transparent, timely information on water use and aquifer storage. Enhanced water system efficiency could be achieved by targeting incentives for efficiency measures to big users (industry and communities), reducing system losses, community education and protection of riparian vegetation and wetland habitats. Water management would be improved through research, development and extension that promote technology adoption and better understanding of regional hydrology. As in other regional systems, better processes of regional planning would drive investment to areas of highest priority.

A transformed system sees regional water resources secured through sensible legislation and efficient infrastructure. Water is appropriately valued to drive efficiency and highest value use. Water use in irrigation, farming and grazing systems is efficient and water distribution is powered with renewable energy. Environmental flows are secure and support adaptive, sustainable regional ecosystems. Appropriate infrastructure supports the established use of recycled water in industry and community to reduce pressure on domestic supplies and the environment.

Energy

The regional energy system is defined under the change model as localised, renewable, efficient and reliable (Figure 8).

The system is influenced by the need for energy security under relatively poor reliability, and rising energy costs driving energy efficiency improvements (domestic, farm and transport). The need to reduce greenhouse gas emission results in technical innovation that is in turn driving changes in energy generation and storage. Change is constrained by the action of vested interests in the fossil fuel industry and the environmental cost of increased water use in fossil fuel extraction.

The regional energy system is currently characterised as centralised, fossil fuel intensive with inefficient transmission over vast distances, with a growing renewable energy sector. Awareness of energy efficiency measures is increasing but government energy policy is largely ad hoc and suffers from a lack of standard building codes and effective national incentives for change. There is conflict over land use between traditional agricultural enterprises and extractive mining, in particular coal seam gas. Low affordability of energy efficiency measures results in rising social inequality and health implications for the region. Domestic wood heating is common and causes urban air pollution, loss of habitat (from collection of fuel) and human health problems. Carbon capture and storage is an unproven technology and remains unimplemented.

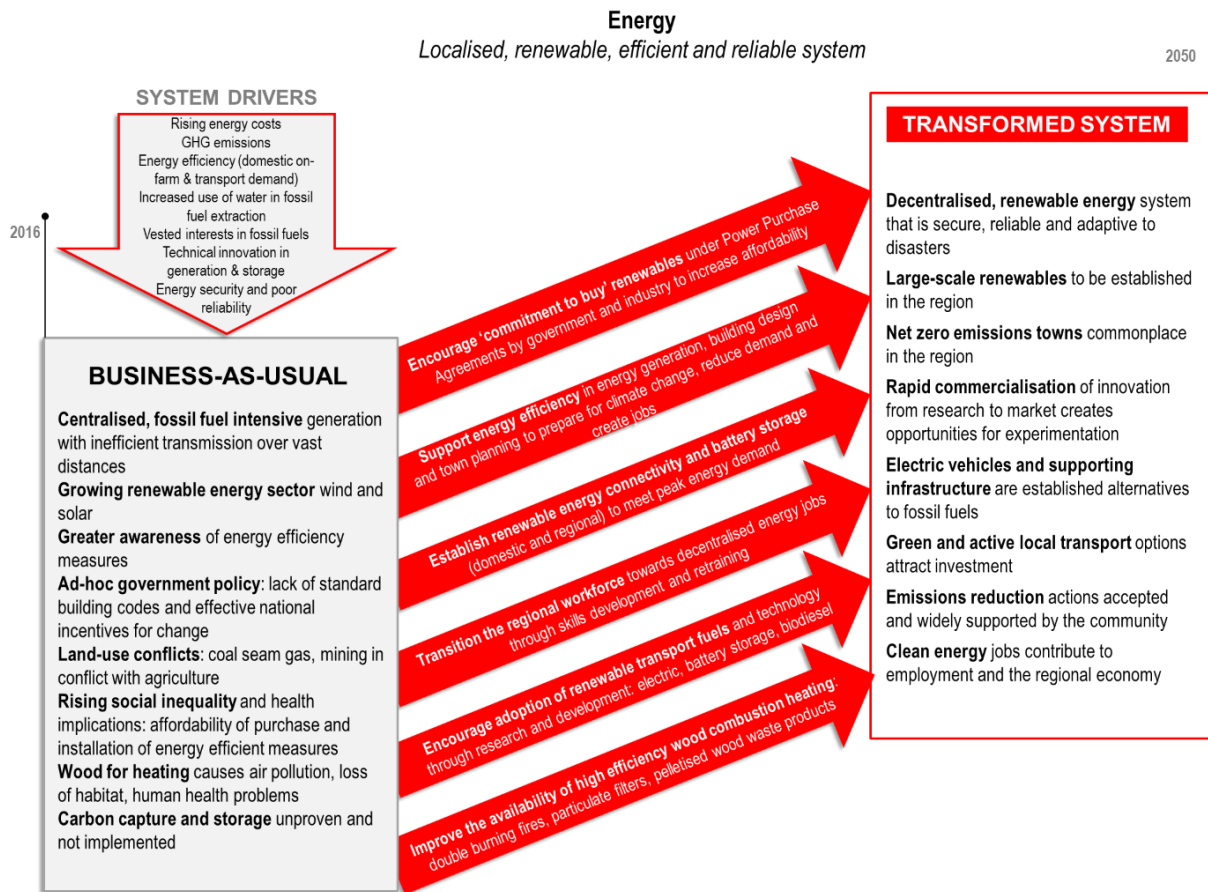


Figure 8: Change model for energy

Transition pathways for the regional energy system include a formalisation of agreements by government and industry to purchase renewable energy to improve its affordability, and increased support for energy efficiency in generation, building design and town planning to reduce demand and create jobs. Peak regional energy demands could be met through greater renewable energy connectivity and battery storage (both domestic and region scale). Investment in skills development and training would allow the workforce to transition to decentralised energy jobs. Increased effort in research and development would encourage adoption of renewable transport fuels and technology (e.g. electric vehicles, battery storage and biodiesel use). Improvements in the availability of high efficiency wood combustion heaters would be an interim measure to ease social inequity in energy availability.

A transformed energy system is based on decentralised, renewable generation that is secure, reliable and adaptive to disasters. Large-scale renewables are established in the region, contributing to the state's energy mix. Many towns throughout the region have net zero carbon emissions. Commercialisation of innovation from energy research is rapid and creates opportunities for business and community experimentation. Local transport is 'green' and active and infrastructure to support widescale use of electric vehicles is established. The community accepts and supports emissions reductions efforts and clean energy jobs contribute to employment and the regional economy.

3 How is New England North West vulnerable to climate change?

In partnership with regional decision-makers, the WERA process considers the climate vulnerability of regional communities in the context of biophysical impacts and socioeconomic change, with a focus on government service planning and delivery. By drawing on regionally specific data and local knowledge under the five capitals framework, an integrated understanding is developed of the relationships within key systems, and desirable adaptive responses and futures are identified.

3.1 Social and economic

People

The New England North West region encompasses the traditional lands of the Anaiwan, Gumbaynggirr, Banbai, Bundjalung, Ngarabal, Dhungutti, Nganyaywana, Bigambul, Worimi, Birpal, Guyambal and Kamilaroi peoples.

The region consists of multiple language groups and incorporates all or part of 30 Local Aboriginal Land Councils. Based on 2011 Census data, the Indigenous population of the region is estimated to be 15,803 people or 9% of the total population (ABS 2013a).

In the region there are over 4154 cultural heritage sites and 11 Aboriginal Places identified under and protected by provisions of the *National Parks and Wildlife Act 1974*. Of these, over 600 are considered to be highly significant and include sites used for burials, ceremonies and dreaming, and places that have social and contemporary usage for Aboriginal people today. There are three Indigenous Protection Areas in the region which are recognised by the Australian Government as an important part of the National Reserve System.

The region’s total population in 2011 was 182,600 (ABS 2013a). Figure 9 provides a comparison of populations within each local government area (LGA) ranging from 58,250 people in the Tamworth Regional LGA to 3100 in the Walcha Shire LGA.

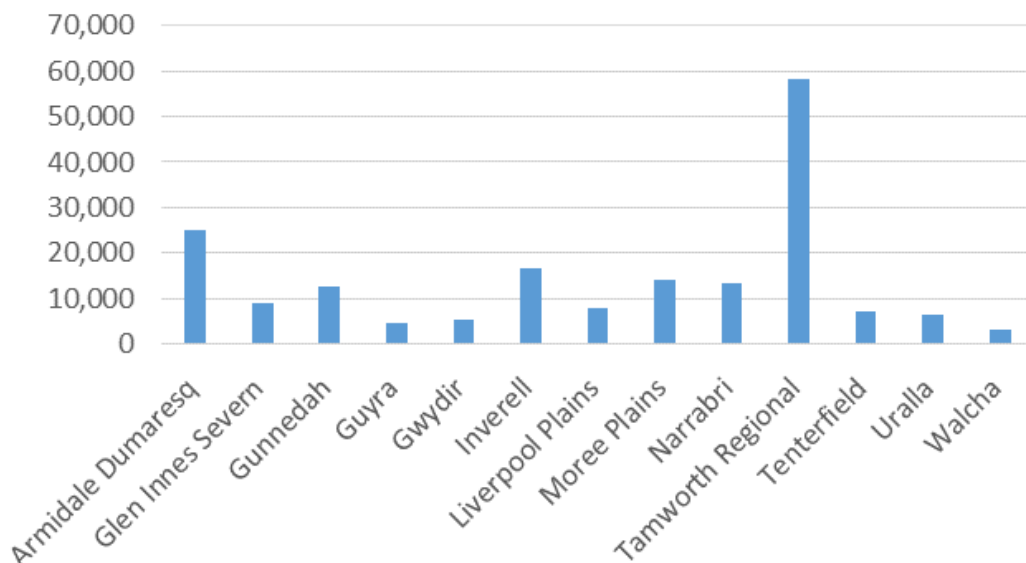


Figure 9: Local government area population statistics from 2011
 Source: Department of Planning and Environment (2015)

The population of the New England North West region is projected to grow by 8% over the next 17 years (to 2031)¹. The rate of growth varies across the age profiles with the number of young people (less than 15 years old) declining by 2%, people of working age (15–64) also declining by 6% and people 65 or older growing by 8%. This will see the proportion of people aged 65 years or older grow from 17% to 25% of the total population by 2031 (Department of Planning and Environment 2015).

The workforce participation rate for the region in 2011 was 73.6% (NSW 73%) and the working age population (i.e. those aged 15–64) of the region comprised 62.1% (NSW 66%) of the total population (ABS 2013b).

The region generally has both a younger and an older population compared to NSW as a whole, with a pronounced difference in the working age population (Figure 10). The region has higher dependency ratios than the state overall, meaning that a smaller proportion of its working age population is supporting a higher proportion of people deemed not to be in the workforce.

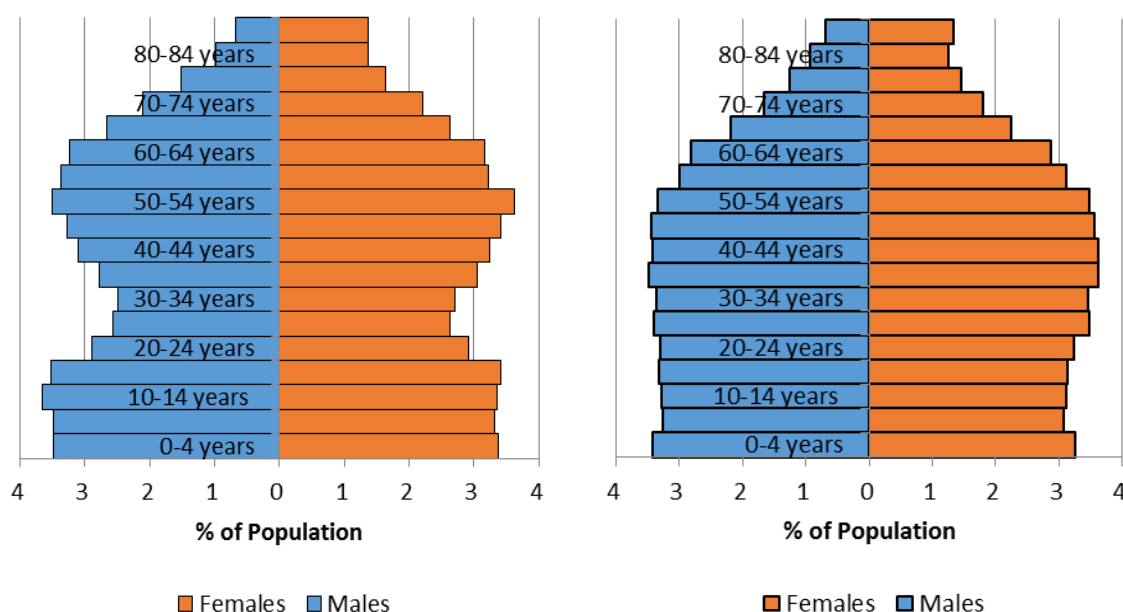


Figure 10: Age distribution in the New England North West region (left) compared to NSW (right) Source: Australian Bureau of Statistics (2013b)

Stakeholders from the region expressed the greater importance of social relationships and bonds, family links, groups, support networks and influences over political decisions. Some key points when assessing social capital for the region include:

- 85% of the region has a well-developed proficiency in English speaking compared to 13% not well or not at all, among non-English speaking background people (ABS 2013a)
- 70% of the region is families, with the highest proportion of families classed as coupled families with no children (42%), followed by coupled families with children under 15 years (28%) (ABS 2013a)
- 24% of the population in 2011 was involved in volunteer activity (ABS 2013a)
- being able to contact family and friends not living in the same household can enhance a person's feelings of connectedness to the wider community and can build social resilience. Based on the 2014 General social survey (ABS 2015) most households have face-to-face contact with family or friends living outside of the household at least once a week or every day (Figure 11).

¹ Projections were sourced in 2015 and applied; for updated revised population projections see NSW Planning and Environment, www.planning.nsw.gov.au/projections

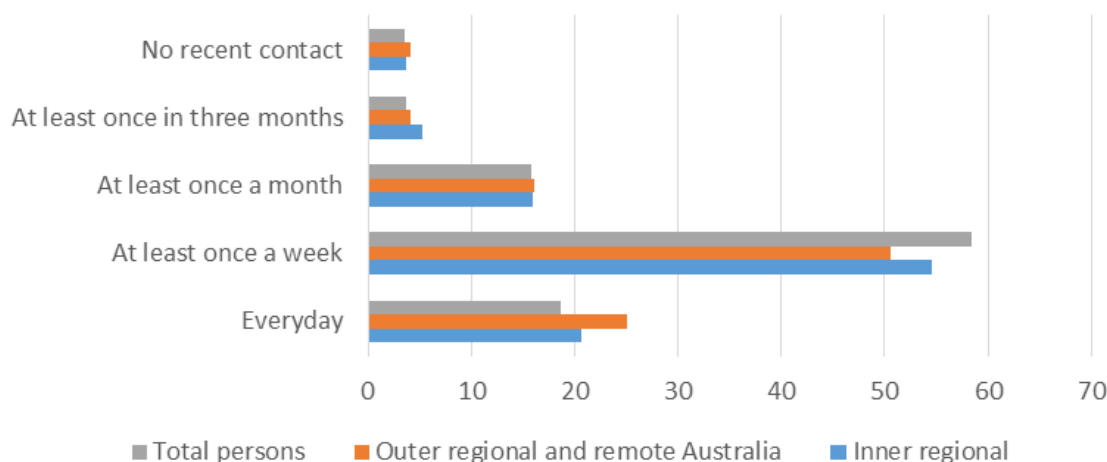


Figure 11: Frequency of face-to-face contact with family or friends living outside the household Source: Australian Bureau of Statistics (2015)

Human capital considers the skills, health and education of individuals that contribute to the productivity of labour and physical capability to respond to climate. Based on 2011 Census data key attributes of human capital for the region are:

- compared to the whole of NSW, people living in the region were much less likely to have completed Year 12 education and more likely to have left school before or directly after Year 10; people were less likely to have a post-secondary schooling qualification above certificate level (ABS 2013a)
- 92.7% of people living in the region spoke English at home compared with 2.5% who spoke another language (ABS 2013a)
- compared to the whole of NSW, the workforce had an under-representation of professionals and clerical workers and an over-representation of managers and labourers (ABS 2013a)
- the incidence of obesity is higher than for NSW as a whole (Centre for Epidemiology & Evidence n.d.)
- four local government areas were ranked in the top 20 for socioeconomic disadvantage based on the ABS Socio-Economic Indexes for Areas (SEIFA; ABS 2013b)
- communities generally experience difficulties accessing health services (ABS 2015).

Economy

The NENW region has a strong and growing economy valued at over \$8.9 billion and supporting over 75,000 jobs (Department of Industry 2015). Industry is quite diverse, with the major employment sectors being agriculture, forestry and fishing, health care and social assistance, retail trade, education and training, and accommodation and food services. The agriculture sector is the region's largest industry, with a 15% share of both regional output and employment (Table 1).

The education and training sector, which is anchored by the University of New England, New England Institute of TAFE and aviation training facilities, is the second largest industry in the region, contributing around 8% to Gross Regional Product (GRP; Department of Industry 2015). Health care and social assistance is one of the largest sectors, with increased demand from a growing and ageing population likely to drive continued growth in this sector. The region's visitor economy contributes around \$740 million (or 8%) to its GRP, supporting a range of industries including the accommodation and food services and allied retail trade sectors (Department of Industry 2015).

Table 1: Top five industries by contribution to GRP and top five employers by industry

Industries by contribution to GRP in 2013	Employers by industry in 2011
1. Agriculture, Forestry and Fishing (14.6%)	1. Agriculture, Forestry and Fishing (15.0%)
2. Education and Training (7.7%)	2. Health Care and Social Assistance (12.6%)
3. Health Care and Social Assistance (7.6%)	3. Retail Trade (11.5%)
4. Public Administration and Safety (5.4%)	4. Education and Training (10.8%)
5. Manufacturing (5.4%)	5. Accommodation and Food Services (7.0%)

Source: Department of Industry 2015

Physical capital comprises the items produced by economic activity from other types of capital such as the built environment, infrastructure and equipment (houses, schools, clinics, roads, farm machinery, and producer goods accessible by community). Based on 2011 Census data key attributes of physical capital for the region are:

- Separate occupied houses (77.5%) are the dominant dwelling type, followed by unoccupied dwellings (12.9%). A small percentage are flats or units (5.8%) and semi-detached (2.7%) dwellings (ABS 2013a).
- Broadband is the most available internet connection type (58%); however, at 30%, absence of internet access was high (NSW 20%) (ABS 2013a).
- There are a total of 35 private schools, 126 public schools, 21 hospitals and 36 libraries (Education NSW 2016; Health NSW 2016; Private Schools Directory 2016).

3.2 Biophysical

The New England North West region has highly diverse landscapes, including rainforest covered volcanic plateaus and escarpments, alpine communities, remnant inland forests, wetlands of national and international significance, diverse grasslands in the west and a large diversity of forest ecosystems.

Approximately one third of the region is covered by native vegetation and contains several World Heritage listed areas such as the Washpool, Gibraltar Range, Oxley Wild Rivers and Werrikimbe national parks and the Pilliga Community Conservation Areas.

The majority of the region is located in the Murray–Darling Basin. The main river systems are the Namoi, Gwydir and Macintyre along with the upper reaches of the coastal river systems of the Clarence, Macleay and Manning rivers.

The region has a diverse range of climates. The Northern Tablelands have a temperate climate with warm summers and cool winters. The far north-western plains are hot and semi-arid, while much of the North West Slopes have a humid subtropical climate.

3.3 Expected regional climate change

Information on projected climate for the region can be found in the New England North West Climate Change Snapshot report on the AdaptNSW website (OEH 2014) The snapshot provides near future (2030) and far future (2070) scenarios (see Tables 2 and 3 below).

The climate projections for 2020–2039 are described in the snapshots as *near future*, or as 2030, the latter representing the average for the 20-year period. The climate projections for 2060–2079 are described in the snapshots as *far future*, or as 2070, the latter representing the average of the 20-year period.

In summary:

- The region is expected to experience an increase in all temperature variables (average, maximum and minimum), more hot days, and fewer cold nights for the near and far futures. Heatwaves are also projected to increase, be hotter and last longer.

- Seasonality of rainfall will change. Autumn rainfall will increase in the near future and the far future. The majority of models agree that winter rainfall will decrease in the near future. Summer rainfall is projected to decrease in the near future; however, summer rainfall is projected to increase in the far future.
- Fire risk will increase, with projected increases in average and severe Forest Fire Danger Index values in the near future and the far future.

Table 2: Climate change projections for the New England region

Climate variable (average across the region)	Trend	Projections	
		Near future (2030)	Far future (2070)
Atmospheric CO ₂	Increase	A2 IPCC emissions scenario	
Max temperature	Increase	0.7°C	2.2°C (2.5°C in spring)
Min temperature	Increase	0.7°C	2.3°C
Hot days	Increase	1 – 10	1 – 30
Cold nights	Decrease	10 – 20	20 – over 40
Heatwaves	Increase (frequency)	1 – 1.5 events	2.5 – 4.5 events
	Increase (intensity)	1.5 – 4.5°C	4.5°C
	Increase (duration)	1.4 – 3.5 days	7 – 9 days
Annual rainfall*	Drying & wetting	–9% to +13%	–8 to +24%
Changes in average rainfall by season*	Drying & wetting	Summer 0% to –10%	Summer 0% to +20%
		Autumn +5% to +20%	Autumn +5% to +30%
		Winter 0% to –10%	Winter 0% to –20%
		Spring 0% to –10%	Spring –10% to +20%

Table 3: Climate change projections for the North West region

Climate variable (average across the region)	Trend	Projections	
		Near future (2030)	Far future (2070)
Atmospheric CO ₂	Increase	A2 IPCC emissions scenario	
Max temperature	Increase	0.7°C	2.2°C (2.5°C in spring)
Min temperature	Increase	<0.5 – 1.0°C	1.5 – 3°C
Hot days	Increase	10 – 20	20 – >40
Cold nights	Decrease	1 – 10	5 – 30
Heatwaves	Increase (frequency)	1 – 1.5 events	2.5 – 4.5 events
	Increase (intensity)	1.5 – 4.5°C	4.5°C
	Increase (duration)	1.4 – 3.5 days	7 – 9 days
Annual rainfall*	Drying & wetting	–9% to +13%	–8 to +24%
Changes in average rainfall by season*	Drying & wetting	Summer 0% to –10%	Summer +5% to +30%
		Autumn +10% to +30%	Autumn +10% to +30%
		Winter 0% to –20%	Winter 0% to +10%
		Spring 0% to +10%	Spring 0% to –10%

*Negative values represent drying and positive values represent wetting under projections for annual rainfall and seasonality rainfall. Source: Office of Environment and Heritage (2014)

Climate change will impact agricultural systems (affecting crops, evaporation of surface water and stock), vulnerable groups within regional communities (such as the ill, very young and the elderly), natural ecosystems, regional infrastructure and fire management (see Appendix A).

3.4 Vulnerability affecting government services

Local decision-makers identified eight factors that affect the vulnerability of the New England North West region, which interact to set constraints and opportunities around the ability of government to service the community. Already influencing the region, the importance of these vulnerabilities is likely to be amplified by changes to climate:

1. **Economic viability:** essential to attract investment, support adaptation and maintain liveability
2. **Regional infrastructure:** investment in efficient, appropriate and adapted infrastructure supports community transformation.
3. **Resilient ecosystems:** sensitive to changes in climate, resilience ensures the supply of natural resources that underpin regional prosperity.
4. **Political influence:** supports strategic visions, planning and governance.
5. **Diverse education and employment:** regional skills are not currently well aligned with the requirements of adaptation to climate, changes in the job market and adoption of technical innovations.
6. **Healthy community:** declining community health requires increasing investment under changing climate.
7. **Social cohesion and equity:** a widening gap between major centres and small settlements in community service requirements, access and delivery.
8. **Research, development and extension:** underpins innovation, adoption and prosperity.

Vulnerability

Regions in NSW vary in their vulnerability to climate change and their exposure and sensitivity. Figure 12 shows a snapshot of vulnerability for the New England North West region. The snapshot draws on workshop activities, the adaptation survey, discussions and supporting literature and data to illustrate regional vulnerability as having three components:

- **red boxes:** exposure to the range of biophysical and socioeconomic drivers that could potentially stress the ability of the region to function
- **orange boxes:** sensitivity to the diverse impacts that result from exposure to drivers of change
- **green box:** adaptive capacity, which is the set of attributes that act to determine how the region might respond to reduce future vulnerability. If present, these attributes can enable adaptation. If these attributes are absent or negative, then adaptive responses will be constrained, and the region will remain vulnerable.

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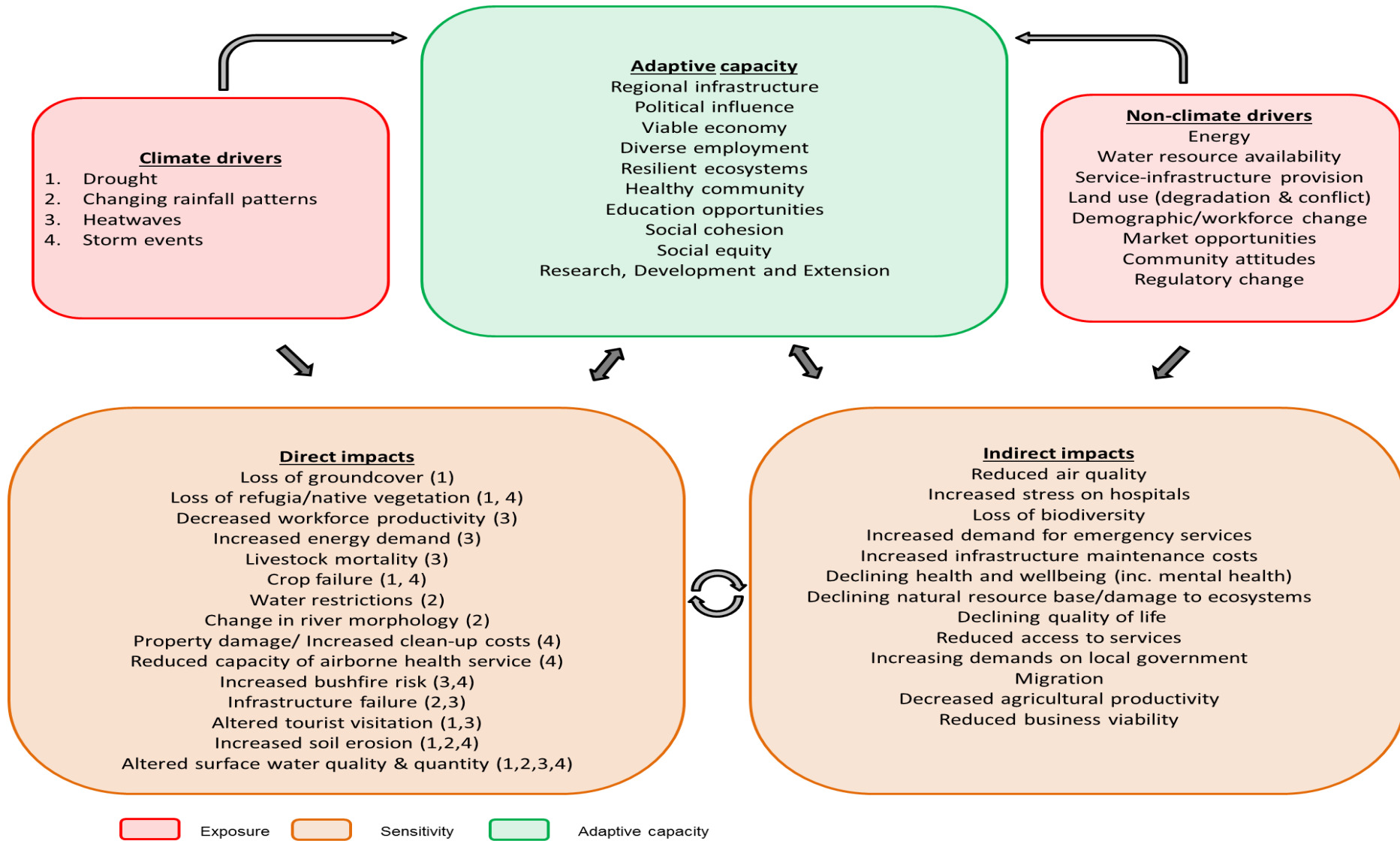


Figure 12: Snapshot of vulnerability in the New England North West region Numbers in brackets under direct impacts link the impact to the climate driver(s)

Exposure

Climate drivers

Four main climate drivers for the New England North West were identified through the survey and workshops: drought, changing rainfall patterns (amount, seasonality and effectiveness), heatwaves and more intense storm events. Of these drivers, changes to rainfall and heatwaves are projected in the regional climate modelling mentioned in Section 3.3 above and on the AdaptNSW website (OEH 2014).

Non-climate drivers

Non-climate drivers are drawn from the system transition models representing the range of socioeconomic and biophysical changes currently affecting the region. They operate at a range of scales from international (market opportunities) to national (workforce change), to regional (water resource availability) and local (land-use conflict, community attitudes). While they act independently of climate drivers, some may interact with climate impacts within the region. For example, one source of land-use conflict is coal seam gas exploration driven by national fossil fuel demand and perceived by agricultural landholders to compromise water resources. However, changing rainfall patterns and drought (climate drivers) experienced in the New England North West result in heightened sensitivity locally around threats to water resources, potentially escalating conflict.

Sensitivity

Direct impacts

The impact of climate change in the New England North West region manifests through the effects of extreme events. These direct impacts, shown in Figure 12, summarise the initial interconnected impacts that ripple through the region's systems (see also the impact chain diagram in Figure 17). For example, the direct impacts of drought cause a loss of groundcover. Heatwaves result in a spike in energy demand and reduced workforce productivity, and storm events cause damage to infrastructure and limit the operational capacity of airborne health services. Multiple impacts from individual climate drivers often converge at critical points of intersection. For example, impacts from drought and storm events converge to cause a loss of refugia and native vegetation as a result of changes to surface water availability and quality. Impacts of drought and heatwaves converge to alter tourist visitation, which has flow-on effects to local businesses. All four climate drivers intersect to alter surface water quality and quantity which may lead to the imposition of water restrictions and increased water supply and treatment costs.

Indirect impacts

These are the concluding impacts, which have 'snowballed' along the impact chains shown in Figure 17. They represent further socioeconomic and biophysical drivers of change that affect the region, culminating from climate drivers, and are heavily influenced by non-climate drivers in complex ways. For example, non-climate drivers such as demographic change resulting in an ageing population may lead to increased demands on local government and emergency services and stress on hospitals. Furthermore, non-climate drivers such as water resource availability may lead to declining agricultural productivity as well as negative effects on ecosystems, and community health and wellbeing. The value of water is also influenced by a combination of climate drivers through changes to surface water flows, increased potable water use and declining surface water quality.

Adaptive capacity

The attributes listed under adaptive capacity are largely aspirational. They represent a set of available resources, or changes to resource use, that provide options to act to reduce regional vulnerability to climate change in the face of future uncertainty.

For example, under the stress imposed by climate change, resilient regional landscapes assist natural systems to remain healthy and supply the ecosystem services that support communities. Exploitation of renewable energy potential would deliver opportunities to develop a high-tech regional skills base ensuring greater social equity through increased employment. Irrespective of impacts on the region, a healthy and cohesive regional community reduces reliance on hospital and emergency services and the financial burden on local government of remote communities suffering from chronic illness. The transition pathways identified in the change models for the key regional systems (Chapter 2) and the 'first steps' projects outlined in Chapter 5 provide a mechanism to achieve regional aspirations for adaptive capacity.

While sectors of the regional economy may prioritise differently the various aspects of vulnerability that affect their service delivery, there is considerable overlap among them. Table 4 lists the sectoral priorities for the direct and indirect impacts and adaptive capacity indicators.

Table 4: Sectoral priorities for direct and indirect climate impacts and adaptive capacity

Sector	Direct climate impacts	Indirect climate impacts	Adaptive capacity
Economy and industry	<ul style="list-style-type: none"> Water restrictions Loss of groundcover 	<ul style="list-style-type: none"> Declining natural resource base/damage to ecosystems Decreased agricultural productivity 	<ul style="list-style-type: none"> Regional infrastructure <ul style="list-style-type: none"> Viable economy Resilient ecosystems
Human services	<ul style="list-style-type: none"> Water restrictions 	<ul style="list-style-type: none"> Declining health and wellbeing (including mental health) Reduced access to services 	<ul style="list-style-type: none"> Healthy community <ul style="list-style-type: none"> Education opportunities Viable economy
Settlements and infrastructure	<ul style="list-style-type: none"> Infrastructure failure Loss of refugia and native vegetation Increased soil erosion 	<ul style="list-style-type: none"> Loss of biodiversity 	<ul style="list-style-type: none"> Regional infrastructure <ul style="list-style-type: none"> Viable economy
Natural resources and ecosystems	<ul style="list-style-type: none"> Altered surface water quality and quantity Loss of refugia and native vegetation Increased energy demand 	<ul style="list-style-type: none"> Declining natural resource base/damage to ecosystems Loss of biodiversity Migration 	<ul style="list-style-type: none"> Resilient ecosystems Healthy community <ul style="list-style-type: none"> Social equity
Emergency management	<ul style="list-style-type: none"> Infrastructure failure Altered surface water quality and quantity 	<ul style="list-style-type: none"> Increased demand for emergency services Loss of biodiversity Declining health and wellbeing (including mental health) 	<ul style="list-style-type: none"> Regional infrastructure <ul style="list-style-type: none"> Viable economy Resilient ecosystems <ul style="list-style-type: none"> Political influence

4 How do we know?

4.1 Description of the ERA process

The Enabling Regional Adaptation (ERA) process has been designed to develop a shared understanding among stakeholders of the likely vulnerability to climate change, and stimulate action to plan adaptation. To undertake the assessment, ERA engages state and local government participants from different sectors to ensure cross-sectoral and cross-scale operational knowledge and constraints are considered.

Sector	Scope
Emergency management	Emergency management (fire, flood, heat, bushfire), infrastructure and utilities, public health / disaster management
Human services	Education, health, senior, youth and child services, meals on wheels, library services, disability services, community services, health and education asset management and planning
Economy and industry	Business development, tourism, legal, professional services
Landscapes and ecosystems	Natural resource management, biodiversity, conservation, Aboriginal and historic heritage
Settlements and infrastructure	Regional and local strategic planning, local development, buildings and settlements, transport (rail, road, freight, buses) water (stormwater, sewer, water), energy, telecommunications, community infrastructure

Due to the complexity inherent in analysing adaptation at a regional scale, the approach uses both qualitative and quantitative techniques to integrate multiple lines of evidence gathered through subregional workshops, participant surveys, and shift-share analysis to identify locally competitive industries derived from ABS Census data.

ERA engages participants in cross-sectoral workshops where they are provided with regional climate projections, socioeconomic data and regional knowledge. Through a series of hands-on activities participants determine impact chains, adaptive capacity and key regional systems. Final outputs of this process provide a description of regional climate vulnerabilities, system transition models and projects to activate pathways (Figure 12). An online survey was also undertaken before and after the workshops (see Chapter 6).

ERA has been carried out in such a way that it incorporates:

- a system thinking approach that acknowledges communities exist within human–natural (or social–ecological) systems
- participatory engagement in which stakeholders co-create an understanding of vulnerability through their deep understanding of the region
- a focus on developing an understanding of the constraints to adaptation, and on identifying opportunities for building adaptive capacity so communities can deal better with climate shocks regardless of their nature or timing
- qualitative analysis supported wherever possible with quantitative data, which acknowledges that societal interactions are complex and contradictory in nature, and not amenable to expert-led, reductionist approaches to problem analysis.

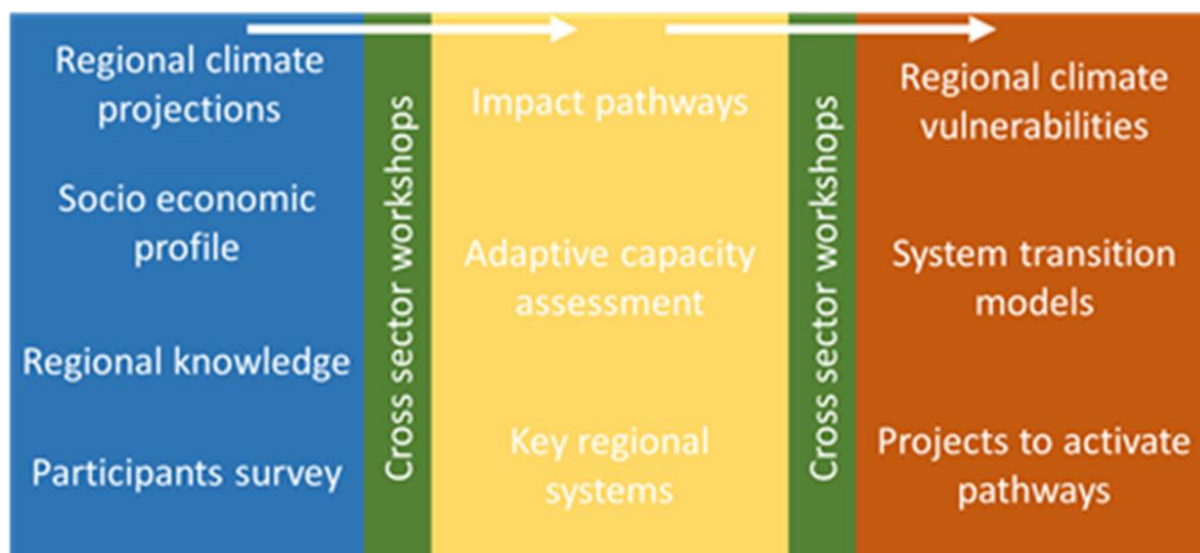


Figure 13: Enabling Regional Adaptation process

4.2 New England North West regional workshops

In early 2016, OEH and the Institute for Sustainable Futures led a series of workshops in the New England North West region as part of an ERA process for Western NSW (the WERA project). The workshops used participatory learning techniques to discuss, explore and gather information and data on the impact of climate change on regional systems and opportunities to respond. The workshops were held in two stages: the subregional workshops focused on identifying regional climate vulnerabilities and the integration workshop focused on developing regional change models.

Two subregional workshops were held in April 2016 in Inverell and Tamworth. The workshops facilitated a consultation with 58 representatives of NSW Government agencies, local government and key regional stakeholders, including:

- Aboriginal Affairs NSW
- Armidale Regional Council
- Armidale Rural Financial Counselling Service
- Arts North West
- Crown Lands
- Department of Education and Training
- Department of Family and Community Services*
- Department of Planning and Environment*
- Department of Premier and Cabinet*
- Department of Primary Industries*
- Glen Innes Severn Council
- Gunnedah Shire Council
- Guyra Shire Council
- Gwydir Shire Council
- Hunter New England Central Coast Primary Health Network
- Hunter New England Health*
- Inverell Shire Council
- Liverpool Plains Shire Council
- Moree Plains Shire Council
- Namoi Joint Organisation of Councils*
- Narrabri Shire Council
- North West Local Land Services*
- Northern Tablelands Local Land Services
- NSW Department of Industry
- NSW Department of Justice
- NSW Police*
- NSW Public Works
- NSW WorkCover
- Office of Environment and Heritage
- Office of Regional Development*
- Rural Fire Service
- TAFE New England
- Tamworth Regional Council
- Tenterfield Shire Council
- Uralla Shire Council

Note: An asterisk denotes organisations represented on the project steering committee.

Workshops aimed to:

- conduct an Integrated Regional Vulnerability Assessment (IRVA) to understand the climate impacts for the region and assess adaptive capacity to respond
- present the latest climate projections for the New England North West region
- present background socioeconomic analysis to inform workshop discussions of system changes
- identify regional systems that needed to change to reduce vulnerability to climate change.

The integration workshop was held in mid-July with 31 participants to:

- construct a climate impact timeline to encourage consideration of climate projections in light of extreme climate events, regional socioeconomic trends and policy processes (Figure 14)
- develop qualitative, system change models that identify transition pathways leading to a transformed future
- prioritise regional adaptation actions (through discrete projects) to promote transition and limit maladaptation
- continue to build the regional capacity to deliver best practice adaptation.

The workshop process acknowledged that understanding the current vulnerability of government service delivery in the region relies on assembling the tacit knowledge that resides in the collective store of experience of NSW public sector decision-makers. The aim was to gather information to inform future regional planning to enable regional adaptation to climate change.



Figure 14: Climate impact timeline for the New England North West region

4.3 Impact chains

Understanding how climate variability and extreme events will affect the region is a vital first step towards planning and implementing adaptation responses. Drawing on the regional climate projections and socioeconomic information, participants constructed impact diagrams to illustrate impact chains and influence relationships stemming from each of the major climate drivers. A section of the diagram showing the detail of impacts related to changing rainfall patterns is shown in Figure 15. The entire diagram illustrating the complexity of effects from the four main climate drivers is shown in Figure 17. These diagrams allowed two types of impacts to be identified along impact chains: direct impacts were those that were directly attributable to climate change and appear on impact chains near climate variables; indirect impacts resulted from the flow-on effects of climate variables and are also influenced by external regional drivers. Indirect impacts appear further along the impact chains.

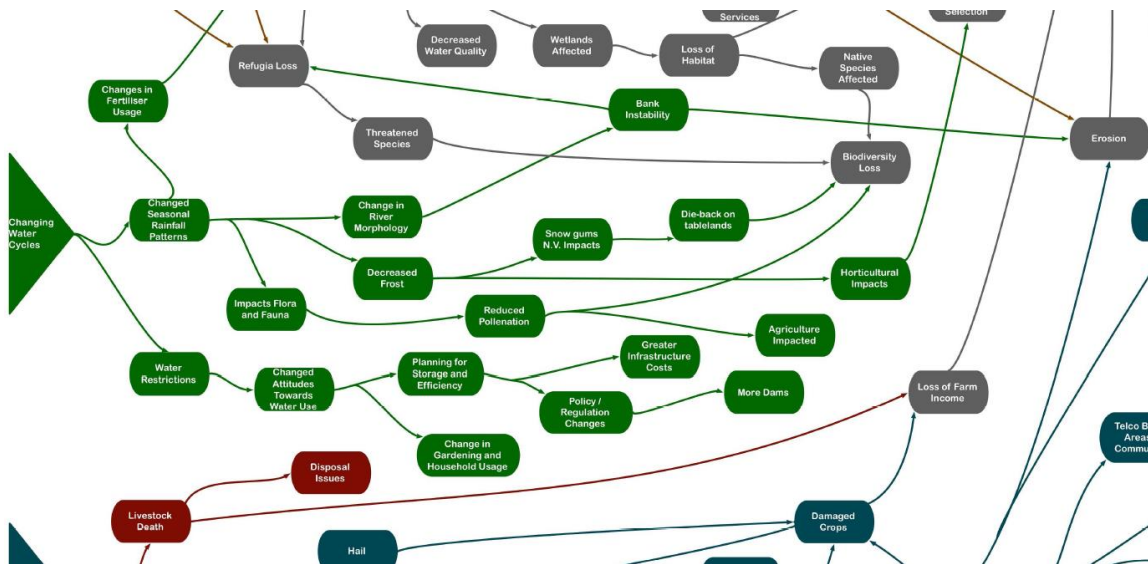


Figure 15: Section of the New England North West climate impact diagram showing the impact of changing water cycles

4.4 Key regional systems

Each subregional workshop identified the regional systems considered most in need of transformation to adapt to climate change. Four key systems were identified in the Inverell workshop and five in the Tamworth workshop (Figure 16). These nine systems were refined in the integration workshops to reduce redundancy and focus specifically on systems that could be influenced through action at a regional scale. The models are not intended to represent all aspects of the region; rather they reflect the expertise of workshop participants and provide a mosaic of the major systems of the NENW region.

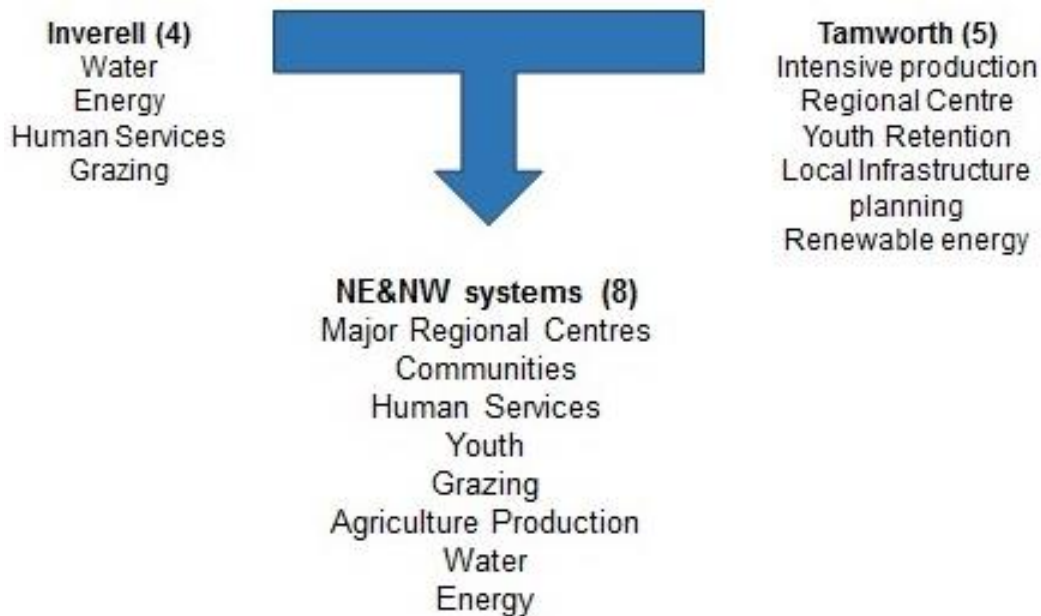


Figure 16: The key regional systems identified for the New England North West region

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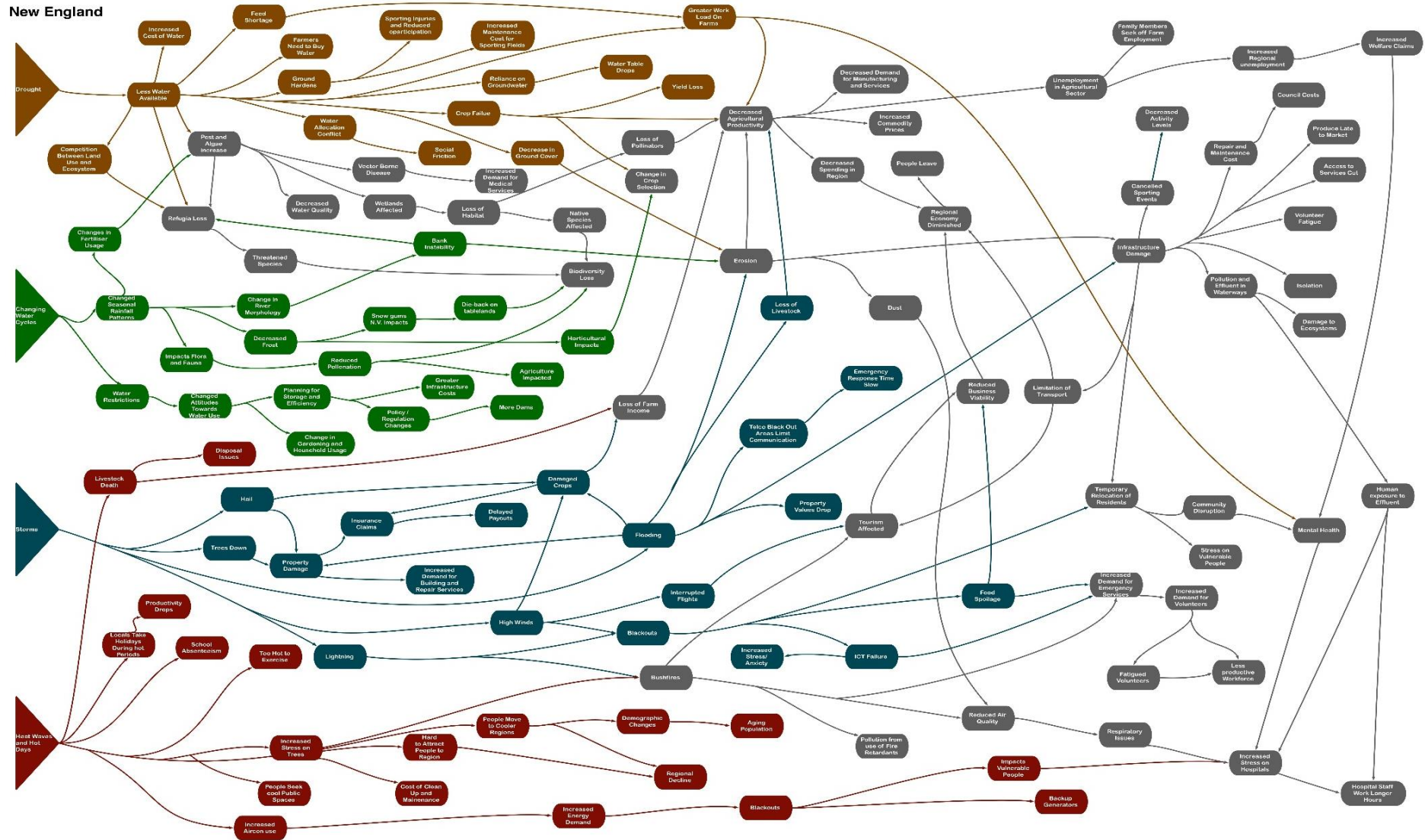


Figure 17: Climate impact chains for the New England North West region

4.5 System change models

Thinking of adaptation as a series of strategic pathways to transition away from business-as-usual was an effective technique to engage workshop participants in a discussion of system transformation in the region. The approach envisions transformational change toward a desirable future as a series of transition pathways that emerge from current practice either through existing innovations or because of new drivers of change (Figure 18).

For each of the key systems the workshop participants discussed:

- business-as-usual (BAU) – what constitutes BAU in their service delivery area and what changes or ‘tweaks’ are being made to ensure resilience of the current system
- system drivers – the relative strengths of multiple drivers determine the extent and direction of change within the system. Drivers of change lead to the emergence of ‘pockets’ of innovation that offer transition pathways to a ‘planned’ transformation
- transition pathways – any new practices/changes/trends that may serve as an alternative to BAU that are emerging now or in the near future. These pathways could emerge from changes in the economy, society, the environment, technological development or politics
- barriers and enablers – for selected transition pathways participants identified the barriers to and enablers of change, who they need to work with, and any aligned processes or policies
- transformed system – participants were asked to identify their vision of service delivery in 2050 and articulate what the features of the transformed system would be.

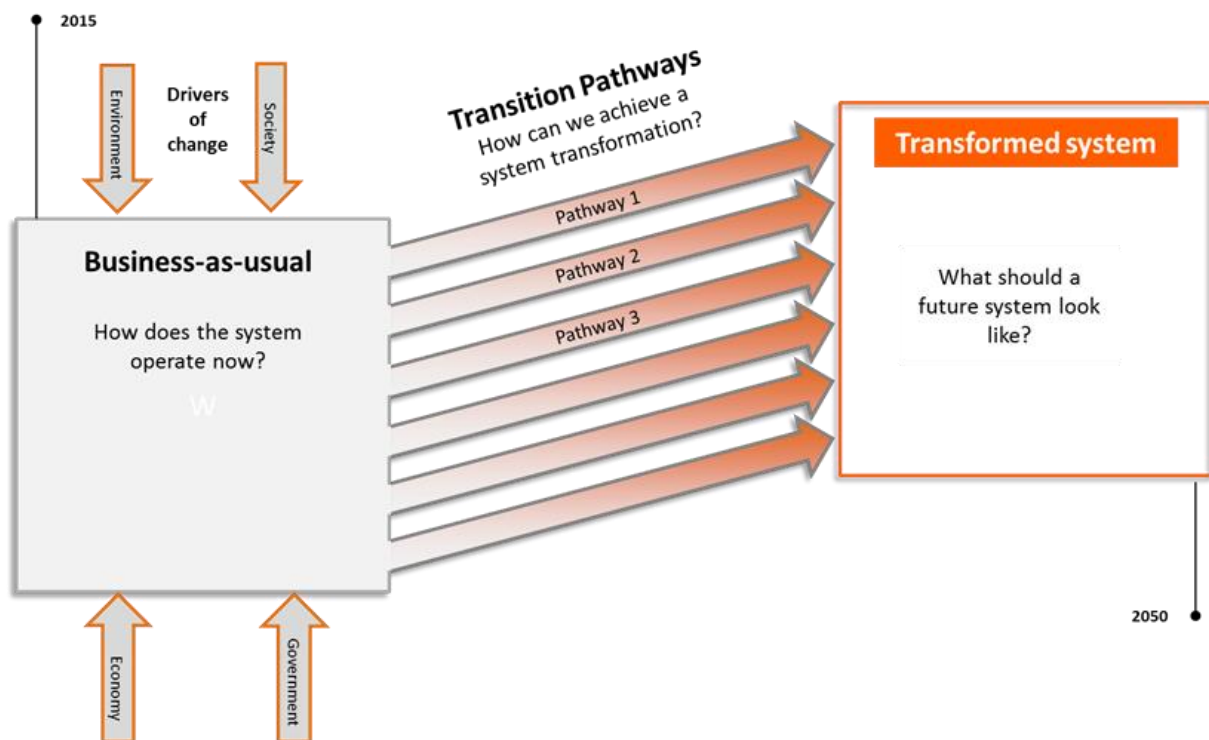


Figure 18: Conceptual model of transformative change Source: adapted from Jacobs et al. (2016)

5 What can we do about it?

5.1 Projects to activate pathways

Workshop participants voted on the various pathways for each of the eight regional systems to determine the key priorities for government from the range of transition pathways. The participants then worked together in cross-sectoral groups to identify transition projects to progress toward regional transformations to address climate vulnerabilities. Descriptions of these projects are outlined in Table 5.

Table 5: Pilot projects to activate pathways

Pilot project	Description	System
Multicultural playground and food festival	Build social tolerance, networks and understanding between diverse cultural communities by providing a kids festival/interaction where differences (including delicious food) are celebrated and shared	Major regional centres
Collaborative regional innovation base (CRIB)	Foster technology start-ups and regional data sharing by establishing a CRIB/incubator (e.g. low rent for small business) for local knowledge holders and youth/recent students to develop local business or community solutions	Major regional centres
Engagement local knowledge platform	Hear from regional voices on regional priorities, opportunities and investments by running two engagement platforms using DET facilities during school holidays: 1. Village Development Network (community reps from smaller regional towns); 2. Town Development Network (community/business reps from Moree, Armidale, Inverell) for input into strategic planning processes	Communities
Managing bushfire risk in biodiversity offsets	Investigate fire management requirements in biodiversity offset agreements, to ensure bushfire risks in remote locations and relating to national parks and Crown lands are being adequately managed	Communities
Telehealth training and expansion	Implementation and training of 'telehealth' (web-based health services) within the University of New England. Department of Rural Health, Tamworth and Armidale	Human services
Improve NENW youth mental health services	Convene a workshop/working group to seek opportunities for improved coordination and partnerships of youth mental and allied health services for the New England North West between all levels of government including NGOs	Youth
Healthy soils	Partner with an interested research organisation to map the regional soil types and overlay this information with climate change projections to identify best agricultural lands in order to protect the most productive areas and intensification of Ag/spin-off's in agriculture processing	Grazing
Market farmers	A marketing campaign promoting a positive image of farming, to increase the profile of farming and promote career pathways for youth and new entrants into the farming sector	Grazing
Diversify your farm	Undertake research into local market failures to identify opportunities for diversification and government intervention to uncover opportunities for farmers to consider appropriate markets for diversifying farming practices	Grazing

Pilot project	Description	System
Regional carbon offsets	Investigating the business case and socioecological co-benefits (and costs) associated with regional scale carbon offset market under the Commonwealth Emissions Reduction Fund. Improve governance, research and development of a regionally based carbon offset scheme	Agriculture production
Reinstituting concept and feasibility studies	Investigate government role in facilitating feasibility studies to ensure projects are planned and ready for implementation when funding becomes available. Reinstatement of government funding for feasibility studies would lower the entry barrier for investors and strengthen the regional business case for investment attraction	Agriculture production
Landcare renewal	Centralise regional information and resources so as to reinvent, reintegrate, reinvigorate and support regional Landcare groups to build the capacity of farmers and landholders	Agriculture production
Develop a cooperative research centre (CRC) for regional water	Seek interested partners to investigate the viability of using the CRC model (as successfully developed for the cotton industry) to undertake research activities focused on water planning, efficiency and technology that define and model future water requirements for the region. This project will aim to develop a sustainable future based on best practice by undertaking multi-disciplinary research and help solve major economic, environmental and social challenges facing the region as a result of climate change	Water
Water, environment and technology (WET)	Convene a working group to consider integrated regional planning and plan collaboration on water management, environment and technology	Water
Water, alliance, training, educational resources (WATER)	Develop a business case for an extension program to assist farmers on water and energy efficiency, then seek funding. This program will aim at raising awareness through training and resources	Water
Bulk power purchase agreements (PPA) for large energy users	Identify lead agency to coordinate the PPA proposal to large energy users (over 100MWh/year), to bid for bulk PPA for Renewal Energy (RE) and Energy Efficiency (EE) purchase agreements	Energy

5.2 Actions underway

Since the inception of the WERA project in the New England North West, a number of actions to enhance regional adaptation planning have commenced, including:

- inclusion of references to the WERA process in the Draft New England North West Regional Plan
- Get Ready Narrabri was submitted as a project under this year's Community Resilience Innovation Program. This innovative community engagement project will pilot the use of a deliberative democracy approach of two Citizens' Juries (one adult, one youth) to engage with the Narrabri community on the issue of flood risk management and climate change projections.
- awarding of a regional scholarship for a New England North West ERA participant to attend the Learning to Adapt professional development program delivered by the Environment Institute of Australia and New Zealand and supported by OEH
- interagency discussions to plan and establish a regional renewable energy taskforce in collaboration with the North Coast region.

5.3 Supporting processes

Climate Change Fund

In November 2016, the NSW Government announced an Environmental Future Funding package, which includes a Climate Change Policy Framework outlining the Government's ongoing commitment to action on climate change. It also included a Draft Climate Change Fund Strategic Plan, with priority investment areas and potential actions for up to \$500 million of new funding over the next five years from the Climate Change Fund. The draft strategic plan proposes three priority investment areas that will form the basis of future action plans for:

- accelerating advanced energy
- national leadership in energy efficiency
- preparing for a changing climate.

Building Resilience to Climate Change program

The Building Resilience to Climate Change (BRCC) program is a partnership between Local Government NSW and OEHL to address identified climate change risks and vulnerabilities facing NSW councils.

The program was established to encourage:

- enhanced consideration of climate change impacts in local and regional decision making
- delivery of projects that minimise climate change impacts for local and regional decision makers
- implementation of climate change adaptation beyond current projects and programs
- fostering of adaptive capacity in local government through a community of practitioners across professional disciplines with direct experience in implementing adaptation responses across NSW.

Community Resilience Innovation Program

The Community Resilience Innovation Program (CRIP) supports a broad range of community-led projects designed to increase all-hazard disaster preparedness and build community capacity and resilience. CRIP projects are based on collaboration and partnership between local community organisations and emergency services agencies. CRIP aims to:

- encourage local communities to engage in creative, community-focused activities that will enhance disaster resilience
- develop effective partnerships and build networks between local community organisations, councils, businesses and emergency services agencies
- foster ways to effectively engage the local community in emergency management and resilience building
- share knowledge and lessons learnt about new approaches and models through project evaluation
- support initiatives that can be integrated into current business and maintained in the longer term.

CRIP is a scheme under the Natural Disaster Resilience Program, funded by the NSW and Commonwealth governments through the *National Partnership Agreement on Natural Disaster Resilience*.

6 Measuring progress

6.1 Adaptation process

The ability to detect change is a critical component of any monitoring program because it facilitates adaptive management (Allan & Curtis 2005); however, issues associated with monitoring and evaluating climate adaptation are well-documented and include (Bours et al. 2013):

- measuring adaptation against a moving climate baseline
- consideration of avoided impacts through counterfactual arguments that are difficult to prove, such as ‘if we hadn’t undertaken this adaptation action the outcomes might have been much worse’.
- the difficulty with attempting to attribute an adaptation outcome to a particular course of action, as often multiple actions have contributed to improved climate resilience
- local adaptation actions can have outcomes that span multiple scales, sectors and responses
- the lack of a universal set of indicators against which adaptation can be measured.

Despite these difficulties, organisations (private and public) are moving from *awareness* about the need to manage climate change risks to *implementing actions* to manage them. This has led to the emergence of a common set of practices considered necessary to deliver effective adaptation to climate change: the adaptation process cycle (Figure 19). All the processes in the cycle commonly occur as part of action to adapt to climate in NSW.

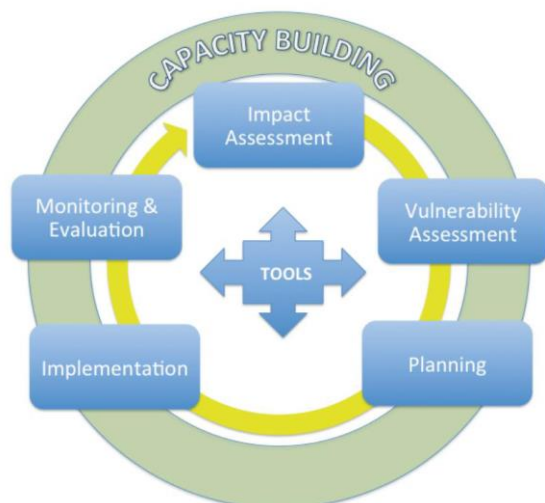


Figure 19: The adaptation process cycle Source: Hansen et al. (2013)

A well-defined process cycle is central to effective benchmarking. Benchmarking can be used to evaluate an organisation, business or process against external criteria. The objectives of benchmarking are to determine what and where improvements may be made, to analyse the ways in which other groups achieve high performance, and to use this information to drive improvements in performance. Benchmarking represents a ‘soft policy’ that encourages flexible planning, local consultation and incorporation of local context coupled with institutional support at higher scales of governance. Soft policy instruments can sustain proactive behaviour to achieve desirable outcomes that are embedded and accepted in everyday practices.

For climate change, benchmarking the adaptation process at the regional scale circumvents many of the problems with attempting to assess and aggregate local-scale adaptation actions. The WERA process focuses on assessing the degree to which organisations are employing an effective adaptation process rather than the effectiveness of government adaptation processes or interventions; the underlying assumption being that good process leads to good adaptation decisions. This type of approach was used by Hansen et al. (2013) in a national climate adaptation benchmarking exercise conducted across a number of sectors in the USA.

6.2 Adaptive capacity

One way to promote adaptation action is to build regional capacity to adapt (Jacobs et al. 2015). Targeted capacity building requires an understanding of where the barriers to action lie in the region, which is generally related to the resources available for adaptation and the ability to use them. These resources commonly include awareness, knowledge and skills, and staff resources (human capital), engagement and networking with the community and other organisations (social capital), the formulation of strategic plans, and the financial resources to implement adaptation actions. Monitoring adaptive capacity over time can provide an additional measure of regional change.

6.3 Regional online survey

A qualitative survey was conducted to benchmark regional adaptation actions at the start of the project, to provide a baseline, and following completion of the WERA workshop process, as a preliminary assessment of change. The survey was available online for a period of four weeks between February and March 2016 (initial) and again in April 2017 for three weeks (post-workshops).

The response rate varied considerably between the two survey times. The results presented here will focus on the initial survey because the response rate was higher, and therefore is likely to represent regional conditions more reliably. The change in response rate means that small differences in results between sampling times are difficult to attribute to any single factor. They may be the result of an altered sampling frame (for example, differences in representation across tiers of government or a change in the mix of agencies that responded to the survey) or to real differences in regional conditions. Despite this we will present differences in response to selected questions between the two surveys, particularly where they relate to identification of new, local adaptation projects.

The outcomes of the initial survey informed the multi-stakeholder WERA workshops conducted in the New England North West region. In total, 68 people from the region, from all levels of government, completed the survey. Just over half (57%) of respondents represented NSW Government agencies, 29% local government and 15% regional agencies. The smallest groups represented were from non-government organisations, representing 4%. About 9% of survey respondents (six of the 68) identified as being of Aboriginal heritage.

In total, 27 respondents completed the follow-up survey. The representation of respondents was spread across NSW Government agencies (67% or 18 respondents), local government (26% or seven respondents) and non-government organisations (7% or two respondents). Only one of the respondents identified themselves as being of Aboriginal or Torres Strait Islander heritage. Just over half (56% or 15 respondents) who completed the survey had attended at least one of the OEH ERA workshops in 2016.

Perceived key climate change risks

In both surveys the respondents identified a number of climate related risks facing the New England North West. The top four were perceived to be drought, changing rainfall patterns, heatwaves and intense storm events with high winds (Figure 20). Increased hail events and frost were perceived as the least important climate related risks for the region.

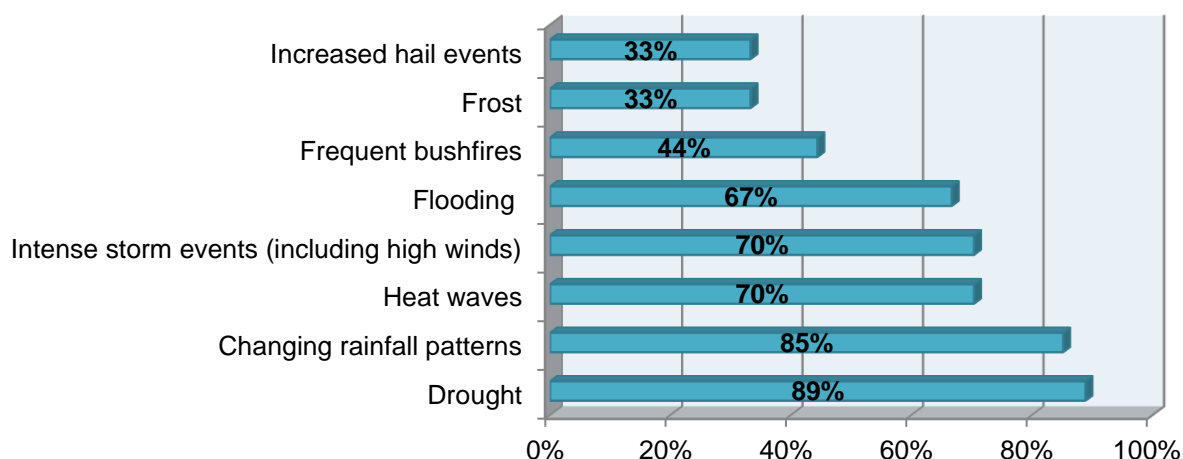


Figure 20: Climate risks identified for the New England North West region

Importance of climate change adaptation

A series of questions was asked to ascertain the importance of climate change adaptation from an individual and organisational perspective. The majority of the respondents (75%) agreed that climate change adaptation is a moderate to strong priority both personally and in their professional roles, while 12% said it was not a priority. Over half (55%) of respondents noted that climate change adaptation was a moderate to strong priority for their organisation and a further 19% considered it a slight priority. About 14% said it was not a priority and 12% were unsure.

Adaptation action

The surveys explored the wide range of adaptation actions that organisations or individuals had been involved with in the past, actions they are currently engaged in, and adaptation actions that are likely to occur in the future (Figure 21).

The top four adaptation actions undertaken either in the **past** or **present** include:

- assessing the risks posed by climate change
- awareness raising or education of staff and local communities
- building trust, networks and partnerships
- monitoring and evaluation of adaptation actions.

All of these actions are important to provide the evidence base for policy decisions and build cross-linkages. Not surprisingly, one of the most identified **future** actions is changing policies and strategies to account for climate change impacts and encouraging the emergency management sector to account for climate change.

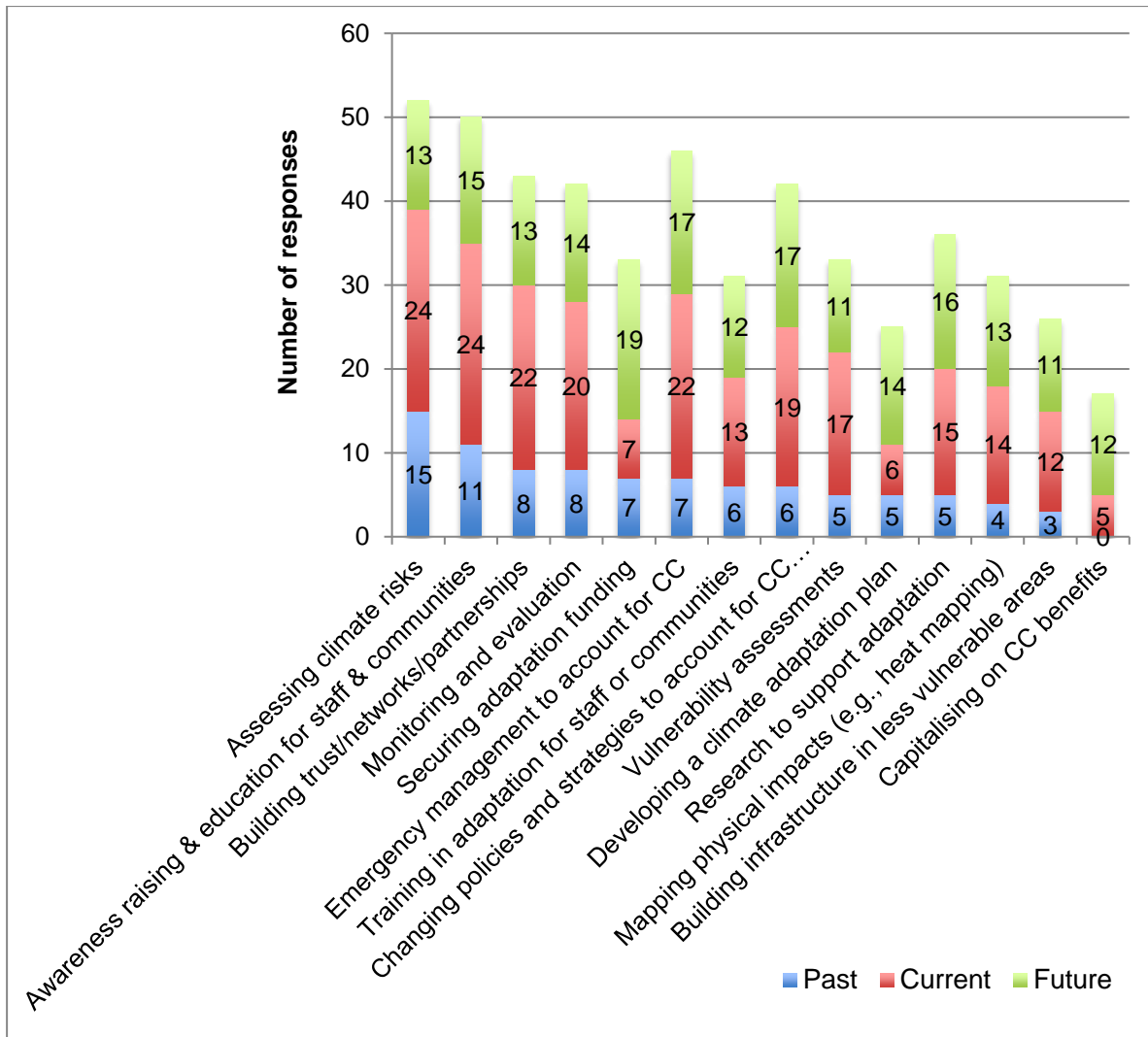


Figure 21: Adaptation actions across temporal scales

Developing an adaptation plan and building infrastructure in locations that are less exposed to climate extremes were the least pursued adaptation actions in both surveys.

Adaptation actions can span multiple scales, sectors and responses as shown in Figure 22. Adaptation actions such as awareness raising, educating and training agency staff or the community, and assessing climate risks and working with the emergency management sector to account for climate risks in their planning, were generally conducted at a local or regional scale. Building social capital is also important at both the state and regional level through building trust, expanding networks and nurturing partnerships.

Respondents identified changing policies and strategies to account for climate change impacts as one of the most important actions to be conducted at the state level, as well as funding and conducting research on climate change impacts and actions.

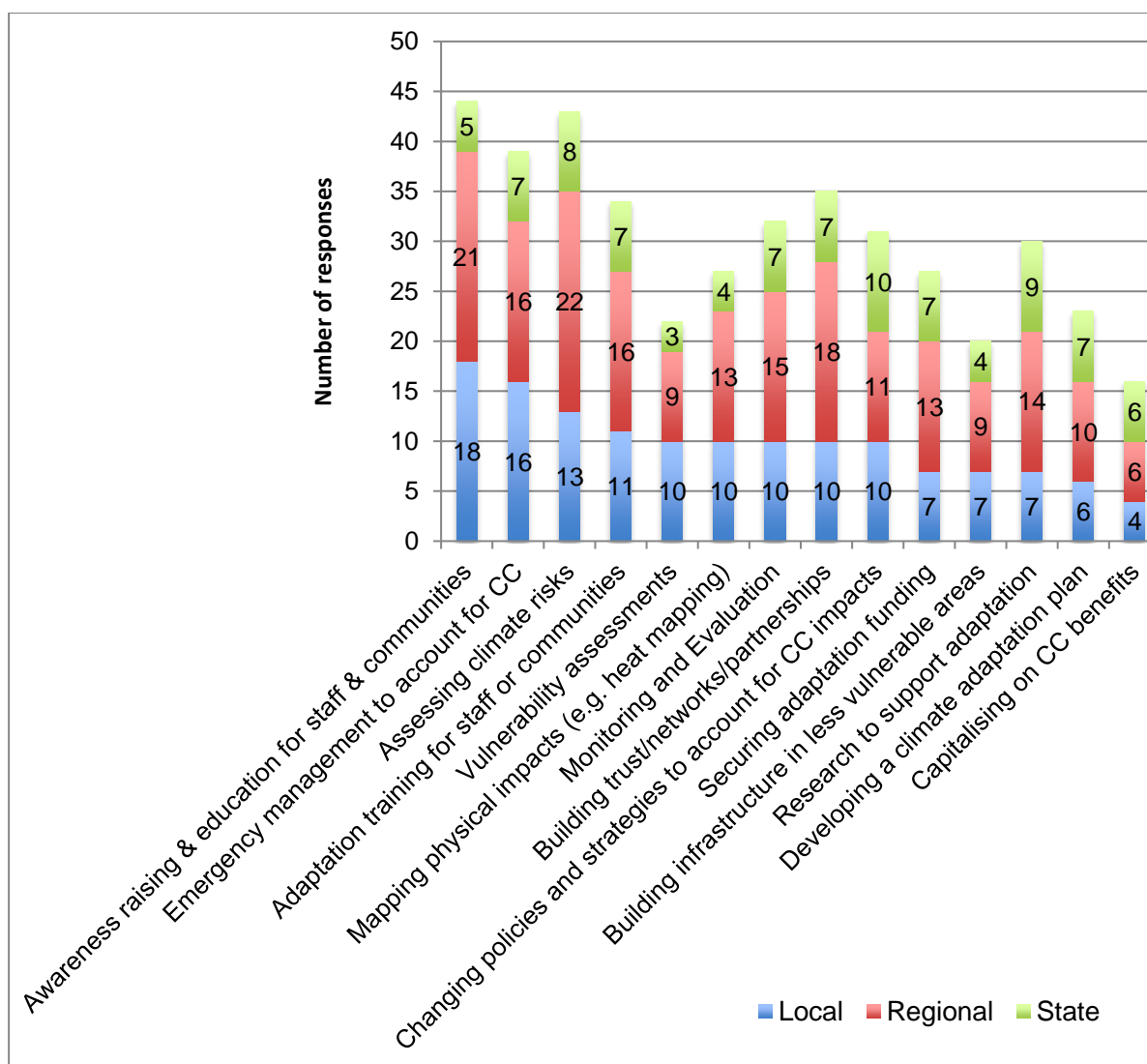


Figure 22: Adaptation actions across geographical scales

Organisational capacity to undertake climate change adaptation

The survey also explored organisational capacity to undertake regional adaptation actions. Organisational capacity can be broken down into seven key areas:

1. Awareness of the impacts of climate change
2. Knowledge and skills to adapt to a changing climate
3. Resources to undertake regional adaptation action
4. Engagement with the community and organisations within the region
5. Strategic planning
6. Funding for adaptation
7. Implementation of regional adaptation.

Median responses to the capacity assessment statements suggested that the region is generally constrained in its capacity to adapt. Respondents believed they were aware of the future impacts of climate on the region; however, they suggested that regional adaptation was constrained by the other attributes of capacity, although there was some variation in individual responses.

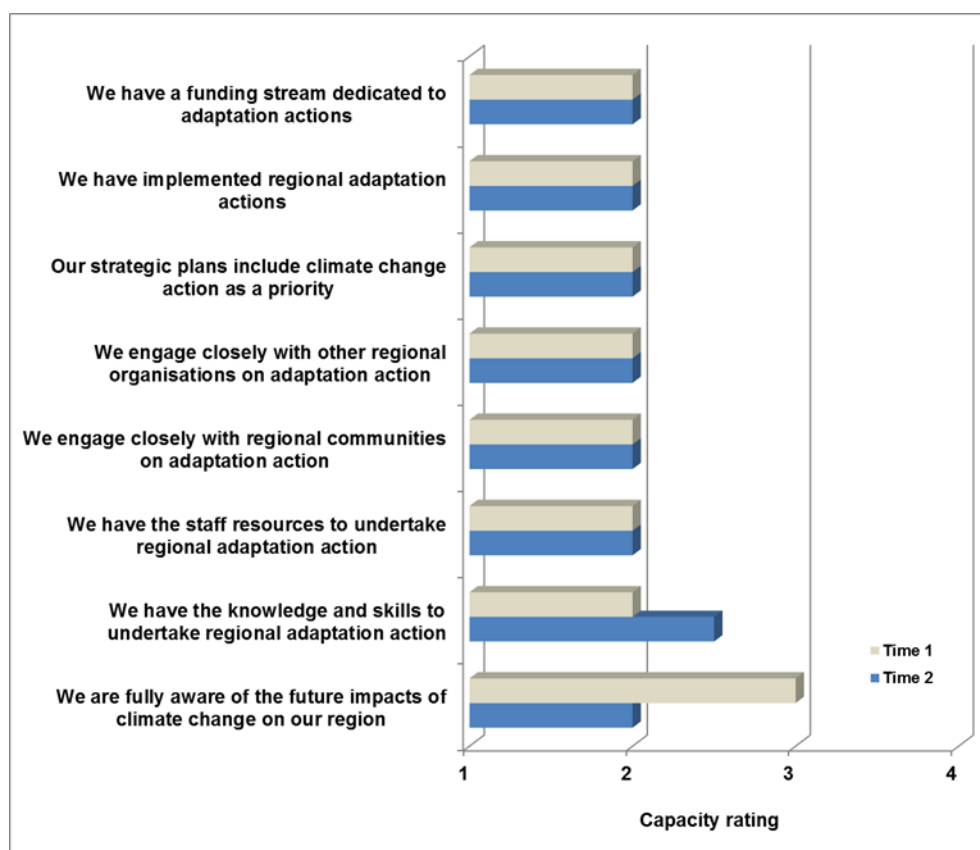


Figure 23: Adaptive capacity for the New England North West Ratings are the median level of agreement with each statement where 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree; N = 21

Regional adaptation initiatives

The surveys aimed to gain a deeper understanding of the specific types of adaptation actions that had taken place in the region. Some of the adaptation actions identified focused on key areas of importance to the region such as agriculture, natural resource security, energy and community engagement.

Agriculture

Agriculture is increasingly focusing on the implications of climate change, in particular, of climate variability and heatwaves. For example, the breeding of plant species to improve drought tolerance, and the modification of farming and rangeland grazing systems for climate featured. Guidance is being provided to farmers about how to incorporate climate variability in their business plans and strategies and tips to apply for funding and low interest loans to cope with this variability.

The Bureau of Meteorology and the CSIRO have conducted presentations to landholders in the region; however, some of the presentations were reportedly heavily science-based and used language that was difficult for an intelligent lay audience to follow. A key lesson learned from the process was the need to ensure data is presented in language that is accessible to the audience. Ultimately, landholders want to know how the information presented relates to their farm and the decisions they need to make.

Natural resource management

In natural resource management, increasing water security is a focus in the region through the Off Stream Water Storage Project in which disused gravel pits are used for water storage (e.g. the Beardy weir). The depth and reduced surface area of these pits compared with other major water sources reduces evaporation rates and allows for better management of water quality.

A Natural Resource Management Plan for climate change has been developed. This plan incorporates climate change projections and impact information into prioritisation tools and guidance documents for implementation by land managers.

Energy

The region has recently been part of an initiative to increase energy efficiency through the biggest rollout of regional LED street lighting in Australia to date, resulting in large energy and cost savings. The success of this project is attributed to securing access to funding and continued persistence.

Community health and safety

Other adaptation actions relate to the development of health and safety priorities, systems and processes in workplaces to reduce vulnerabilities to a changing climate. This project was implemented due to a greater acceptance of changing work health and safety obligations for workers and businesses.

Community education and awareness raising events

In 2008, a Climate Change Conference was held in partnership with Inverell Shire Council that focused on climate change adaptation. Over 120 people attended the conference and the positive feedback from attendees indicated an increase in community understanding and knowledge. This event was successful in engaging the community and awareness raising because it was delivered at the local scale using a coordinated, statewide approach. However, it was noted that the message about climate change is difficult to convey.

Funding was identified as the number one challenge to overcome in achieving more adaptation action in the region and to build regional capacity. One respondent noted the need to continue to lobby funding bodies about the importance of providing longer-term funding to roll out projects.

Planned climate change adaptation actions

One new initiative, the 'Carbon Farm' initiative at The Living Classroom in Bingara, was identified in the follow-up survey.

Monitoring and evaluation of adaptation actions

Programs, research and recommendations require continual monitoring, evaluation and adjustment to ensure they meet the needs of the regional communities in a dynamically changing environment. The final survey question asked if monitoring and evaluation (M&E) of adaptation initiatives are undertaken on a regular basis. Less than 35% of respondents (11 of 32) confirmed that adaptation actions are being regularly monitored with a further 25% (eight of 32) noting that M&E occurs infrequently. Approximately 31% of respondents answered that actions are not being monitored and 9% were unsure.

7 How to turn these findings into action

This report contains a collective understanding of the likely vulnerability to climate change of the New England North West region and aims to stimulate action to plan adaptation. It documents regional challenges and actions identified by local decision-makers as critical to their community's prosperity and endurance. Local councils and state agencies will need to continue to collaborate and look for opportunities and policy windows to enable transformation of the eight systems identified in this report.

To address the region's vulnerability to climate change, begin by pursuing the following opportunities and be on the lookout for new ideas as well:

- **Understand regional vulnerability** – Table 4 of the report outlines the exposure and sensitivity of the region to climate and other regional drivers of change. It provides a lens through which the specific attributes of the region can be viewed as a means of addressing threats (adaptive capacity). It can also help to identify what attributes are absent or negative, highlighting which adaptive responses will be constrained, leaving the region vulnerable.
- **Understand the flow-on impacts of climate shocks and stressors across the community** – The impact chains in Figure 15 show how climate variability and extreme events will affect the region and illustrate the complexity of consequences from the four main climate drivers that were identified.
- **Assess climate change adaptation progress in the region** – The survey results in Chapter 6 outline the key climate risks and the status of adaptation currently underway. This provides a benchmark against which future action can be measured.
- **Embed the transition models into regional and local strategic plans** – The transition models look at key regional systems that will need to be significantly different in the future due to climate change, and other specific regional drivers of change. Embedding the actions in the transition pathways into project and program development will aid cross-sectoral adaptation and support regional efforts to transform to a desirable future. This can be achieved through strategic planning or operational opportunities.
- **Seek funding to activate transition pathways** – The assessment method used to identify the regional vulnerabilities is a peer reviewed methodology, meaning it provides a robust and scientifically rigorous way to prioritise adaptation projects and responses. It provides a sound evidence base to support adaptation projects and justify subsequent investment.
- **Communicate the expected physical changes** – Tables 2 and 3 and Appendix A summarise the changes to climate variables that can be expected in the future and also the likely impacts across different sectors. Community education and staff training will help the whole region to increase its preparedness.
- **Leverage existing cross-jurisdictional leadership groups** – These groups are central to coordinating and driving climate change adaptation in the New England North West region and are a valuable resource to help build momentum.

Appendix A: Expected physical responses to climate change for the New England North West

Physical response	Trend	Projection	Implications
Heat	Increase	Heatwaves are projected to occur more often, be more intense and last longer. Across most of NSW there will be more days over 40°C. For further information refer to <i>Minimising the impacts of extreme heat: A guide for local government</i> . climatechange.environment.nsw.gov.au/Adapting-to-climate-change/Local-government	<ul style="list-style-type: none"> • Human health • Urbanisation • Biodiversity • Fire weather • Agricultural productivity
Hillslope erosion	Increase	Areas which already experience high erosion rates are projected to see increases in erosion. For this region, soil erosion caused from projected erosivity is projected to increase by 4.3% in the near future and 17.4% in the far future. For further information refer to <i>Soil Erosion Climate Change Impact Snapshot</i> . climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Soil/Soil-Erosion	<ul style="list-style-type: none"> • Water quality • Agricultural productivity • Biodiversity
Soil properties (SOC, pH and sum of bases)	Increase – decrease	The projections across this region of soil organic carbon are complex, with both increases and decreases in different areas and depths. In the region, pH is projected to experience only marginal change with the exception of the North West which is projected to become slightly more acidic in the far future. Sum of bases are projected to increase in both upper and lower soil depths for both the near and far futures. For further information refer to <i>Soil Properties Climate Change Impact Snapshot</i> . climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Soil/Soil-Properties	<ul style="list-style-type: none"> • Agricultural productivity (+ and –) • Natural ecosystems
Rainfall erosivity	Increase	In the region rainfall erosivity is projected to increase in autumn and spring for both the near and far futures. In the North West rainfall erosivity will decrease in summer and winter in near future. However increases are projected for all seasons by the far future. For further information refer to <i>Rainfall erosivity</i> in the <i>Soil Erosion Climate Change Impact Snapshot</i> . climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Soil/Soil-Erosion	<ul style="list-style-type: none"> • Water quality • Agricultural productivity • Biodiversity
Rainfall extremes	Increase	Rainfall extremes are projected to increase in the near future and far future. The state planning regions with the most frequent significant increases in extreme rainfall indices in the far future are the Far West, Riverina Murray, and New England North West. For further information visit the Adapt NSW website: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Floods-and-storms	<ul style="list-style-type: none"> • Flooding • Agricultural productivity • Emergency services • Local government

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Physical response	Trend	Projection	Implications
Flood		For further information visit the Adapt NSW website: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Floods-and-storms	<ul style="list-style-type: none"> • Urban and rural properties • Agricultural productivity • Emergency services • Local government
Hydrology (surface flow/ runoff and recharge)	Increase	<p>The projections of future runoff are spatially variable across the region. Some large increases in annual runoff are projected across some western parts of the region in the far future. This region is projected to have increases in runoff during autumn in both near and far futures, especially in areas around Moree in the far future. Summer and winter projections are more complicated with less runoff in the near future and greater runoff in the far future.</p> <p>On an annual basis, less recharge is likely across most of the region in the near future. Projections are spatially variable in the far future, with higher recharge projected over many parts of the region but less recharge along the New England Range. Considerably less recharge to groundwater is likely during summer in the near future.</p> <p>For further information refer to <i>Hydrology Climate Change Impact Snapshot</i>: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Water-resources/Groundwater-recharge-and-surface-runoff</p>	<ul style="list-style-type: none"> • Councils' stormwater infrastructure • Town water supplies • Agricultural productivity
Drought	Increase	<p>For this region, time spent in drought is projected, with medium confidence, to increase over the course of the century.</p> <p>For further information see the CSIRO and BoM Technical Report (2015): www.climatechangeinaustralia.gov.au/en/publications-library/technical-report/</p>	<ul style="list-style-type: none"> • Human health • Town water supplies • Agricultural productivity • Biodiversity
Evaporation	Increase	<p>Likely increase across all seasons.</p> <p>For further information refer to <i>Hydrology Climate Change Impact Snapshot</i>: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Water-resources/Groundwater-recharge-and-surface-runoff</p>	<ul style="list-style-type: none"> • Agricultural productivity • Biodiversity • Water security
East coast lows (ECLs)	Seasonality changes/ increasing intensity	<p>Climate modelling projects a decrease in the number of small to moderate ECLs in the cool season with little change in these storms during the warm season. However extreme ECLs in the warmer months may increase in number but extreme ECLs in cool seasons may not change.</p> <p>For further information visit Adapt NSW website: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/East-Coast-Lows</p>	<ul style="list-style-type: none"> • Emergency services • Water security • Local government

Western Enabling Regional Adaptation – New England North West

Physical response	Trend	Projection	Implications
Fire weather	Increase	<p>Average and severe fire weather is projected to increase in summer, spring and winter, however autumn is projected to have a slight decrease in severe fire weather in the near future (taking into account increases in autumn rainfall). It is important to note that fire weather has been defined using the Forest Fire Danger Index and so for areas in the region that are predominantly grasslands, fire risk may be more accurately assessed using the Grass Fire Danger Index.</p> <p>For further information visit the Adapt NSW website: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Bushfires</p>	<ul style="list-style-type: none">• Fire regimes• Emergency services• Hazard reduction

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