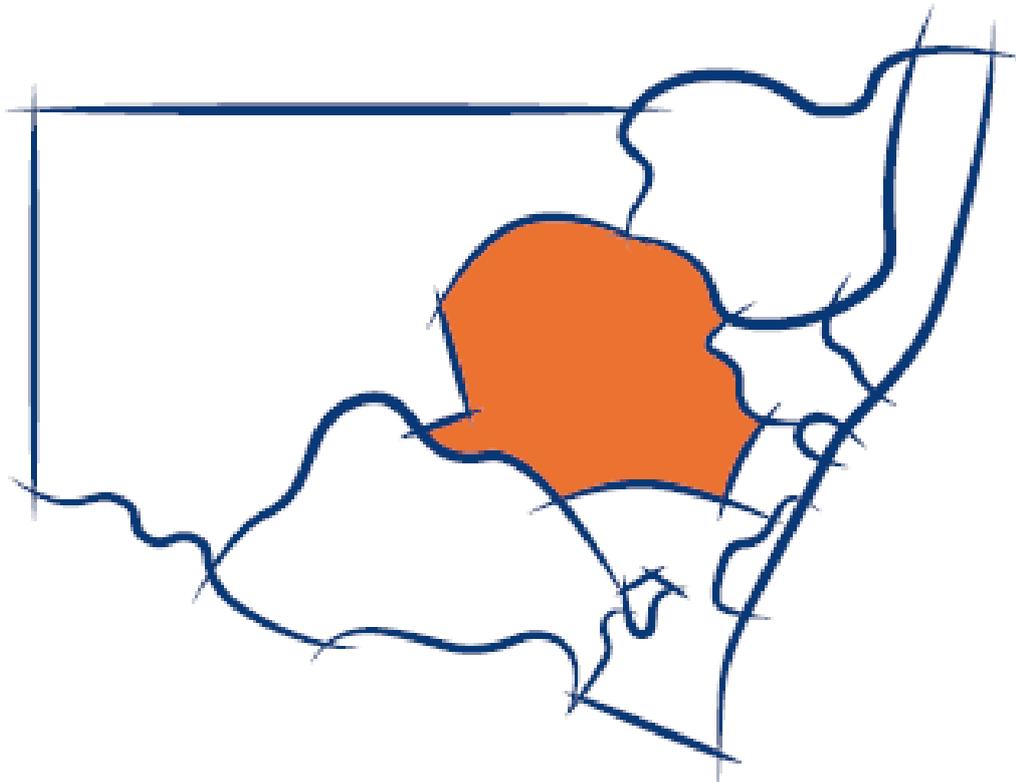




Western Enabling Regional Adaptation

Central West and Orana 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 and local government 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 Riverina Murray 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 Central West and Orana 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 Central West and Orana, 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 Central West and Orana 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 Central West and Orana 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 Central West and Orana, eight regional systems were identified by participants as vulnerable to climate change and in need of change to ensure ongoing community resilience, namely:

- small communities
- transport
- water
- regional knowledge
- mixed farming
- horticulture
- energy
- tourism.

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.

Small communities

The Central West and Orana region supports a range of sizes of human settlements from large regional cities (Bathurst, Orange and Dubbo) to small towns and hamlets. Small communities (Figure 1) were defined as those living in settlements of fewer than 5000 people. This definition implies that, with the exception of the region's three larger cities, most settlements are considered as vulnerable to drivers of change.

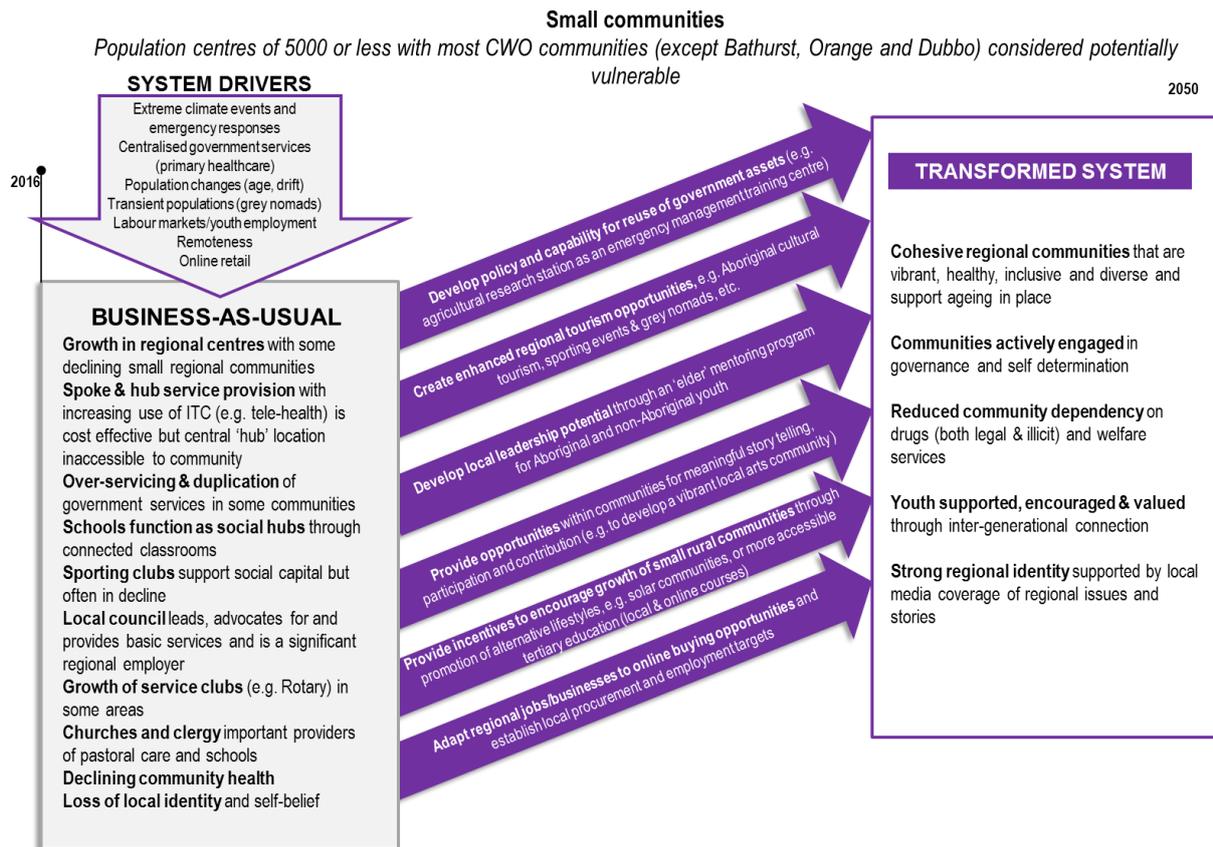


Figure 1: Change model for small communities

Government service delivery to small communities comes under pressure from a range of drivers including: the remoteness of many smaller centres contributing to population change from ageing, loss of youth and migration (or 'drift') of people away from smaller settlements; increasingly centralised government service delivery (particularly for primary health care); and difficulties in attracting and retaining a skilled local workforce, with an emphasis on a lack of employment opportunities for youth. Additional drivers of change in small communities include the seasonal influx of transient populations (such as 'grey nomads'), the impacts of extreme climate events (in particular drought and flooding) in relation to the delivery of emergency services, and the trend towards online retail, which diverts expenditure from the local retail economy placing pressure on small business viability.

The region was described as having a 'two-speed' economy with growth occurring in large regional cities at the expense of some smaller regional communities, which are in decline. Government services are delivered largely through a 'spoke and hub' model with increasing reliance on the internet, which improves cost effectiveness but limits access to the central hub for many communities. Potential over-servicing and duplication of government services occurs in some locations. Local government is increasingly a significant regional employer and plays a major role in leading, advocating for and delivering basic community services. Schools, sporting clubs and service clubs (e.g. Rotary) provide support for local social capital and community cohesion, with churches and clergy offering pastoral care. In general, regional indicators of community health show declining health status. As people leave, some small communities suffer loss of local identity and self-belief, which limits their ability to cope with change.

Pathways that could transition these small communities to a transformed system include the provision of incentives to encourage the growth of small communities through promotion of alternative regional lifestyles in combination with policy initiatives to encourage reuse of under-utilised government assets and a range of business development opportunities, such as enhanced regional tourism or targeting development of local arts communities. In addition, the

adaptation of regional jobs to online retail opportunities (such as warehousing, software and logistics) should be supported by local procurement policies. Economic development requires enhancement of local social capital through platforms (social or traditional media) that feature local stories and through development of local leadership potential (e.g. elder mentoring of youth). Improvements in community health could accrue from programs to recruit and train community health workers in measures to address chronic illness and combat drug use.

Following these pathways will lead to a transformed future that envisions cohesive regional communities which are more resilient and actively engaged in their own governance. Greater self-determination and a stronger regional identity have emerged through reduced community dependency on drugs and welfare services, stronger inter-generational connectivity that values and encourages local youth, and an ability to convey and appreciate stories of regional issues and local success.

Transport

The transport system for the Central West and Orana was defined as the safe, efficient, cost effective and sustainable movement of people and freight in the region (Figure 2).

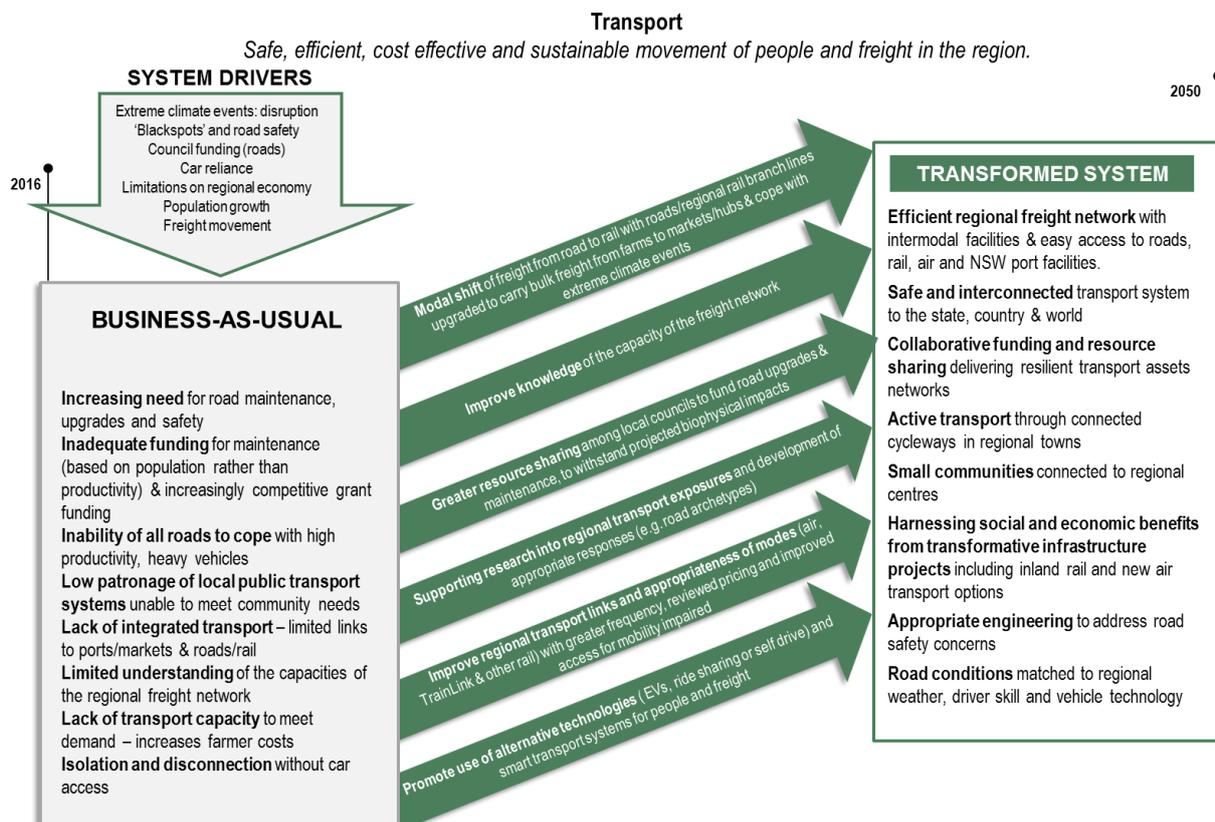


Figure 2: Change model for transport

In the current climate context, transport in the region is characterised by a growing need for maintenance and safety upgrades due to increasingly competitive funding, which is based on population rather than productivity. Public transport in some parts of the region does not meet community needs, which entrenches car dependence and as a result is poorly patronised. Some roads are unable to cope with heavy vehicles (such as B-doubles and triples), and there is a concern that integration is limited by existing linkages between ports and markets and alternate modes (in particular road and rail). There is a lack of capacity to

meet existing demand (especially from the agriculture sector) and limited understanding of the capacity of the regional freight network.

Pathways that would encourage transformation in the transport system include modal shifts for freight from road to new rail, with branch lines of both modes upgraded to better service the agriculture sector and cope with extreme climate events. System transition would be supported through improvements to regional transport links and more appropriate modes (such as air and rail) that feature services that are more frequent and affordable with improved disability and seniors access. Research into regional transport exposures to climate shocks and stressors, improved knowledge of the capacity of the existing freight network and greater resource sharing among local councils to fund maintenance and upgrades, are required. To take advantage of the development of innovation, the use of alternative technologies (e.g. electric and autonomous vehicles and ride sharing) and smart transport systems should be promoted. Reflecting and aligning these pathways in the regional transport plan would be beneficial.

A transformed regional transport system envisions an efficient and resilient regional freight network that features easy access to alternative transport modes and intermodal facilities. The system is safe and captures social and economic benefits from new infrastructure such as regional air transport, inland rail and Golden Highway upgrades. It provides regional connectivity at a range of scales (from state to nation to globe). Within the region small communities are better connected to regional centres and feature active transport through cycleways in regional towns. Road safety concerns have been addressed through more appropriate engineering ensuring road conditions are matched to regional weather, driver skills and vehicle technology.

Water

The water system for the Central West and Orana was defined as encompassing surface and groundwater sources for potable supply, environment and irrigation use (Figure 3). The system includes infrastructure, policies and regulations, and extends to cover dependent ecosystems (e.g. groundwater dependency).

System drivers were complex and multi-scalar. The water system is strongly influenced by changes in rainfall patterns which alter water availability, community expectations of service delivery and the management of risk by decision-makers. Widescale drivers such as population growth in regional centres, sociopolitical pressure and the regulation of the water market through the Murray–Darling Basin Plan (MDBP) combine with more localised pressure from over-allocation of the resource, water user behaviour and competition for potable supply, to effect system change.

The current system of water allocation is based on historical usage and current availability. The system was considered to be made up of two main components: water for irrigation and for potable use. For irrigation, management was focused on human needs over those of the environment with the movement of water limited by existing infrastructure. The separation of water and property rights and the gazettal of water sharing plans promote improvement in water management supported by adoption of new technology to forecast irrigation supply and demand. Supply of potable water supports the viability of local government through revenue from licensing, utility operation and trade of water. Potable water treatment is regulated by the NSW Government with little demand for diversity in water products to allow treatment better matched to end use. Efficiencies driven through the water market are seen as favouring larger and wealthier business interests.

Pathways leading to a transformed water system include better management of climate impacts on the environment through landscape connectivity and improved monitoring. Management of water supply and demand could be improved through economic instruments to encourage altered consumption patterns, adoption of integrated water cycle management at green field sites and development of a business case to support the multiple benefits of water harvesting. Water security for small towns would be improved through enhanced regional infrastructure and for irrigation, through rapid adoption of technical innovation and consumer education. Overall system efficiency would be enhanced by the installation of centralised controls using in-ground sensors to automate water trading and delivery.

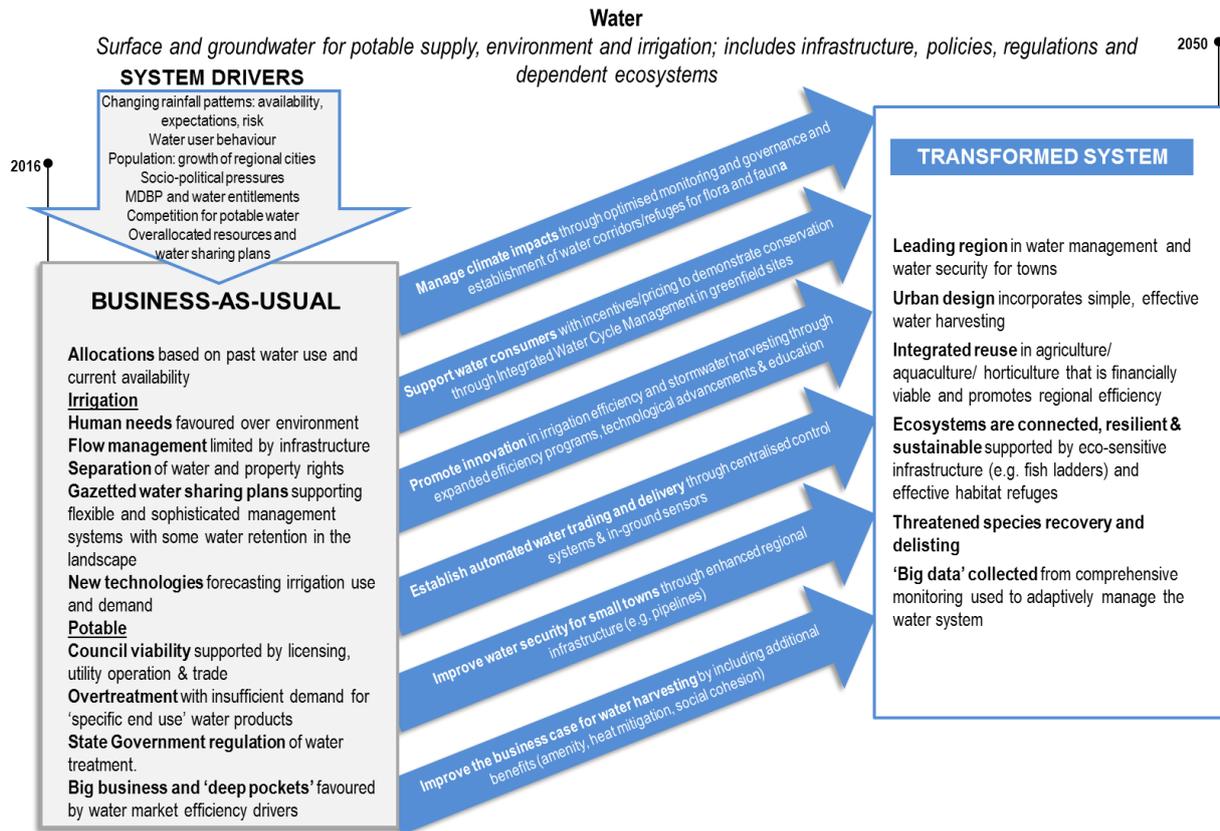


Figure 3: Change model for water

A transformed system sees the Central West and Orana as a leading region in water management and security of town supply. Human settlements incorporate water harvesting and agricultural industries have integrated water reuse into production systems. Connected, resilient and sustainable ecosystems enable threatened species recovery, supported by eco-sensitive water infrastructure. The system is managed adaptively through comprehensive monitoring and modern data analytics.

Regional knowledge

An integrated regional knowledge system for the Central West and Orana does not currently exist and was viewed as a development that would underpin change in other systems. A regional knowledge system (Figure 4) was defined as public, standardised data and modelling by communities, governments and NGOs to support decision-making, analysis, monitoring and evaluation of the progress of change and the service needs of the community.

The development of a regional knowledge system is driven by a view that current decision-making is hampered by poor regional data services. Issues of data acquisition (cost, time

required, inadequate sharing), lack of investment in data services and ineffective use of existing funds are significant barriers to overcome. In addition, social concerns about privacy, civil libertarianism and a cultural aversion to government data collection also constrain knowledge system development.

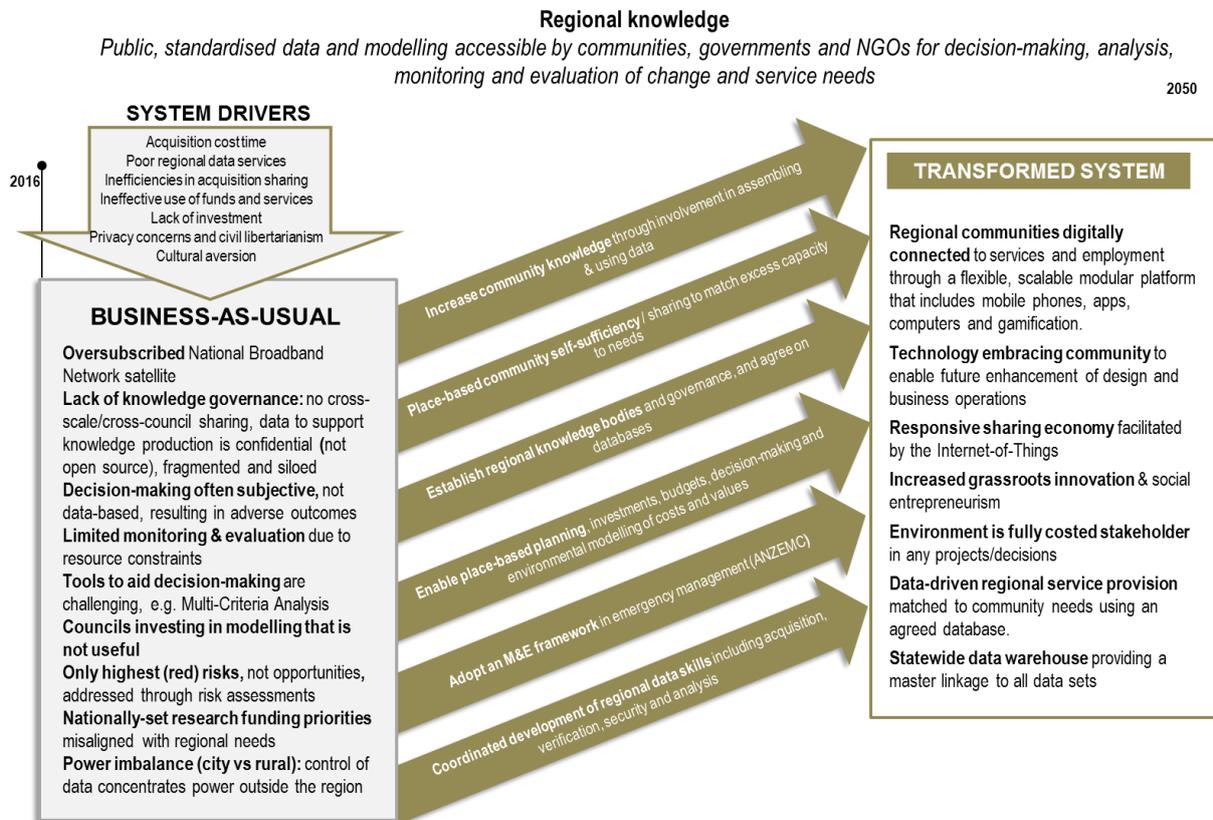


Figure 4: Change model for regional knowledge

The current state of regional knowledge is characterised by an oversubscribed NBN satellite service and a general lack of knowledge governance in which data is fragmented, siloed, rarely shared effectively and largely controlled from Sydney. Decision-making is often subjective and addresses only the highest levels ('red') of risk. The available decision support tools are challenging to use and local government investment in modelling is often misdirected. Monitoring and evaluation of program outcomes is resource limited and national research priorities are rarely aligned with regional needs.

Transition pathways toward the development of a knowledge system for Central West and Orana include coordinated development of regional data skills in acquisition, verification, security and analysis. For the community, regional knowledge expands through familiarity with the assembly and usage of data, which enables development of place-based sharing economies and greater self-sufficiency (e.g. using software applications to match excess capacity to needs). Improved governance is addressed through the establishment of regional knowledge bodies to oversee governance of agreed databases and monitoring and evaluation frameworks. Improvements in knowledge governance also facilitate place-based decision-making on planning, investment and environmental modelling.

A transformed system envisions regional communities that embrace technology and are digitally connected to services and employment through a range of flexible, scalable, modular platforms. The Internet-of-Things has enabled establishment of a responsive sharing economy and grassroots innovation and social entrepreneurship are an accepted facet of life. Improved knowledge has ensured that the environment is a fully costed stakeholder in decision-making. Agreed databases are warehoused and available NSW-wide and drive regional service provision that is closely aligned with community needs.

Mixed farming

Mixed farming in the Central West and Orana is defined as a non-irrigated agricultural system that incorporates crop and livestock enterprises (Figure 5).

Drivers of change that act on mixed farming include climate (changing rainfall patterns), demographics (ageing farmers, youth migration and skills shortages), management of agricultural land (degradation and fragmentation), indirect impacts of climate change on biosecurity and animal welfare (especially heat waves), and market demand for agricultural products.

Regional mixed farming systems are characterised as remaining viable through improvements in efficiency and local value adding with the geographical range of some types of enterprises shifting under exposure to changing climate. Management tools are available to assist decision-making in relation to disease outbreaks, optimum crop rotations and pest and weed control. Dual purpose crops (grazing and grain), such as winter wheat cultivars are commonly integrated into production systems. Management increasingly focuses on maintenance of soil health and conservation of soil moisture aided by adoption of precision farming techniques. Changes in animal husbandry have resulted in improved production and fertility of sheep, integration of goats into grazing enterprises and greater use of feedlots for livestock fattening. Conflict over land use between agriculture and mining (in particular coal seam gas extraction) is increasing.

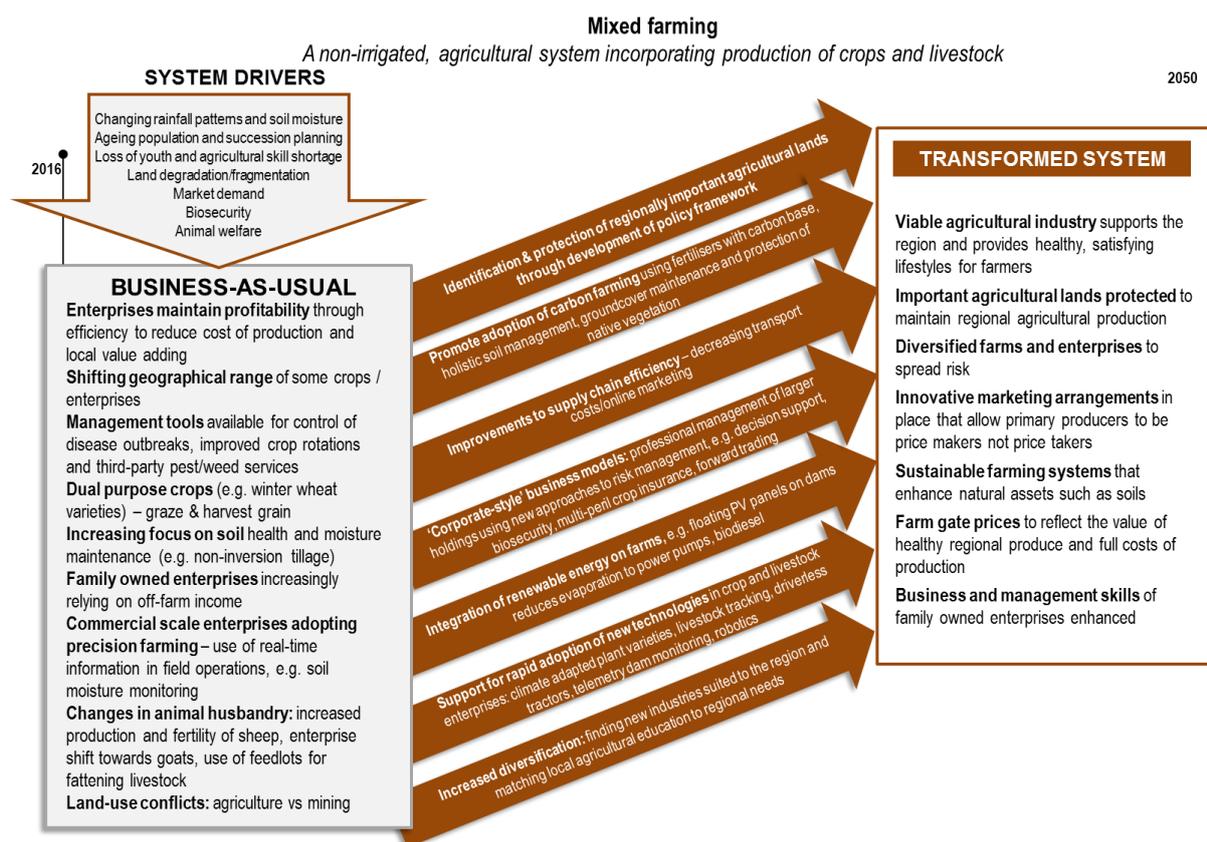


Figure 5: Change model for mixed farming

Pathways to enable the transition of mixed farming systems include the identification and protection of agricultural land, integration of carbon farming techniques into traditional enterprises and support for the rapid adoption of new technologies in plant and animal genetics, remote sensing and robotics. Improvements to the efficiency of agricultural supply chains (especially logistics and marketing) and the management of risk on consolidated agricultural holdings under corporate-style business models are also required. Expansion of renewable energy generation on farms can complement traditional agricultural enterprises, offsets farm energy costs and improves regional energy security. Opportunities for diversification into new industries should be exploited.

A transformed system of mixed farming sees the regional economy supported by viable agricultural industries that provide healthy, satisfying lifestyles for farmers. Significant agricultural lands are protected to ensure regional productivity into the future. Farm enterprises are diversified to spread risk and have established innovative marketing arrangements that enhance farmers' negotiating power over prices and which reflect the value of production systems that are healthy and sustainable.

Horticulture

Horticulture in the region is defined as the production of woody perennial tree and vine crops in primarily irrigated systems (Figure 6).

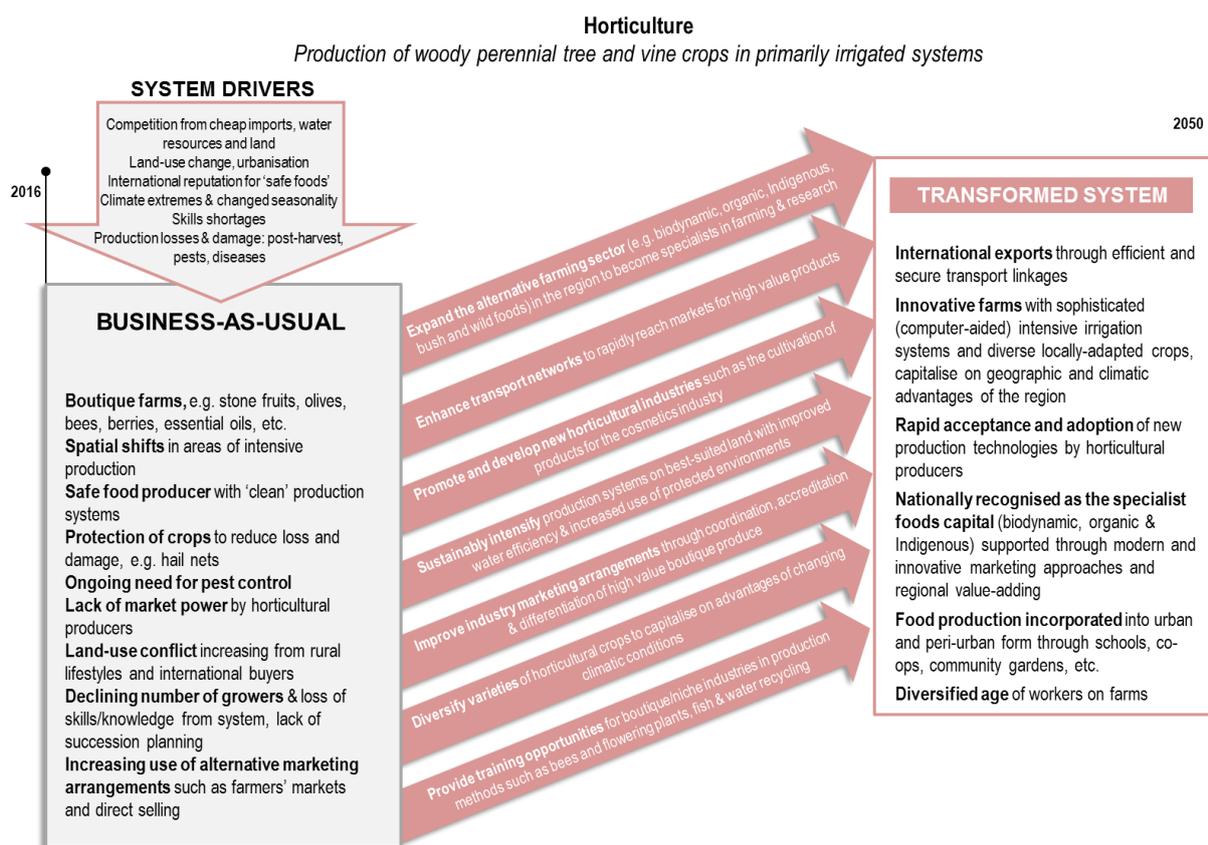


Figure 6: Change model for horticulture

The major drivers of change for horticulture include climate extremes and changed seasonality, production losses (pests and diseases), post-harvest damage, and competition for resources, especially water and land, often exacerbated by urban encroachment, for rural lifestyles or new settlements. Export demand is driven by Australia's international reputation as a 'safe' food producer but is offset by competition in local markets from cheap imported produce. Workforce skills shortages, in common with the agriculture sector throughout NSW, drive changes in management practices.

Horticulture in the Central West and Orana is comprised of boutique farms yielding a diverse range of products including stone fruits, olives, berries, honey and essential oils. Areas of intensive production are undergoing spatial shifts with protection of crops (e.g. hail nets) commonly installed to reduce loss and damage. The ongoing need for pest control is a major production cost. Producers suffer from a lack of market power and increasing conflict over land resources (e.g. urban encroachment, international buyers). The industry is also struggling to cope with a declining number of growers through retirement, an associated loss of skills and knowledge, and a lack of effective options to ensure succession. The horticulture sector's reputation as a safe food producer and the inability of producers to influence prices through traditional marketing chains encourages exploration of alternative marketing arrangements such as farmers' markets and direct selling.

Transition pathways for regional horticulture include expansion and diversification of the sector into alternative farming (organic production, bush foods), new crop varieties better adapted to changing climate, and innovative products to supply, for example, the cosmetics industry. These initiatives require support from enhanced rapid transport networks for high value perishables, workforce training, and improvements in marketing arrangements that coordinate, accredit and differentiate innovative boutique products. The sustainable intensification of production systems on best-suited land with improved water efficiency and increased use of protected environments is also needed.

Transformation of regional horticulture envisions production of locally-adapted crops from innovative farms employing sophisticated irrigation systems. The age profile of the horticultural workforce is broader and farm managers are rapid adopters of new technologies. The region is recognised nationally as the 'alternative foods capital' through modern and innovative marketing approaches and regional value adding. Planning in the region's major urban centres incorporates food production into the urban and peri-urban form, enhancing regional liveability.

Energy

The Central West and Orana energy system was defined as energy production from a diverse combination of renewable and non-renewable sources (Figure 7).

The energy system is influenced by a combination of 'push-pull' factors ranging from path dependency on fossil fuels and relatively low prices for coal constraining change, to the need to curb greenhouse gas emissions and climate change impacts promoting change. Other system drivers include rising energy costs, increasing requirements for electricity grid maintenance and power station transmission losses.

The region's energy system is characterised as a centralised system with limited local ownership in which coal is perceived as cheap compared to renewable energy and provides regional employment through power stations and coal mines. These issues lead to a perception that change is unnecessary and limited commitment from central government to improve rural energy systems despite the need for increasing investment in upgrades and maintenance of the distribution grid. Use of wood fires for domestic heating, hot water and cooking is in decline due to the impact of poor urban air quality on community health. The renewable energy industry in the region is small but growing through the uptake of domestic photovoltaic power and solar hot water and larger scale developments in solar and wind farms. Opportunities for business development around carbon sequestration are expanding.

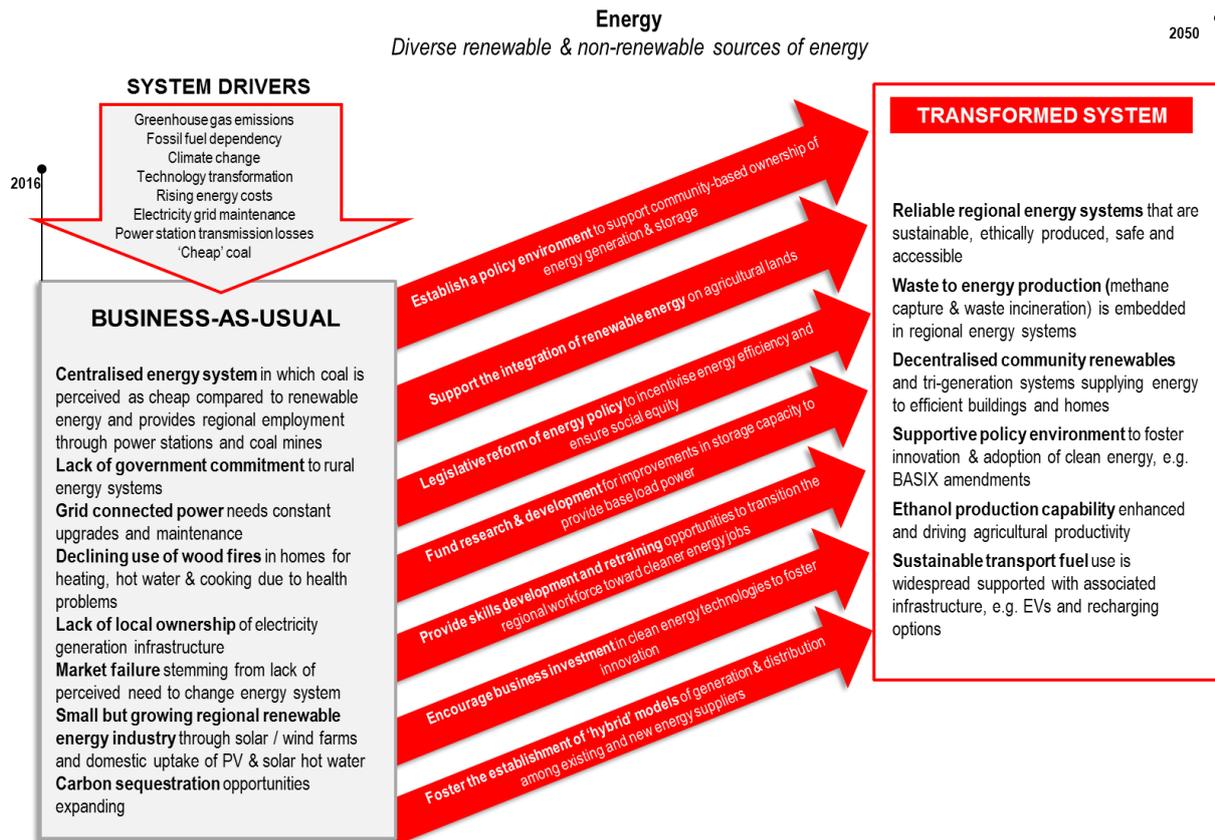


Figure 7: Change model for energy

Transition pathways call for the establishment of a policy environment to support community-based ownership of energy generation and storage combined with legislative reform to incentivise energy efficiency and ensure social equity. Hybrid models of generation and distribution by energy suppliers should be established. Funding is needed for research and development into improvements in storage capacity to provide base load power. Businesses should be encouraged to invest in clean energy technologies to foster innovation, and pursue opportunities for integration of renewable energy generation and agriculture. Skills development and retaining will allow the regional workforce to transition to secure employment in the clean energy sector.

Transformation in regional energy envisions a system that is reliable, sustainable and safe, and that embodies ethical production and equity of access for communities. Production is decentralised, utilises waste as an energy source and delivers renewable energy through high-tech generation systems to energy efficient homes and buildings. Regional capability for ethanol production from the agriculture sector enhances farm viability and contributes to the supply of sustainable transport fuels. The transformed system is supported by a policy environment that fosters innovation and adoption of clean energy technologies.

Tourism

Tourism in the Central West and Orana was defined as a sector seeking to attract and increase visitation to grow and diversify the regional economy without changing the 'essence' of the region (Figure 8).

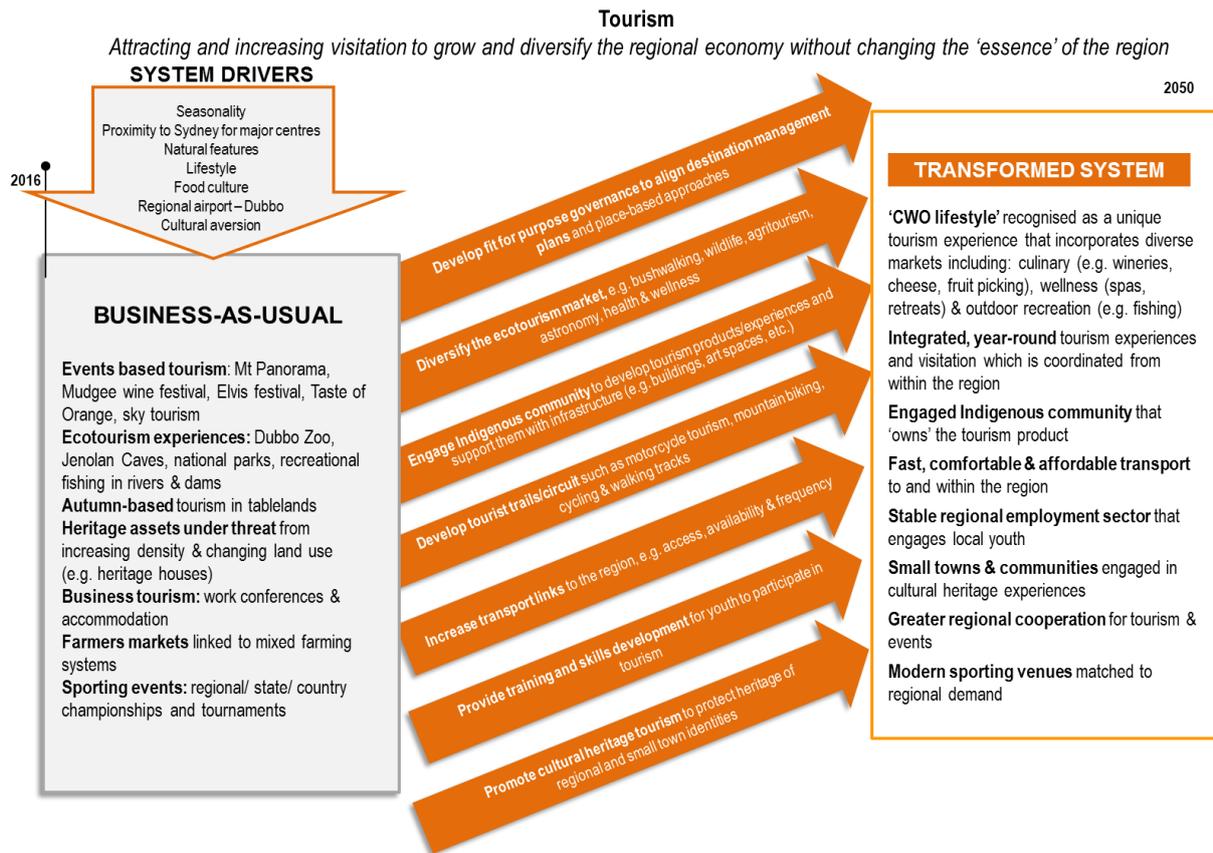


Figure 8: Change model for tourism

The system is influenced by a range of drivers including proximity to Sydney (for Bathurst and Orange) and regional air services (particularly Dubbo), distinct seasonality and natural features, and a developing lifestyle and food culture. The sector was considered constrained by a traditional, cultural aversion to tourism in some locations, and by inefficiencies in coordinating Commonwealth, centralised state and local resources and messaging. Regional coordination, based in the region, was considered vital to protecting and growing these markets.

The system is characterised as highly segmented and includes events-based tourism (e.g. car racing, wine and sky tourism), ecotourism experiences (e.g. Dubbo zoo, Jenolan Caves), and autumn tourism in the Tablelands, which are generally uncoordinated. Other tourism segments showing potential include business tourism (professional conferences and associated accommodation), sporting events (championships and tournaments), and farmers' markets linked to produce from local horticulture and mixed farming enterprises. Heritage assets which are largely under-exploited for tourism are under threat from increasing density of housing and changing land use.

Transition pathways identify the need to build on successful place-based approaches (such as the Unearth-ed campaign) and to align destination management plans into an overarching tourism strategy. The strategy would seek to diversify the ecotourism market to take advantage of the region's natural features; engage the Aboriginal community and support them with infrastructure in development of cultural tourism products and experiences; protect and promote cultural heritage assets/values of the region's small towns; and develop tourist trails and circuits for motorcycles, pushbikes and hikers. Access, availability and frequency of transport links to the region need improvement. Youth participation in tourism would be encouraged by fostering local training and skills development opportunities.

A transformed tourism sector envisions the 'region's lifestyle' recognised as offering a range of unique tourism experiences based on food, wellness and outdoor recreation. Due to regionally based governance arrangements and place-based approaches, and monitoring and reporting on end user expectations and needs, visitors can experience tourism that is integrated and year-round exploiting the region's distinct seasonal climate. The Aboriginal community is engaged in and 'owns' tourism products and businesses. Transport to and within the region is fast, comfortable and affordable which facilitates the engagement of small towns in cultural heritage tourism experiences. The region's sporting venues are modern and closely matched to demand. Tourism events are closely integrated and cooperate to enhance the sector's potential as a stable employer, particularly for regional youth.

3 How is Central West and Orana 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 Central West and Orana region encompasses the traditional lands of the Wiradjuri, Kamilaroi, Darug, and Weilwan peoples (HO & DUAP 1996).

The region consists of multiple language groups and incorporates all or part of 15 Local Aboriginal Land Councils. Based on 2011 Census data, the Indigenous population of the region is estimated to be 21,599 people or 7.8% of the total population.

In the region, there are over 10,667 cultural heritage sites and 11 Aboriginal Places identified under and protected by provisions of the *National Parks and Wildlife Act 1974*. There is one Indigenous Protection Area in the region which is recognised by the Australian Government as an important part of the National Reserve System.

The region’s total population in 2011 was 276,850. Figure 9 provides a comparison of populations within each local government area (LGA) ranging from 40,250 people in the Dubbo Shire LGA to 2850 in the Warren Shire LGA.

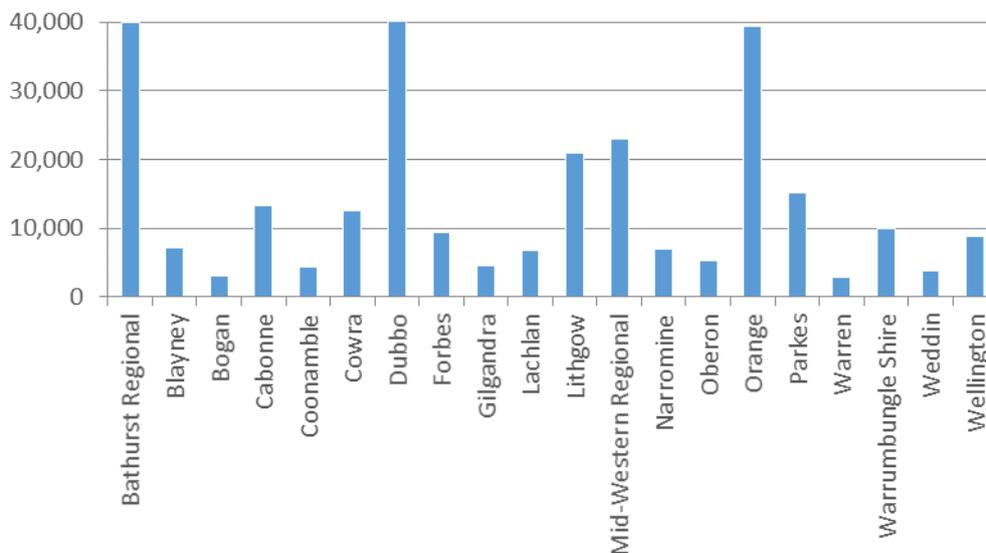


Figure 9: Local government area population statistics from 2011

Source: Department of Planning and Environment (2015)

The population of the Central West and Orana region is projected to grow by 8% over the next 15 years (to 2031). 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) are also declining by 2% and people 65 or older growing by 59%. This will see the proportion of people aged 65 years or over grow from 16% to 24% of the total population by 2031 (Department of Planning and Environment 2015).

The workforce participation rate for the region in 2011 was 74.2% (NSW 73%) and the working age population (i.e. those aged 15 to 64 years) of the region comprised 62% (NSW 66%) of the total population, although it is acknowledged that many workers continue past their 65th birthday.

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 aged population is supporting a higher proportion of people deemed not to be in the workforce.

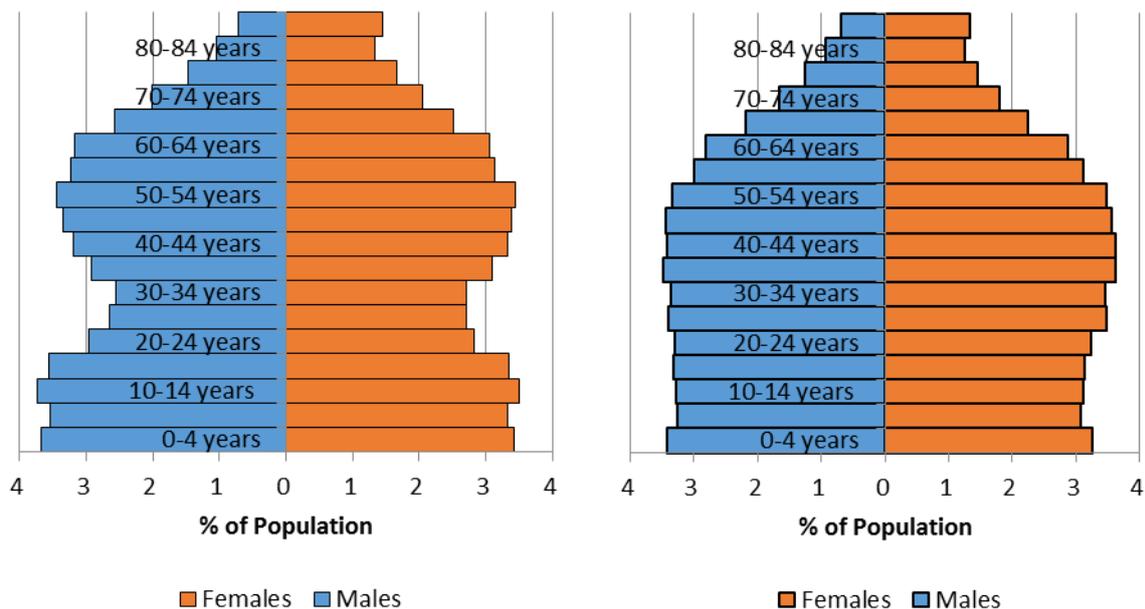


Figure 10: Age distribution in the Central West and Orana region (left) compared to NSW (right) Source: Australian Bureau of Statistics (2013b)

Stakeholders from the region expressed the 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:

- 81% of the region has a well-developed proficiency in English speaking compared to 11% not well or not at all (ABS 2013a)
- 70% of the region is families, with the highest proportion of families classed as coupled families with no children (40%), followed by coupled families with children under 15 (30%) (ABS 2013a)
- 21% 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).

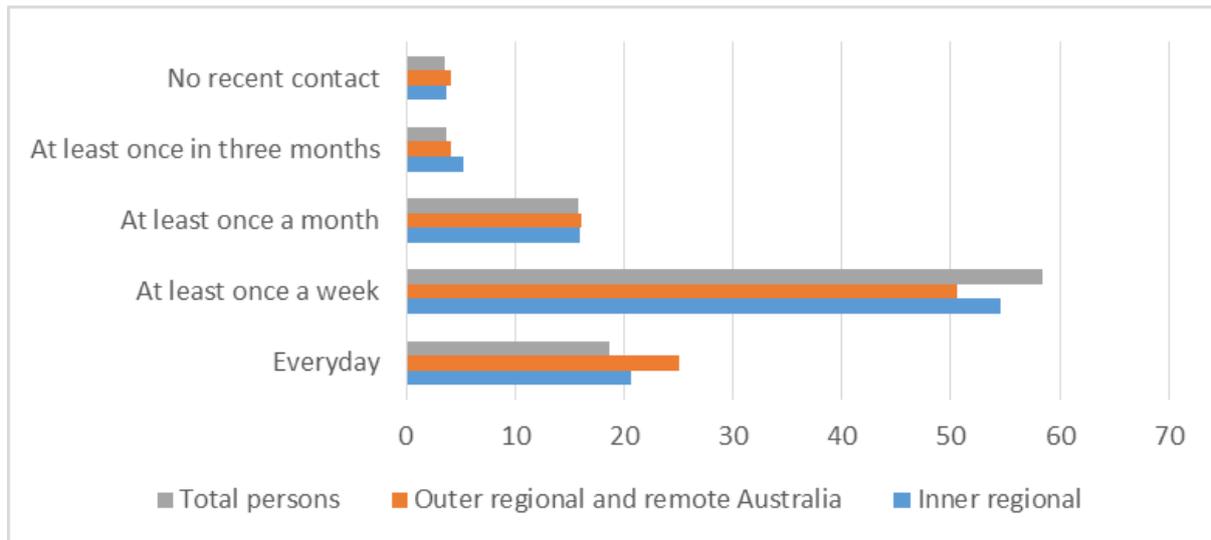


Figure 11: Frequency of face-to-face contact with family or friends living outside the household Source: Australian Bureau of Statistics (2015)

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% of people living in the region spoke English at home compared with 2.8% 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

In 2013, the region contributed \$16 billion to Gross Regional Product (GRP) and supported 104,000 local jobs (Department of Industry 2015). Industry is quite diverse, with the major employment sectors being health care and social assistance, retail trade, agriculture, forestry and fishing, education and training, and accommodation and manufacturing. The mining sector contributes over 20% of the total mining output for NSW at \$2.5 billion and employs 4885 people (Table 1).

The region accounts for 18% of all agricultural production in NSW and is also a significant employer. 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 \$1.2 billion, supporting a range of industries including the accommodation and food services and allied retail trade sectors.

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. Mining (14.7%)	1. Health Care and Social Assistance (13.1%)
2. Agriculture, Forestry and Fishing (8.2%)	2. Retail Trade (11.1%)
3. Health Care and Social Assistance (7.0%)	3. Agriculture, Forestry and Fishing (10.6%)
4. Manufacturing (6.4%)	4. Education and Training (9.7%)
5. Education and Training (5.8%)	5. Manufacturing (7.8%)

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 (77.9%) are the dominant dwelling type, followed by unoccupied dwellings (13.1%). A small percentage are flats or units (4.2%) and semi-detached (3.9%) dwellings (ABS 2013a).
- Broadband is the most available internet connection type (60%); however, at 28.6%, absence of internet access was high (NSW 20%) (ABS 2013a).
- There are a total of 51 private schools, 156 public schools, 34 hospitals and 40 libraries (Education NSW 2016; Health NSW 2016; Private Schools Directory 2016).

3.2 Biophysical

Lying within the Murray–Darling Basin, the Central West and Orana region extends from Bathurst in the south-east to Nyngan in the north-west. The region is characterised by wide valleys and floodplains, with a number of major Darling River tributaries running through the region, including the Macquarie River. In the east of the region, the Great Dividing Range provides the headwaters to a number of Darling River tributaries, including the Macquarie River.

This region supports a diverse range of flora and fauna due to its inclusion of the western edge of the Great Dividing Range and extension onto the semi-arid floodplains of western NSW. Wetlands are a major ecological feature of the region, including the internationally significant Macquarie Marshes on the Darling Riverine Floodplain, and the Bogan and Lower Castlereagh floodplains. Major conservation reserves include the Pilliga and Macquarie Marshes nature reserves and parts of Wollemi, Blue Mountains, Kanangra-Boyd and Gardens of Stone national parks. A large proportion of the vegetation in this region has been cleared and modified for agriculture, ranging from pastoralism to broadacre cropping and irrigation.

The topography of the region results in a large range of climatic conditions. It is relatively dry on the western plains compared to the Central Tablelands. Summers are warm to hot on the western plains and cooler on the Tablelands, which also experience cool to cold winters.

3.3 Expected regional climate change

Information on projected climate for the region can be found in the Central West and Orana Climate Change Snapshot report on the AdaptNSW website (OEH 2014). The snapshot provides near future (2030) and far future (2070) scenarios. 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.

Drawing from the Central West and Orana Climate Change Snapshot report (see Tables 2 and 3), participants discussed the likely impacts on the region. 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).

Table 2: Climate change projections for the Central 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	<0.5 – 1.5°C	1.5 – 3°C
Min temperature	Increase	<0.5 – 1.0°C	1.5 – 3°C
Hot days	Increase	1 – 20	1 – 30
Cold nights	Decrease	10 – 20	20 – 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	–12% to +11%	–10 to +22%
Changes in average rainfall by season*	Drying & wetting	Summer –10% to +10%	Summer –5% to +20%
		Autumn 0% to +20%	Autumn +10% to +20%
		Winter 0% to +10%	Winter –10% to +20%
		Spring 0% to +20%	Spring 0% to +20%

Table 3: Climate change projections for the Orana 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	<0.5 – 1.5°C	1.5 – 3°C
Min temperature	Increase	<0.5 – 1.0°C	1.5 – 3°C
Hot days	Increase	5 – 20	20 – 30
Cold nights	Decrease	5 – 10	20 – 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	–12% to +11%	–10 to +22%
Changes in average rainfall by season*	Drying & wetting	Summer –10% to +10%	Summer +5% to +20%
		Autumn +10% to +30%	Autumn +10% to +30%
		Winter 0% to –10%	Winter 0% to +20%
		Spring 0% to –20%	Spring 0% to –20%

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

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 spring rainfall will decrease in the near future and far future. Winter 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.

3.4 Vulnerability affecting government services

Local decision-makers identified eight factors that affect the vulnerability of the Central West and Orana 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. **Social equity and cohesion:** a widening gap between major centres and small settlements in community service requirements, access and delivery.
2. **Infrastructure design and integration:** critical to climate adaptation and efficient use of resources.
3. **Resource availability and sharing:** competition for limited natural, human and financial resources requires effective networks to support resource sharing.
4. **Renewable energy potential:** needs investment in technology and incentives for adoption to meet future energy needs.
5. **Regional knowledge base:** inadequate information and lack of sharing results in sub-optimal decision-making.
6. **Landscape resilience:** sensitive to changes in climate, resilience ensures the supply of natural resources that underpin regional prosperity.
7. **Community health:** declining community health will require increasing investment under changing climate.
8. **'High tech' skills:** regional skills are not currently well aligned with the requirements of adaptation to climate, changes in the job market and adoption of technical innovations.

Vulnerability

Regions in NSW vary in their vulnerability to climate change, due to their exposure, sensitivity and capacity to respond. Figure 12 shows a snapshot of vulnerability for the Central West and Orana region. The snapshot draws on workshop activities, the adaptation survey, discussions and supporting literature and data to illustrate regional vulnerability as 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 to climate change.

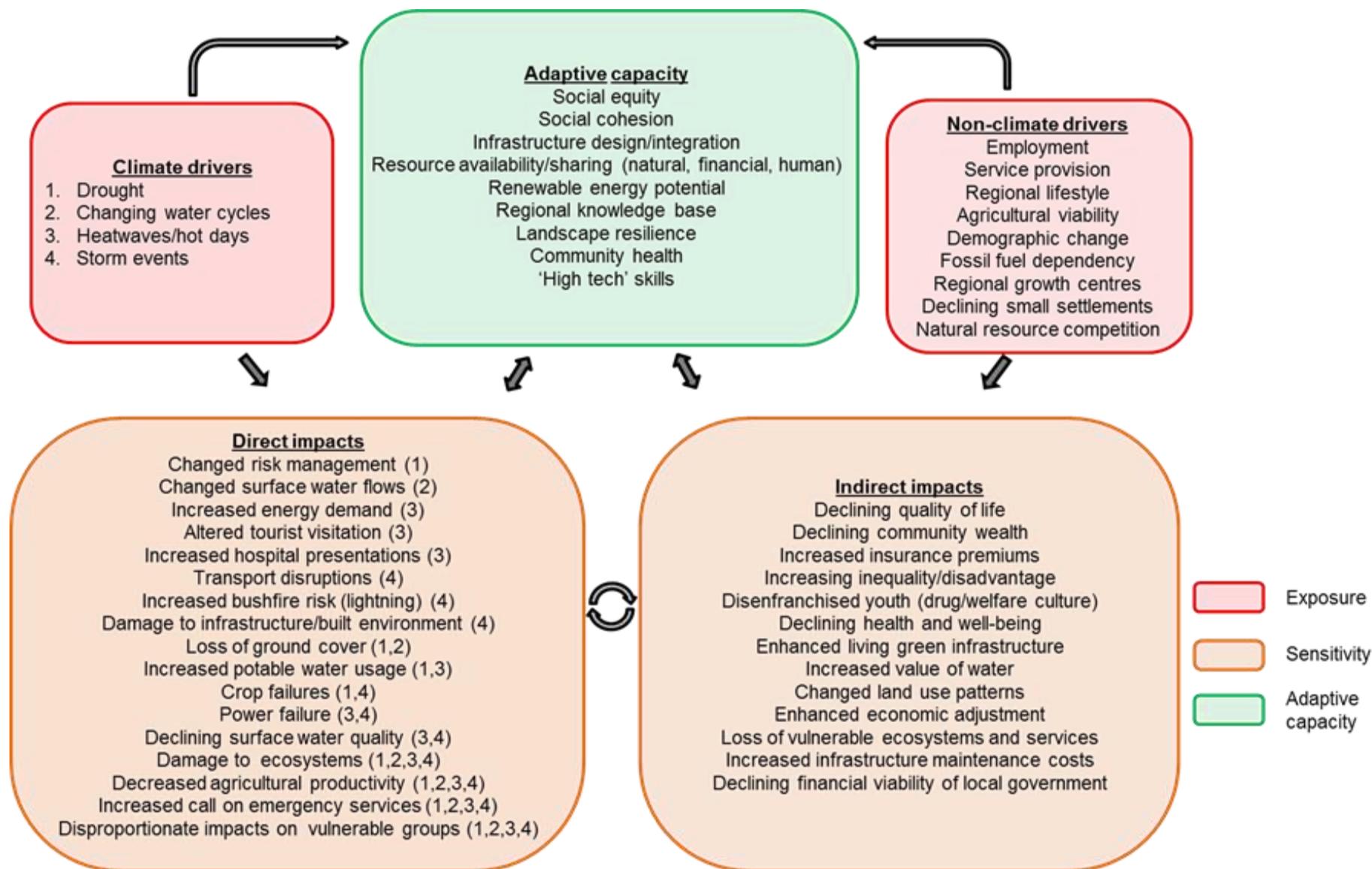


Figure 12: Snapshot of vulnerability in the Central West and Orana region Numbers in brackets under direct impacts link the impact to the climate driver(s)

Exposure

Climate drivers

The main climate drivers of the Central West and Orana identified through the survey and workshops are drought, changing water cycles (in particular seasonality and effectiveness of rainfall), heatwaves and more intense storm events. Of these drivers, changes to rainfall and heatwaves are projected in the regional climate modelling. However, storm events associated with high winds have emerged recently as important regional climate events and are more difficult to predict. Further detail can be found earlier in this section under expected regional climate change and on the AdaptNSW website.

Non-climate drivers

Non-climate drivers are drawn from the range of socioeconomic and biophysical changes currently affecting the Central West and Orana. They operate at a range of scales from national (demographic changes, fossil fuel dependency) to regional (natural resource competition) and local (declining small settlements). While they act independently of climate drivers, they may interact with climate impacts within the region. For example, demographic change is partially attributable to the loss of regional youth to seek employment or education opportunities in larger population centres and occurs independently of climate variations experienced in the Central West and Orana region. However, in combination with climate drivers, demographic change can increase local sensitivity of service provision to climate impacts.

Sensitivity

Direct impacts

The impact of climate change in the Central West and Orana 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 decrease in agricultural productivity as a result of changes to surface water flows and quality, heatwaves result in an upsurge in hospital admissions, and storm events cause damage to infrastructure and disrupt power supply. Multiple impacts from individual climate drivers often converge at critical points of intersection. For example, impacts from drought and changed water cycles converge to exacerbate loss of groundcover, critical to maintaining agricultural sustainability. Impacts of drought and heatwaves converge to increase the demand for potable water. All four climate drivers intersect to damage ecosystems; change agricultural productivity; increase calls for assistance from emergency services and result in disproportionate impacts on vulnerable groups.

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 including the lack of employment opportunities may lead to declining community wealth, increasing social inequality and disenfranchisement of youth. Furthermore, non-climate drivers such as natural resource competition, especially with regards to water resources, may lead to the loss of vulnerable ecosystems and the services they provide, and a general decline in quality of life. 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"> Decreased agricultural productivity 	<ul style="list-style-type: none"> Enhanced economic adjustment Increased value of water 	<ul style="list-style-type: none"> Infrastructure design and integration Regional knowledge base Resource availability and sharing
Human services	<ul style="list-style-type: none"> Increased hospital presentations 	<ul style="list-style-type: none"> Declining health and wellbeing Increasing inequality and disadvantage 	<ul style="list-style-type: none"> Community health Social equity
Settlements and infrastructure	<ul style="list-style-type: none"> Decreased agricultural productivity 	<ul style="list-style-type: none"> Declining community wealth 	<ul style="list-style-type: none"> Resource availability and sharing
Natural resources and ecosystems	<ul style="list-style-type: none"> Damage to ecosystems Changed surface water flows Increased potable water usage Increased energy demand 	<ul style="list-style-type: none"> Loss of vulnerable ecosystems and services Increased value of water 	<ul style="list-style-type: none"> Landscape resilience Resource availability and sharing
Emergency management	<ul style="list-style-type: none"> Increased demand for emergency services 	<ul style="list-style-type: none"> Declining health and wellbeing Increasing inequality/disadvantage 	<ul style="list-style-type: none"> Resource availability and sharing Community health

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 systems 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.

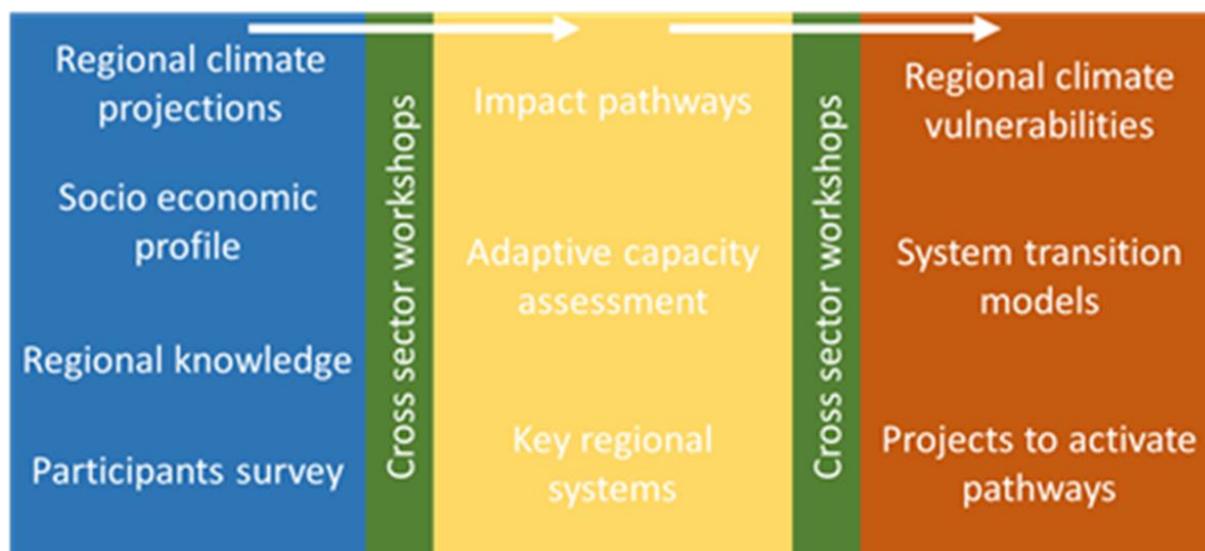


Figure 13: Enabling Regional Adaptation process

4.2 Central West and Orana regional workshops

In early 2016, OEH and the Institute for Sustainable Futures led a series of workshops in Central West and Orana (CWO) 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 workshops focused on developing regional change models.

The subregional workshops were held in March 2016 in Dubbo and Orange. The workshops facilitated a consultation with 55 representatives of NSW Government agencies, local government and key regional stakeholders, including:

- Australian Department of Agriculture and Water Resources
- Australian Department of Human Services
- Bogan Shire Council
- Cabonne Shire Council
- Central NSW Regional Organisation of Councils*
- Cowra Shire Council
- Crown Lands
- Department of Education and Training
- *Department of Family and Community Services
- Department of Industry
- Department of Planning and Environment*
- Department of Premier and Cabinet*
- Department of Primary Industries*
- Dubbo Regional Council
- Environment Protection Authority
- Fire and Rescue
- Gilgandra Shire Council
- Lachlan Shire Council
- Local Land Services*
- Murray–Darling Basin Authority
- Narromine Shire Council
- National Parks Wildlife Service
- NSW Health*
- NSW Police*
- Office of Emergency Management
- Office of Environment and Heritage
- Orana Regional Organisation of Councils
- Orange City Council
- Parkes Shire Council
- *Police
- Regional Development Australia Central West
- Regional Development Australia Orana
- Roads and Maritime Services*
- Rural Fire Service
- State Emergency Services
- TAFE NSW*

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 Central West and Orana region
- present background socioeconomic analysis to inform workshop discussions of system changes
- identify regional systems that need to change to reduce vulnerability to climate change.

One integration workshop was held over two days in May with 30 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

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.

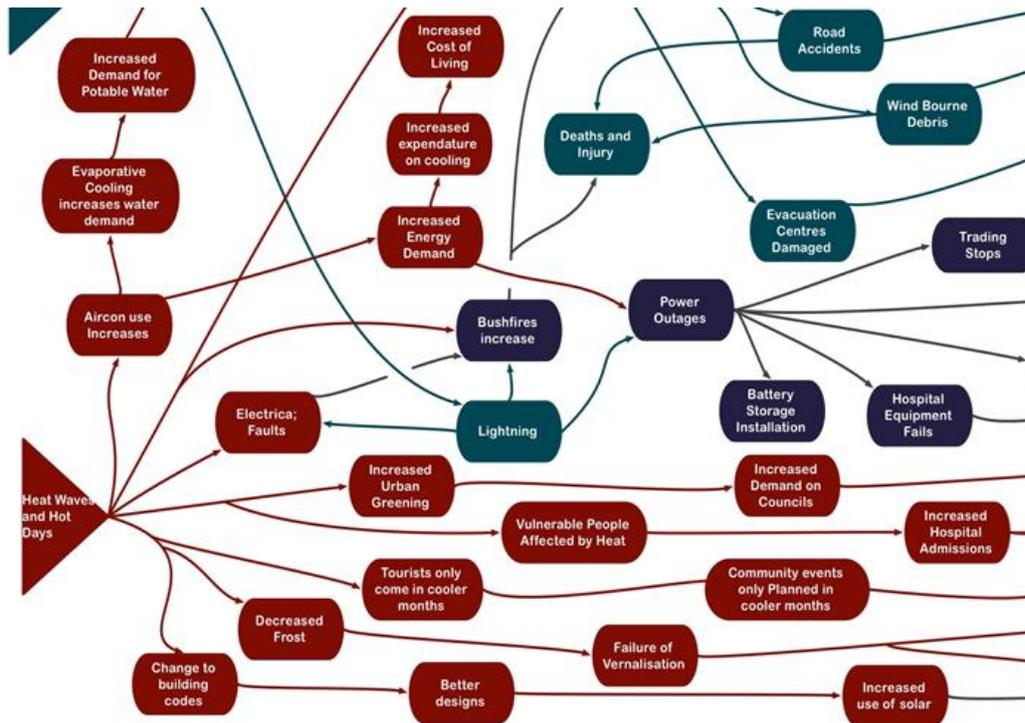


Figure 15: Section of the Central West and Orana climate impact diagram showing the impact of changing water cycles

4.4 Key regional systems

Each subregional workshop identified the regional systems considered most in need of transformation to adapt to climate change. Five key systems were identified in the Dubbo workshop and four in the Orange 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. This process resulted in the development of eight regional change models. 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 Central West and Orana.

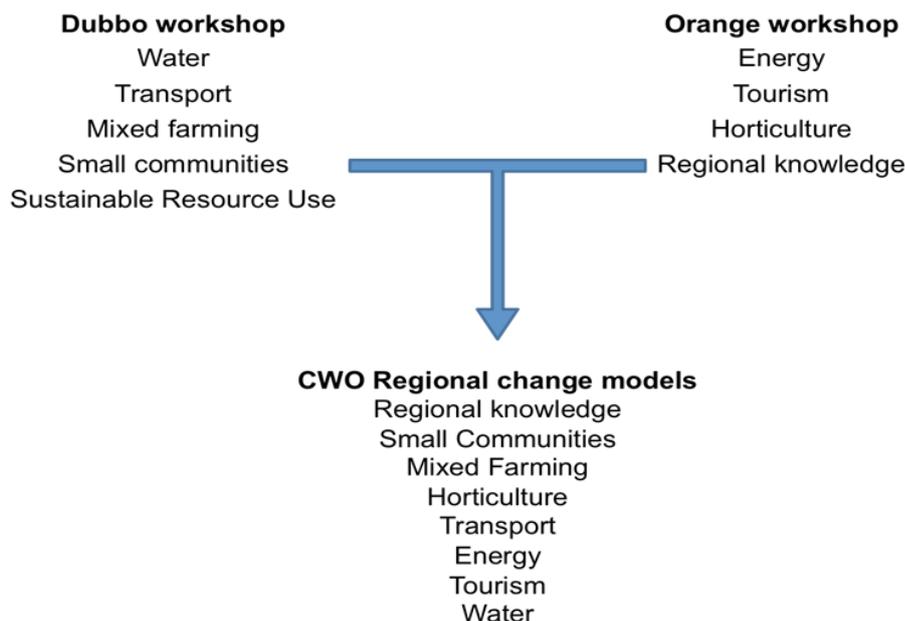


Figure 16: Key regional systems in the Central West and Orana region

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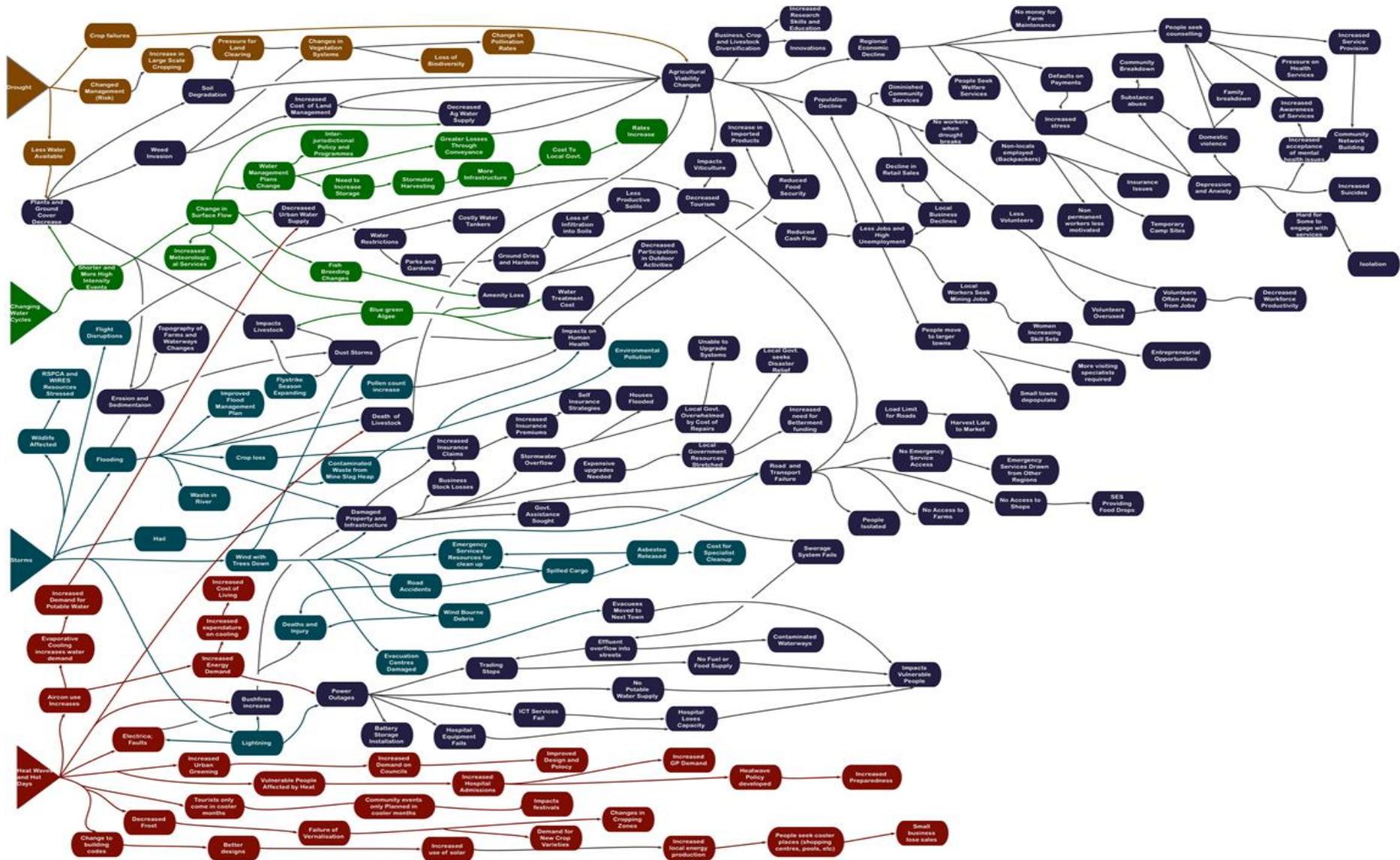


Figure 17: Climate impact chains for the Central West and Orana region

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.

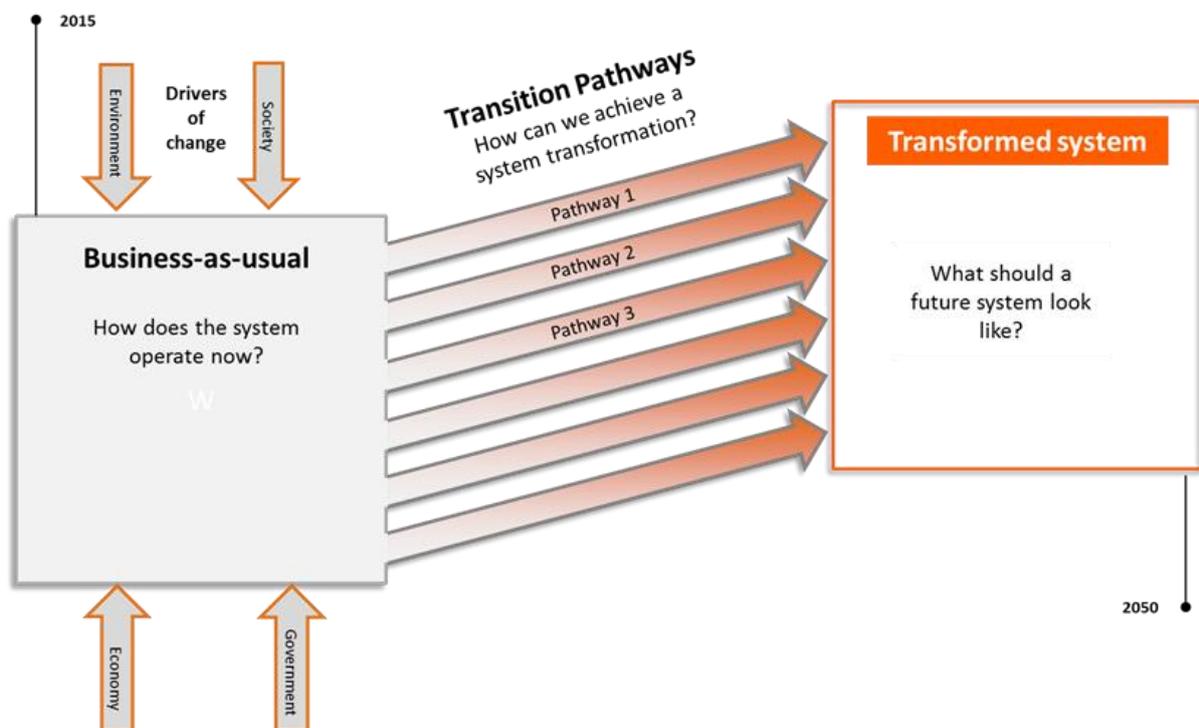


Figure 18: Conceptual model of transformative change Source: adapted from Jacobs et al. (2016)

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	Summary description	System
'16 pages of Services' Workshop	Using a GIS specialist map service delivery overlaps, and then convene a coordinated interagency forum for identifying better focused, customer aligned services.	Small communities
Online engagement pilot	Establish and incentivise a small engagement pilot to test community appetite for online voting, e.g. assess community satisfaction with recent street improvement programs, in Lake Cargelligo or Condobolin.	Small communities
Social cohesion efficiencies	Investigate cost to government service delivery of fractured communities, for example, personal and flow-on costs of travelling/absences due to current social assistance and combat agencies program delivery (potential subproject: investigate the vulnerabilities and costs of current custodial transport processes).	Small communities
Free money!	Provide (subsidise) financial literacy training to boost capacity of small and remote communities (potential pilot in Wellington/Coonamble) to manage domestic finances, thereby building capacity to improve nutrition, self-sufficiency and access/knowledge of related services.	Small communities
Community communication map	Exploring new engagement with discrete (and Indigenous) communities by mapping who and how to engage at the local (community) level.	Small communities
Refresh VET packages for sustainable agriculture, energy and water efficiency	Increase education/awareness and regional skills for land management, energy and water efficiency by incorporating sustainable practices and new technologies into existing (or creating new) training packages and revising licensing requirements.	Water/ energy
Regional review of water infrastructure	Review resource assessments of bore fields, dam augmentation, pipelines, within the context of high risk climate scenarios to inform a safe and secure water supply strategy for the region. Include desktop analysis of collaboration points with local government.	Water

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Pilot project	Summary description	System
Microgrid knowledge transfer project	Capture the learnings from a community controlled microgrid (e.g. using bioenergy from waste) to decentralise the regional energy system and share knowledge across community groups, local government and agencies.	Energy
Community smart meter program	Build community engagement on energy (smart) meters, using library resources (energy kits) to audit, assess and improve residential energy use, and scale up to performance audits of buildings.	Energy
Large scale energy innovation Central West	CentROC to develop a business case for a large-scale energy innovation around community determined priorities, e.g. solar plus, water utilities, energy efficiency, street lighting, electric vehicles.	Energy
Regional knowledge body	Establish a regional body to provide a local voice into decisions affecting communities' regional knowledge priorities, and seek representation from existing governance bodies to align administrative boundaries.	Regional knowledge
Regional data platform	Establish a centralised one-stop-shop with open access data from government agencies that can inform planning, monitoring, evaluation and modelling to enable place-based planning investments, budgets and decision-making.	Regional knowledge
Spare capacity	Coordinate place-based community sharing/ matching spare capacity to enable communities to be more self-sufficient, resilient and anti-fragile and focused on immediate priorities, e.g. emergency management/responses. Suggested pilot using the Mid-Lachlan Alliance (Forbes, Lachlan, Parkes and Weddin).	Regional knowledge
Central West and Orana tourism strategy	Bring together key stakeholders to develop a tourism strategy to drive priority activities (including analyses of current tourism markets, a region-wide event calendar, and development of new tourism products) to enable the coordination of efforts and investments to drive growth in the visitor economy.	Tourism
Protecting priority agricultural lands	Identify priority features of regionally important agricultural land (biophysical characteristics, proximity to transport, projected productivity in relation to future climate and rainfall) and investigate policies to protect areas, so as to minimise land-use conflicts and establish sustainable land values.	Mixed farming
Carbon Farming in the Central West	Establish a pool manager to extend Carbon Farming in the Central West, providing diversified income for farmers, protecting natural areas and demonstrating environmental stewardship.	Mixed farming
Economic opportunities study for horticulture	Convene key knowledge holders and influencers to scope a study that investigates climatic constraints and opportunities for regional horticulture, to inform strategic responses at all levels (including council LEPs) and encourage innovation, attract investment and address current barriers.	Horticulture

5.2 Actions underway

Since the inception of the WERA project in the Central West and Orana, a number of actions to enhance regional adaptation planning have commenced including:

- the conferring of two regional scholarships for participants to attend the Learning to Adapt accreditation course supported by the Environment Institute of Australia and New Zealand
- interagency discussions to fund Aboriginal Housing Office and Land and Housing Corporation installations of air-conditioning systems supported by photovoltaics to improve thermal comfort
- a successful application to the Building Resilience Grant program to ameliorate heat in the Dubbo medical precinct by increasing tree canopy by 300%, protecting elderly pedestrians and using diverted stormwater to water the trees
- Skillset, a Bathurst-based organisation received a \$120,000 grant from OEH through the Thriving Regional Communities program to establish 'Spark Tank', an ideas competition to support grass roots energy innovation in the Central West, encouraging communities to create positive energy solutions
- energy transition networking with community and networks, through Centroc.

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 from the Climate Change Fund over the next five years. 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 OEH 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.

Two Central West and Orana projects were submitted to this grants process, with Dubbo Regional Council succeeding in a grant to increase canopy cover in their central medical district by 300%.

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*. Two Central West and Orana projects were submitted to this grants process.

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 change in NSW.

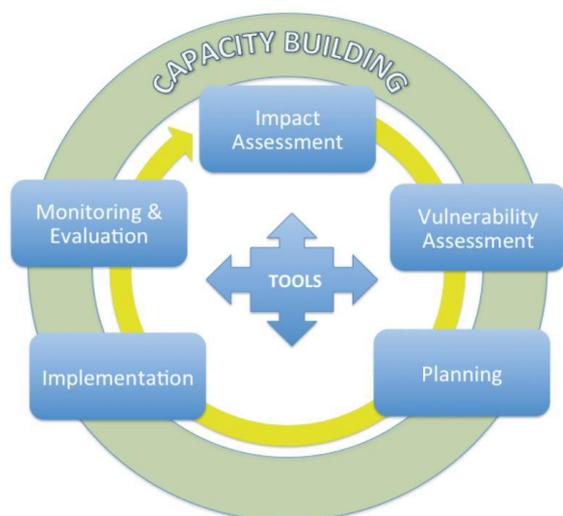


Figure 19: The adaptation process cycle Source: Hansen et al. (2013)

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 six weeks between February and April 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.

In total, 48 people from across all levels of government from the Central West and Orana region took part in the benchmarking survey. The representation was spread across NSW Government agencies (46%), local government (40%) and regional organisations (14%). None of the respondents identified themselves as being of Aboriginal or Torres Strait Islander heritage.

In total, 18 people completed the follow-up survey with representation spread across NSW Government agencies (61%), local government (22%) and regional agencies (17%). None of the respondents identified themselves as being of Aboriginal or Torres Strait Islander heritage. Almost 90% (16 respondents) had attended an OEH ERA workshop in 2016.

Perceived key climate change risks (pre-workshop survey)

In both surveys the respondents identified a number of climate related risks facing the Central West and Orana region. Drought, changing rainfall patterns, heatwaves and intense storms were identified as the top four critical climate risks facing the region (Figure 20). Increased hail events and frost were perceived as the least important climate risks in the region.

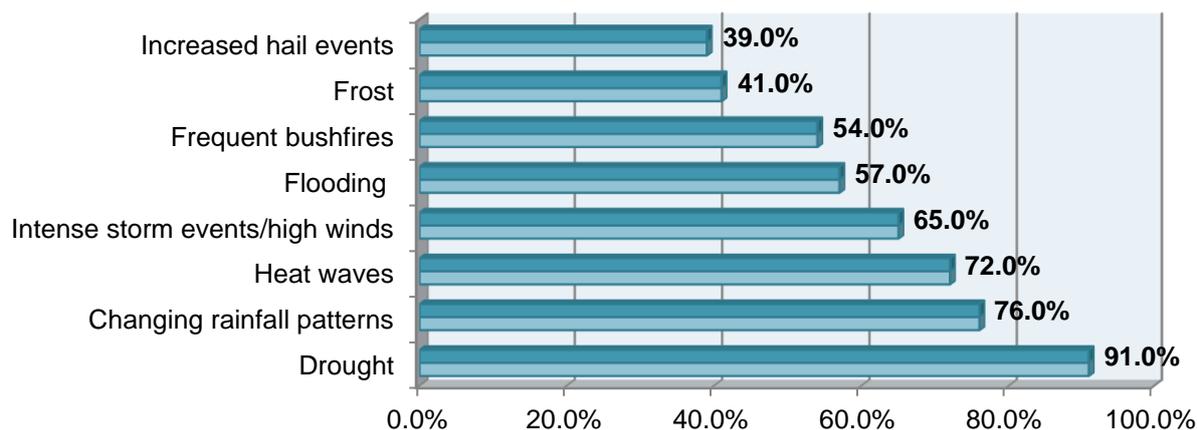


Figure 20: Climate risks identified for the Central West and Orana region

Importance of climate change adaptation

A series of questions was asked to ascertain the importance of climate change adaptation from individual and organisational perspectives. In the benchmarking survey a high proportion (66%) of respondents agreed that climate change adaptation is important to them personally and in their professional roles, 28% said it was slightly important and 6% said it was not important. Climate change adaptation was viewed overall as slightly less important for organisations, with 53% of respondents indicating that climate change adaptation was a moderate to strong priority for their organisation, while 34% considered it a slight priority and 11% that it was not an organisational priority. The follow-up survey showed a slight increase (78%) in the importance of climate change in respondents' professional and personal lives.

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 actions that are likely to occur in the future (Figure 21).

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

- awareness raising or education of staff and local communities
- building trust, networks and partnerships
- assessing the risks posed by climate change
- conducting a vulnerability assessment.

In addition, the follow-up survey identified encouraging emergency management to account for climate change as an important action. All of these actions are important to provide the evidence base for policy decisions and build linkages across organisations. Actions that raise awareness about climate change and inform policies and strategies were identified as **future** actions. Mapping the physical impacts of climate change, building infrastructure in less vulnerable places and securing adaptation funding were the least pursued actions in the past or present actions and the least likely planned actions for the future.

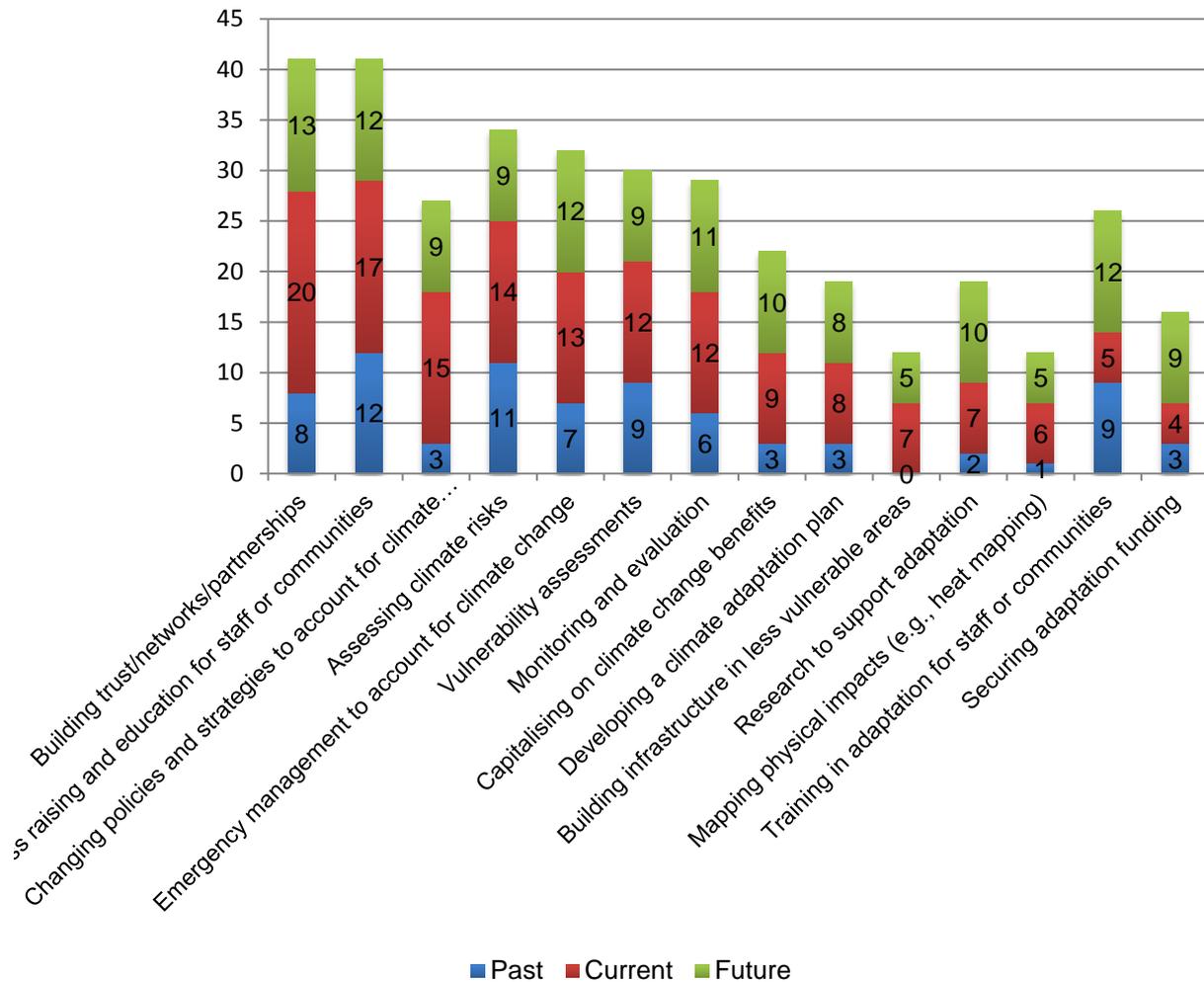


Figure 21: Adaptation actions across temporal scales

Adaptation actions can span multiple scales, sectors and responses as shown in Figure 22. Key adaptation actions including awareness raising or education of staff and local communities; building trust, networks and partnerships; adaptation training for staff or communities; and changing policies and strategies to account for climate change impacts are being undertaken at multiple scales (local, regional and state).

Encouraging emergency management to account for the impacts of climate change was identified as the action most likely to be conducted at the state level. Building social capital was also identified as important at the regional scale through building trust, expanding networks and nurturing partnerships.

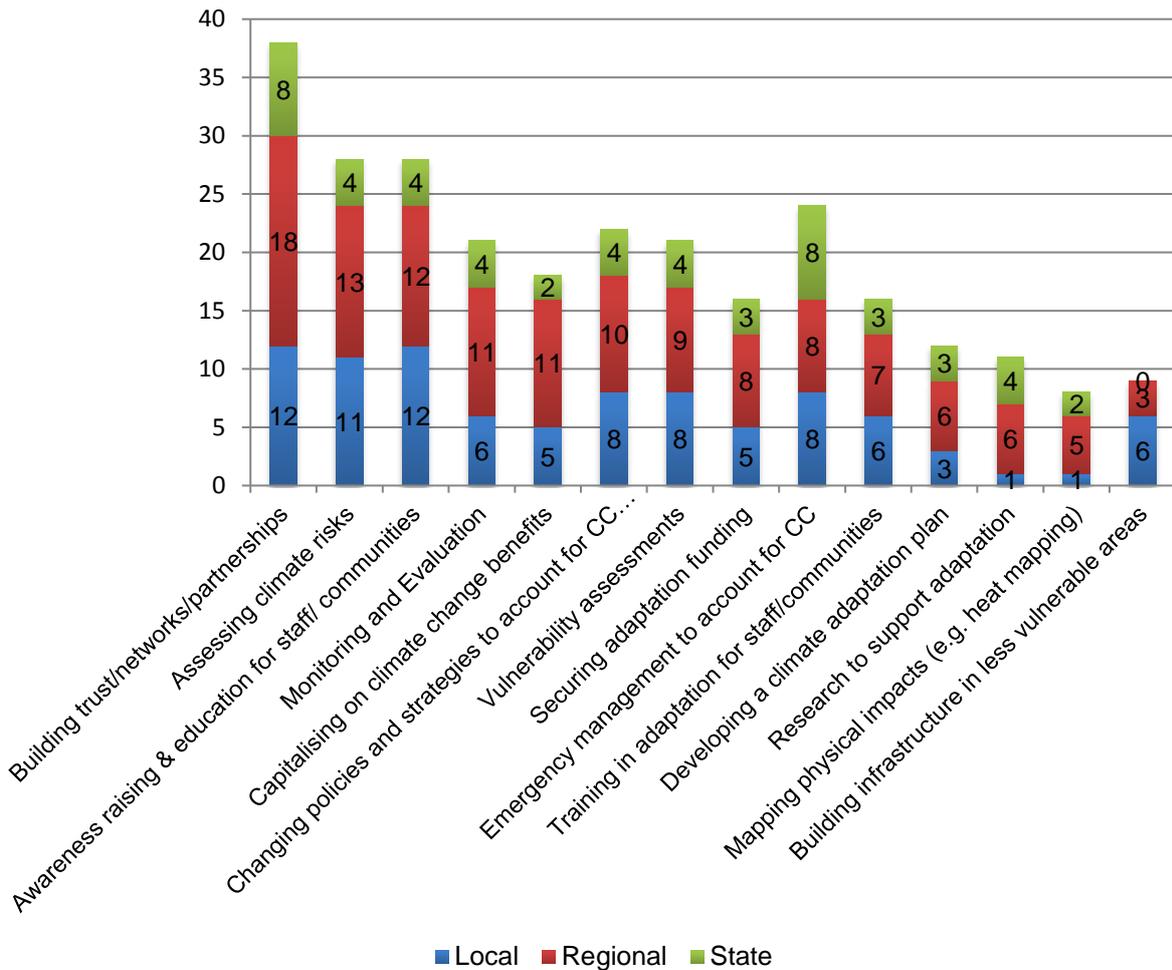


Figure 22: Adaptation actions across geographical scales

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. Raising 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. The responses indicated that regional adaptation was uniformly constrained by all of the attributes of capacity although there was some variation in individual responses. Respondents to the second survey indicated that adaptation was most heavily constrained by a lack of staff resources.

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 health, essential services, landscape management and economic development.

Community health

The Western NSW Local Health District (LHD) runs various programs and education initiatives focused on self-care during extreme weather events such as heatwaves. Furthermore, NSW Health has been using the Public Health Real-time Emergency Department Surveillance System (PHREDSS) to monitor admissions to hospital emergency departments associated with heat events.

Adapting and managing essential services in local government

A water security analysis was undertaken as part of the wider implementation of the 2007 Local Water Utility Best Practice framework. This framework encourages the adoption of best practice management for sustainable water conservation practices and the effective and efficient delivery of water supply and sewerage services.

Some local councils have integrated climate change adaptation into a variety of existing plans; for example, Dubbo Council has integrated it into drought management plans, water demand strategies, the Integrated Water Management Plan, risk management plans, energy strategy and stormwater and flood management plans. This was seen as a positive initiative to embed climate action and as being more efficient than having separate adaptation plans and strategies. Other councils have found that the lack of understanding among council staff as to how to integrate climate change data, information and actions into current strategic plans is a major challenge that needs to be addressed.

Other successful initiatives undertaken by local government include capital works, such as upgrading a water treatment plant and relining of sewers. These initiatives resulted in multiple benefits including water and energy savings, fewer carbon emissions, better reuse and value adding while reducing costs and overheads. Another local government established a Revolving Energy Fund to fund energy efficiency and renewable energy installations. The financial savings over time from these initiatives makes them an easy message to sell to the community.

Improving ecosystem resilience

Other successful actions at a landscape level included the removal of invasive plant species from riparian corridors and carrying out bank stabilisation works to improve riparian landscape function and resilience to climate extremes such as flooding.

Economic diversification and carbon abatement

Other actions involved the diversification of farm income and economic development opportunities for a variety of reasons including the recognition of the impacts that climate change will have on farm productivity.

The Orana region saw great success in the first two Emission Reduction Funds (ERF) auctions involving the land sector. Success was due to low upfront costs and limited opportunity costs as a result of inherently poor productivity on the lands involved; however, there are still challenges with engaging the non-land sector in carbon abatement schemes. This was attributed to a general lack of understanding of scale issues and the range of opportunities available. This challenge was addressed through a workshop that was held in June 2016.

Transport

Transport for NSW (TfNSW) is developing the Future Transport Strategy, which seeks to meet the long-term needs of our customers by establishing the vision for transport technology, infrastructure and services in NSW over the next 40 years. This will entail a number of plans to set the service outcomes for the movement of people and freight across Regional NSW and Greater Sydney, and define the infrastructure required to achieve these outcomes, and include a comprehensive program to engage community, industry and other key stakeholders across NSW to guide development of the Future Transport Strategy, including ongoing engagement with key government agencies, such as through the Enabling Regional Adaptation process.

Challenges

Local governments in the region face a number of challenges in adapting to a changing climate. Lack of time, resources, funds and staff to focus on climate change are an issue especially for some local governments in regional areas.

Resistance to the reality of climate change in some sectors of the community was identified as another challenge. Some community sectors are difficult to engage in discussions around climate extremes, for example older citizens believe they have already experienced and coped with weather extremes so there is no need to devote resources to adapt. The way climate change is communicated is important.

Planned climate change adaptation actions

Three new initiatives were identified in the follow-up survey. The first project investigates flood-proofing the Newell Highway to avoid interruptions to economic activity in the region in the event of future flood events. The second initiative is a collaboration among the Central West Councils. As previously mentioned, Dubbo Regional Council, in partnership with the Environment and Waterways Alliance was funded by BRCC investigated the benefits of tree cover within CBD medical precincts to battle predicted heat island effects. Other initiatives focused on reducing fossil fuel dependency through the rollout of renewable energy and energy efficiency programs with an estimated value of \$5 billion.

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. About 32% of respondents confirmed that adaptation is being regularly monitored by their organisation, while a further 26% indicated that monitoring and evaluation occurs infrequently. However, 37% of respondents answered that M&E is not being undertaken and 5% did not know.

7 How to turn these findings into action

This report contains a collective understanding of the likely vulnerability to climate change of the Central West and Orana 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** – Tables 2 and 3 of the report outline the exposure and sensitivity of the region to climate and other regional drivers of change. This 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 17 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** – Table 2 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 Central West and Orana region and are a valuable resource to help build momentum.

Appendix A: Expected physical responses for the Central West and Orana

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, the erosivity is projected to increase by 4.6% in the near future and 20% 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 of SOC across this region are complex, with both increases and decreases in different areas and depths. The greatest decrease in SOC is around Bathurst and Lithgow in the upper depths in the far future. In the region, pH is projected to experience only marginal change, but a moderate trend to acidification is projected for the lower depth 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 will decrease in summer and winter in the 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. 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
Flood	Not known	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

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Physical response	Trend	Projection	Implications
Hydrology (surface flow/runoff and recharge)	Increase	<p>In the near future, changes in annual runoff across the region are spatially variable. Higher runoff across most of the region is likely in the far future.</p> <p>On an annual basis, less recharge is likely across most of the region in the near future. Higher recharge is projected over many parts of the region in the far future; however, these changes are minimal and contain considerable geographic variation.</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
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 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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