



Australia's National
Science Agency

Communities in Transition

Charters Towers: A Living Transitions Roadmap



Citation

CSIRO, JCU, USQ and TEG. 2020. Charters Towers:
A living transition roadmap, CSIRO, Australia.

Copyright

© Commonwealth Scientific and Industrial Research Organisation 2019. To the extent permitted by law, all rights are reserved and no part of this publication covered by copyright may be reproduced or copied in any form or by any means except with the written permission of CSIRO, the consortium partners and the Regional Council.

Disclaimer

CSIRO advises that the information contained in this publication comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. No reliance or actions must therefore be made on that information without seeking prior expert professional, scientific and technical advice. To the extent permitted by law, CSIRO (including its employees and consultants) excludes all liability to any person for any consequences, including but not limited to all losses, damages, costs, expenses and any other compensation, arising directly or indirectly from using this publication (in part or in whole) and any information or material contained in it.

Acknowledgements

The Clean Growth Choices Consortium would like to thank members of the community, our local experts in the workshop discussions, who made invaluable contributions to the process with their ideas and experiences.

We would also like to extend our sincere thanks for the continued support and help from the Charters Towers Regional Council including Mayor Liz Schmidt, Deputy Mayor Sonia Benneto and all Councillors, CEO Aaron Johansson, and local facilitators Trudi Smith and Melanie Lavelle-Maloney.

The Clean Growth Choices Consortium is comprised of experienced practitioners and researchers from the University of Southern Queensland, James Cook University, CSIRO and The Ecoefficiency Group. The consortium team would like to acknowledge the strong support we received from the Queensland Department of Environment and Science, especially from Georgine Roodenrys, Matthew Arthur, Sandra Avendano and Rosanna Virzi.



The Clean Growth Choices Consortium is delivering the Communities in Transition pilot project with the support of the Queensland Government.

Contents

Summary	2
1 Background	4
2 Developing transition roadmaps.....	5
3 Regional profile.....	6
4 Vision, aspirations, values and goals.....	12
5 Priorities and pathways.....	13
6 Dynamic Roadmap for the future	18
7 Development of prefeasibility business cases	22
8 References	24

Summary

This report is a living roadmap designed to support the Charters Towers Region in securing a prosperous and sustainable future. It is developed as part of the Clean Growth Choices: Communities in Transition (CiT) project through active participation of the Charters Towers Regional Council and community members. This project is supported by a consortium from James Cook University, the University of Southern Queensland, CSIRO and The Ecoefficiency Group. The Clean Growth Choices project has been funded by the Queensland Government as part of its CiT pilot program.

A three-stage process was implemented in this project:

1. Assessing the current state, risks, challenges and opportunities for the region and identifying broad pathways for the future.
2. Generation and rapid evaluation of innovative ideas and options that enable the development of broad pathways.
3. Putting options and pathways into a transition roadmap and for developing business cases.

The process was carried out through a series of meetings, workshops, webinars and other activities with Regional Council leaders and community members (Figure 1).

Key challenges and opportunities identified for the region relate to: a) water availability and waste management issues, b) rural decline, population numbers and composition of the work force, c) extreme weather such as droughts and floods and the potential for these to become more intense, d) access to telecommunications and benefits from digital technology, e) access to affordable, reliable and sustainable energy, f) geographic location, g) increasing consumer demand for clean and green products, and h) natural and cultural assets and the potential for diverse inclusive and sustainable tourism, small business enterprises and economic development.

The community articulated a set of values, visions, and goals for the future of the region. These relate to the region's ability to embrace change and overcome challenges to ensure long-term health, prosperity and sustainability through building: a) a resilient and innovative economy, b) a progressive and cohesive community that is supported by an affordable and attractive rural lifestyle for all ages, and c) a well managed environment that enables a bright future.

Three broad pathways were identified with a set of interventions, mechanisms and outcomes by which the vision and goals could be achieved. The three broad pathways are:

1. Charters Towers as a hub for supply/processing/transport and low-impact agriculture.
2. Dynamic business ventures and sector development.
3. School-to-work: stronger technology transitions and new career paths for the next generation.

These pathways are complementary and have phases that can be implemented to maintain, modify and transform parts of the region to achieve the community's vision and goals. Cross-cutting interventions that relate to all three pathways are: targeted feasibility studies and research, enhanced digital connectivity and more secure, affordable and sustainable energy.

Two prefeasibility business cases have been developed in this initial stage to set the living roadmap in motion:

1. The Dynamic Business and Sector Development initiative: more dynamic and resilient businesses within five priority sectors for economic development.
2. The Making Water Work initiative: delivering greater efficiencies and benefit from integrated agricultural water, supply and value chains.

This report is an initial step in developing a dynamic and living roadmap for regional communities in transition. It will require further work to test and refine the details of the proposed pathways. It will also require ongoing monitoring and reviewing at least every two years to ensure that the set of pathways remains appropriate and sufficient to achieve the vision and goals and are robust enough to changes in global and domestic drivers.

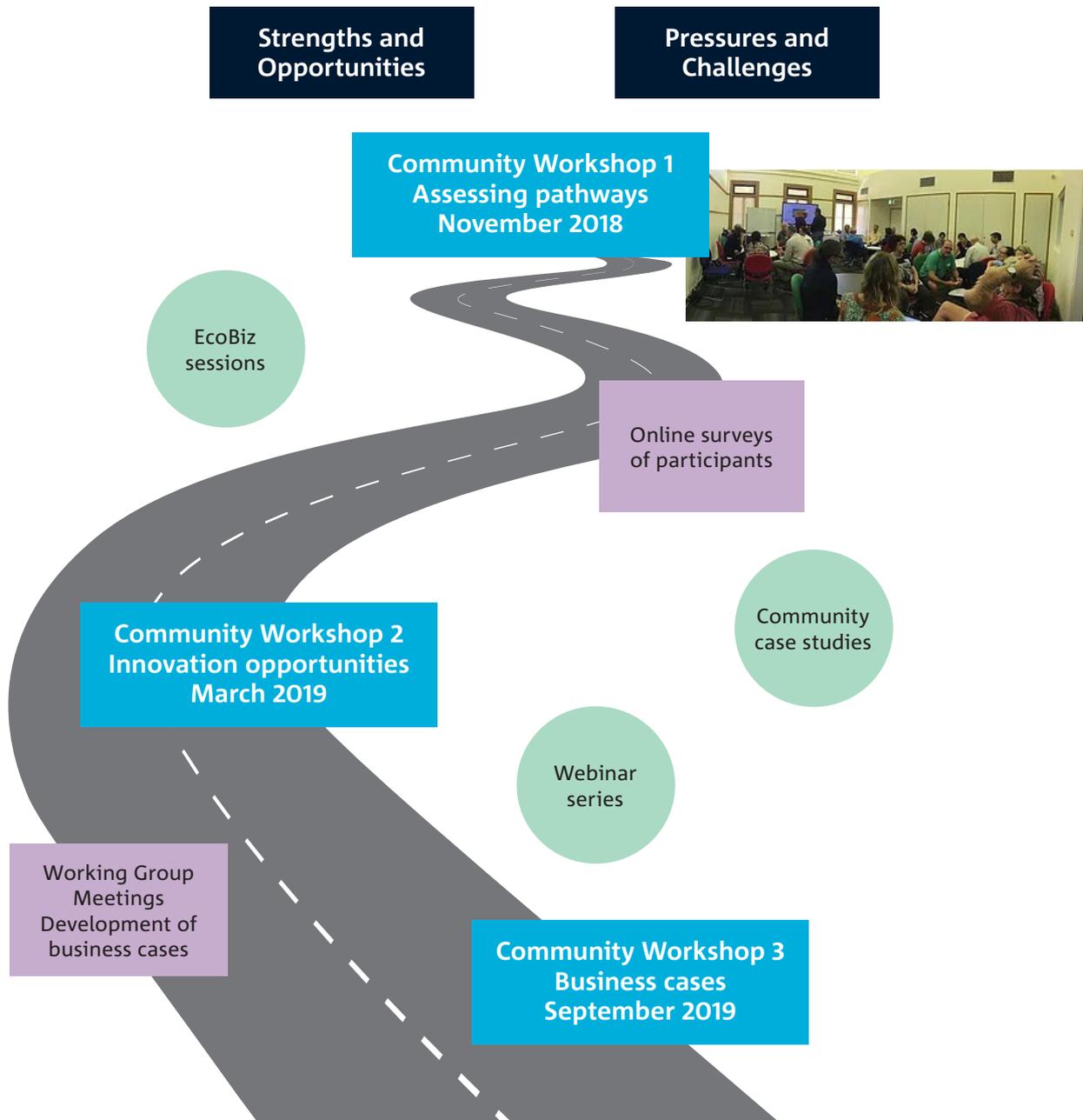


Figure 1. The stages of the program leading to development of the roadmap and business cases.

1 Background

A team from James Cook University (JCU), University of Southern Queensland (USQ), Commonwealth Scientific and Industrial Research Organisation (CSIRO), and The Ecoefficiency Group (TEG) designed a program of work in response to a Queensland Government tender for the delivery of a pathways approach to its Queensland Climate Transition Strategy, *'Pathways to a clean growth economy'*, a strategy that focuses on the risks associated with environmental, social and economic changes. The Queensland Government anticipates that the economy will need to keep adjusting to stay in step with the changing global economy. It assumes that Queensland has a competitive advantage that will assist with the transition, and while the transition will likely occur over decades, it should start right away to be most cost-effective. The State government has said that it will assist and guide these processes by:

- Creating an environment for investment shift and innovation.
- Facilitating existing Queensland industries to transition.
- Working with Queensland's regional communities to transition.

The dynamics of transition is complex and challenging. Transition needs to be led by the communities themselves in ways that are socially acceptable and build collective agency in shaping the future.

This report focuses on the development of an initial living transition roadmap for the Charters Towers Region as part of the Clean Growth Choices: Communities in Transition (CiT) pilot program. The program is an active community capacity building process for strengthening regional leadership and resilience in dealing with economic, social and environmental change. It is helping Queensland regional communities to organise and process what is involved in transitioning over the intermediate to long term to achieve a more sustainable economy by:

- Referring to values, visions and plans to guide each community.
- Drawing on existing networks, knowledge, skills and capabilities.
- Canvassing current pressures, opportunities and future scenarios and visions.
- Identifying broad pathways and multiple options for transitioning and achieving the goals.
- Developing dynamic and future-focused roadmaps and identifying an initial set of business cases that set the roadmap in motion.

The project team is drawn from a collaborative consortium comprised of experts who help communities, businesses and governments develop community resilience strategies. The project team includes, The Institute for Resilient Regions at USQ, The Cairns Institute at JCU, CSIRO Sustainability Pathways Program and The Ecoefficiency Group.

With advice from the Charters Towers Council, the project team worked closely with community members to develop an initial transition roadmap and a few business case proposals. With more detailed work, a fully developed roadmap will assist the community with navigating future uncertainties and changes.

2 Developing transition roadmaps

The Communities in Transition (CiT) program provides a framework for communities to create roadmaps, set their own directions, navigate their own pathways, and design interventions conceived and implemented by the participants themselves. The roadmap development process was informed by the Resilience Adaptation Pathways and Transformation Approach (RAPTA) (O’Connell et al. 2016) and was modified to suit this context (Maru et al. 2018). RAPTA is a design approach to bring best practice in the formulation of programs, projects and other interventions so that they achieve the desired outcomes. The three-stages of the transition planning process is summarised below.

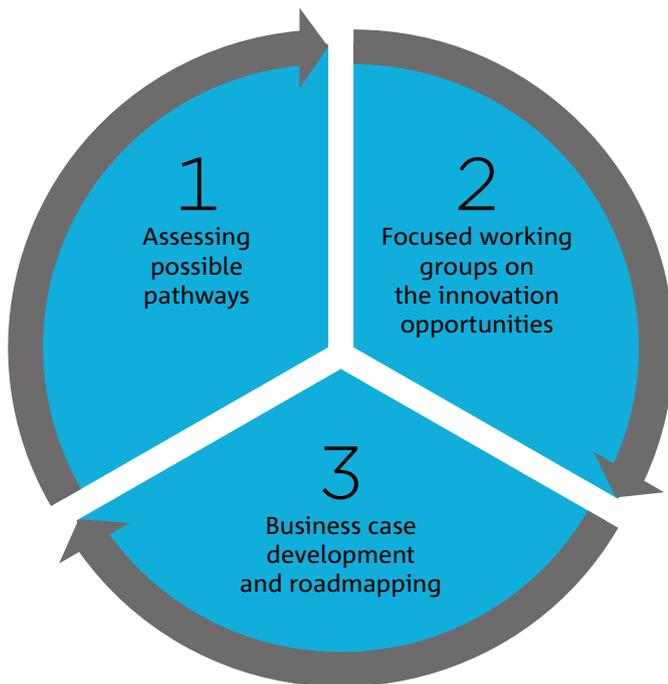


Figure 2. The three stages of the transition planning process.

Stage 1: (Sep – Dec 2018) Assessing the broad pathways to the future

The process started with an assessment of each region’s current state, reflecting on community values, heritage and aspirations, and tabling future opportunities and risks. This phase ended with the Broad Pathways Workshop which discussed the region’s past, present and future. Participants examined the regional profile as well as key challenges and opportunities prepared by the project team and identified possible broad pathways for the future.

Stage 2: (Jan – Jun 2019) Focused working groups for innovative ideas and options

Working groups were formed around the domains of focus that were identified in the broad pathways in Stage 1. As part of this stage, the consortium helped the teams draw on some of the new techniques to rapidly evaluate the real potential of the ideas as well as the enablers needed to overcome barriers and increase chances of success. At the end of this stage, each team had scoped a range of new ideas, settled on the ones that were most likely to be successful, and planned a staged implementation (a ‘pathway’) including actions to address related enablers and barriers.

Stage 3: (Jun – Oct 2019) Creating transition roadmaps and building business cases

Results from the focused working groups were brought together into a single regional community ‘roadmap’ of projects. The consortium assisted the teams to identify pathways of interdependent actions, plan the timing of these actions and identify ‘trigger points’ – things to monitor over time that should stimulate a review of the roadmap and could potentially change an action. The consortium also supported the community teams to scope short-term priorities and prepare a few initial business cases to set the roadmap in motion.

3 Regional profile

Current state of the region

The Charters Towers Local Government Area is a productive agricultural and mining landscape with a rich gold mining history (AEC 2013; RAI 2016). The area has a good supply of water from the Burdekin River, abundant mineral deposits, fertile well-drained soils, about 300 days

of sunshine a year and affordable land. The town of Charters Towers, located 134 km south-west of Townsville (Figure 3), is an established agricultural service centre with good-quality infrastructure and services including high quality schools. Charters Towers is at the heart of the rail and road corridor to Townsville (AEC 2013).

Queensland Statistical Areas, Level 3 (SA3), 2016 - Charters Towers - Ayr - Ingham (ASGS Code 31801)

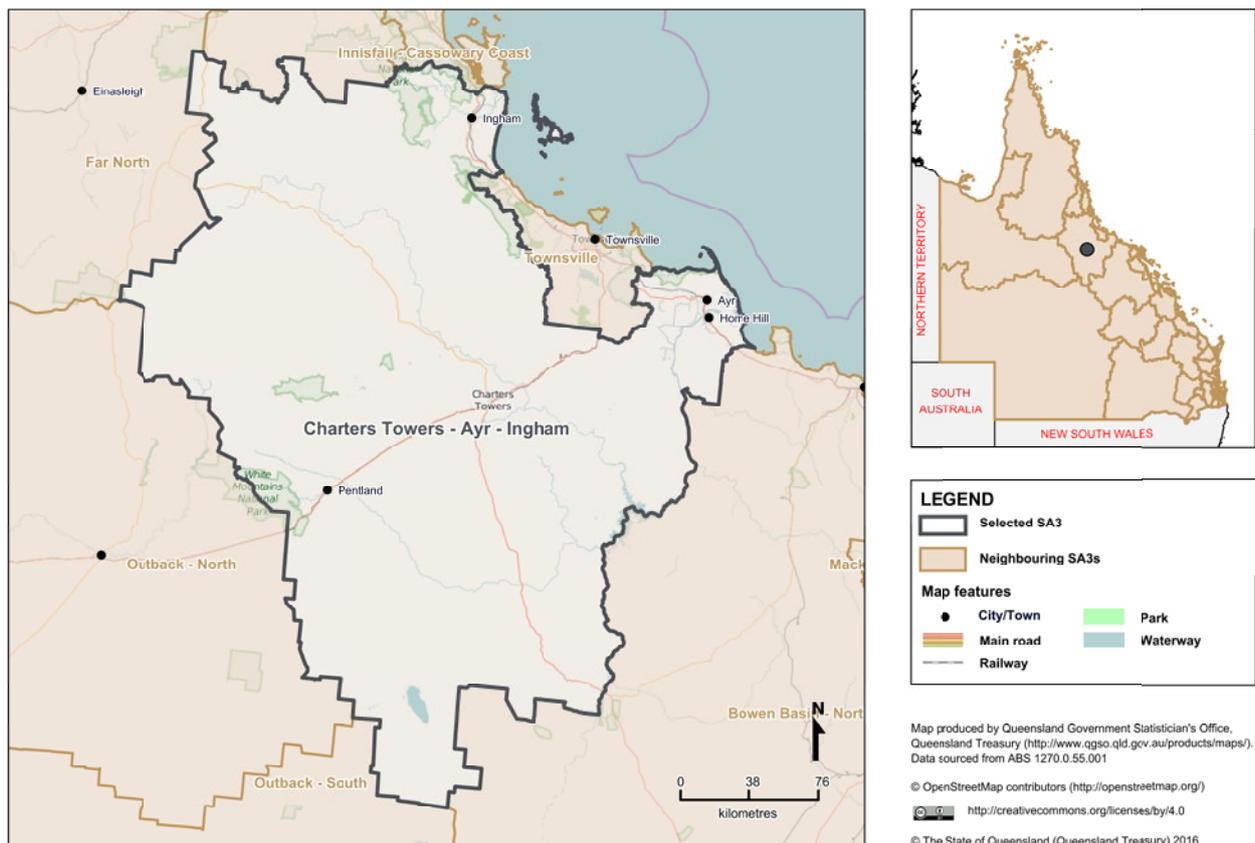


Figure 3. Charters Towers Region (Source: QGSO 2019).

Population composition and dynamics

The 2018 estimated resident population for the Charters Towers Local Government Area was 11,850 (QGSO 2019), down slightly from 2017. In the 2016 census, 18.5% of the population was aged 65 years or older, and fewer people were in the working age group (20–65) compared with the rest of Queensland. With a very low population density of less than one person per hectare, the region experiences a persistent loss of younger people, continuing the pattern of slow decline seen in other rural communities. The population is projected to increase to 12,409 by 2036, adding only 335 people to the current population of the region (QGSO 2019). In the 2016 census, 1,031 people identified as Aboriginal and Torres Strait Islander (8.7% of the total resident population), and 10,410 people (87.6%) identified as Australian citizens (QGSO 2019).

Landscapes and livelihoods

The region is located approximately 300 m above sea level and has a less humid tropical climate with greater variation in temperature than coastal Townsville (NQ Dry Tropics 2019). Charters Towers is a regional centre for mining, beef cattle and education. Due to its mining history, many sites in Charters Towers have been heritage listed. Environmental features include Lake Buchanan, White Mountains National Park, Fletcher Creek, Dalrymple National Park, Hidden Valley and Hervey Range, Great Basalt Wall, as well as the Burdekin River (NQ Dry Tropics 2019).

The gross regional product of the region is approximately \$630 million and supports around 5,182 jobs (NIEIR 2019). In 2017–2018, the top five industries for employment were: Education and Training (15.4%), Health Care and Social Assistance (12.4%), Agriculture, Forestry and Fishing (11.9%), Mining (10.5%) and Retail Trade (9.4%) (NIEIR 2019). For the March 2019 quarter, unemployment was 9.8%, higher than the average for regional Queensland (6.1%) (QGSO 2019).

Challenges and opportunities

The population age structure in the region suggests that many people leave the region to seek employment and do not return until they retire. By one assessment, the region would need to increase its economic output by 80% over the next 20 years to achieve substantial economic growth to improve the living standards of its residents (RAI 2016). The main employment sectors rely heavily on external labour, while projections suggest a significant loss of low skill jobs due to technology. Developing stronger technology transitions and career paths for the next generation is fundamental for economic success and critical for reversing a negative population growth trend (RAI 2016).

There are signs that the region is changing, however, providing new opportunities for residents and newcomers to the area. These changes include the NBN™ network rollout, a proposal for a meat processing facility, the Hells Gates Dam Irrigation Project, a transmission line connecting the North West Minerals Province to the coastal grid and an associated supply chain strategy, the Sconi Cobalt-Nickel-Scandium Project, the Pentland Bioenergy Project and a new waste management strategy (CGCC 2019). All these activities, together with the location of Charters Towers at the heart of the rail and road corridor to Townsville (AEC 2013) help to strengthen its position as a major regional transport, supply and services hub. Its potential was demonstrated during the January–February 2019 monsoonal floods which caused widespread damage to properties and livestock. Many regions, including Charters Towers, were declared disaster areas (QDAF 2019). However, the region's southern road networks remained accessible, meaning the logistics supply chain into the region remained uninterrupted during the event. This strengthens the region's position as a credible, safe and secure logistic/transport hub and as an industry development base (CGCC 2019).

Climate and extreme weather events

Charters Towers has a hot, semiarid climate, with an average daily temperature range from 16.6 °C to 29.4 °C and an average annual rainfall of 632 mm (QGSO 2019). In recent years, Queensland summers have brought an increase in severe storms and floods, droughts, heatwaves and bushfires across the state. Climate change is likely to exacerbate the frequency and severity of these events (QDEH 2016). In future, the Charters Towers Region can expect higher temperatures, hotter and more frequent hot days, more intense downpours, and more intense, though less frequent, tropical cyclones (QDEH 2016). Extreme events affect ecosystem health, industries and settlements, disrupting their access to water, sewerage, storm water, transport and communications services. As evaporation rates increase with increasing annual temperatures, there will be higher rates of soil moisture depletion, reduced ground cover and lower livestock carrying capacity. Higher temperatures and longer dry seasons leading to bushfires may place rural and regional communities in danger. Evidence suggests that extreme weather events can impact on physical and mental wellbeing, and strain limited social support services and key infrastructure in regional, rural and remote areas in Australia (Hossain et al. 2014). The cost of personal and household insurance may also increase as a result (QDEHP 2016).

Rural population decline and new economic development opportunities

The trend of rural population decline suggests a need for greater employment and lifestyle opportunities to attract and retain workers (AEG 2013). Charters Towers Regional Council and its partners have identified the need to build lifestyle infrastructure to attract and retain people and their skills, develop Charters Towers as a major service centre to the rural north and maximise regional tourism opportunities.

New projects and project concepts include a meat processing facility (CTRC 2019). Federal funding of \$54 million is allocated for the construction of Stage 1 of Hells Gate Dam which includes construction of Big Rocks Weir on the Burdekin River and \$4.5 million is committed to development works for a transmission line connecting the North West Minerals Province to the coastal grid. A supply chain strategy for the province will be developed which will include latest developments in energy, transport and infrastructure from Mt Isa to the Port of Townsville (MITEZ 2019).

Tourism and recreation

Many tourists travel through the region each year, especially during winter. Charters Towers is an access point for travelling west to the Northern Territory, north to the Gulf area and south to the channel country (CTRC 2011). A Charters Towers Regional Council Tourism strategy is being prepared for the region with an emphasis on historic tourism (e.g. heritage trails, museums, buildings), agritourism (e.g. Texas Longhorn Tours and Safaris), Indigenous tourism and nature-based tourism.

Two national parks of interest for Indigenous and nature-based tourism are the White Mountains National Park, to which the Gudjala people have traditional links and offers an opportunity for co-development of ecotourism based on Indigenous heritage and natural features (QG 2012), and Dalrymple National Park, which affords nature-based activities, historic relics and a diverse geology which provide important educational resources for universities, schools and outdoor education groups (QDNRM 2011).

Communications and technology

More than a third of current jobs in Charters Towers are at risk of technological change in the next 15 years, with low skill positions most at risk (RAI 2016). However, since the completion of the NBN rollout in Charters Towers in 2016, extended mobile broadband coverage may provide more opportunities for employment in Information and Communications Technology (ICT) and electronics. Based on national trends, it is estimated that up to 244 new professional-level jobs and 89 new managerial-level positions could be added to the Charters Towers ICT sector (RAI 2016). In addition to employment, emerging telecommunications services across Australia can support an array of services to rural and remote

communities and industries provided that adequate and affordable infrastructure and equipment are available. For example, telehealth can assist in the long-distance diagnosis, treatment and prevention of disease and injuries by providing clinical support to improve health outcomes by connecting patients and clinicians who are in different locations (Bradford et al. 2015).

Consumer demands

Changing consumer preferences present challenges and opportunities for the region in a number of areas. In the agricultural sector, connecting consumer preference to farm profitability is seen as increasingly important for maintaining farmer profitability as demonstrated by the growing demand for organic food (Perry 2017). Digital technologies have the potential to enable consumers to precisely track the provenance of food from the field to the pantry. At the same time, commodity crop farmers will be able to match consumer demand for products and produce to create a more valuable crop. The essential connection between agricultural practice and consumer preference is expected to dramatically accelerate the adoption of new sustainable technologies in agriculture (Perry 2017). This is significant for Charters Towers as a key beef-producing region. Australians tend to prefer lean, pasture grown beef, but many overseas consumers, particularly in northern Asia, prefer marbled, grain-fed beef produced through long periods (up to 120 days) of feed-lotting (Greenwood et al. 2018). Forty per cent of Australia's total beef supply and 80% of beef sold in major domestic supermarkets is sourced from the cattle feedlot sector (FutureBeef 2018). Maintaining Australia's preferred status as a quality assured supplier of high-value beef produced under environmentally sustainable systems from 'disease-free' cattle is increasingly competitive and expensive (Greenwood et al. 2018).

Shifts in consumer behaviour also affect retail trade, another key economic sector for Charters Towers. The increasing trend of shopping online is exerting pressure on bricks-and-mortar retailers. Profit margins for online retailers are now roughly double that of bricks-and-mortar stores and will likely continue to grow into the future (Carter 2019; Aussie Broadband 2018). An extra challenge that has been identified for retailers and customers in Charters Towers is the difficulty in accessing shops located in heritage-listed buildings. Although adding to the character and charm of the city, these older buildings are not well designed for people with impaired mobility, such as wheelchair users and the elderly. Possible solutions for addressing some of the challenges for retailers associated with online shopping include showrooming to drive online sales; moving into logistics, with different delivery options; using local e-commerce as a stepping stone to targeting overseas markets, meeting demands for high quality health and food products; and offering a more personalised service including individualised consumer offers and free expert advice to in-store shoppers (Aussie Broadband 2018).

The demand for raw materials which are used in a variety of existing and emerging industries is growing. The growing global demand for 'critical commodities' corresponds with increased demand for photovoltaics, wind turbines, magnets and batteries for electric vehicles, high speed trains and solar batteries (Skirrow et al. 2013). The Sconi deposit near Greenvale currently has two of the world's three known commercially viable deposits of scandium, a high value but scarce metal used to produce aluminium alloys (Business Queensland 2017; AML 2017), as well as substantial deposits of cobalt and nickel, both important in making batteries for electric vehicles (AML 2018). The Queensland Government declared Prescribed Project status for the proposed \$1.4 billion mining and processing operation called the Sconi Cobalt-Nickel-Scandium Project, which is expected to generate 500 jobs during construction, and 300 full-time employment opportunities for the initial 18-year life of the proposed operation (Proactive Investors 2019). However, these projections must also account for the risks of commodity price volatility from increasing competition and unforeseen supply shocks nationally and globally.

Energy: electricity and fuel

Changes in the energy sector make solar energy especially relevant to the region given its favourable climate. In addition to having a low environmental footprint, solar power offers substantial savings to households, the ability to hedge against future electricity price rises and possible marketing and tax advantages. Across the region there are 25,930 dwellings with rooftop solar panels, indicating a solar density of 30% (AGCER 2018). The region sits within the federal electorate of Kennedy, which ranks 30/150 electorates for rooftop solar panel installations (Solar Citizens 2018), indicating higher proportions of Charters Towers residents switching to rooftop solar compared with other Australian electorates. As at September 2018, there were 7,686 small scale solar generation installations (<100 kW) generating 32,474 kW of energy, as well as 1,136 heat pump installations and 1,434 solar hot water installations (AGCER 2018). The \$330 million Kidston solar hydro project, in the Etheridge Shire Council, is expected to be completed by 2021, with its infrastructure corridor traversing the Charters Towers Region near Greenvale. The project will allow energy to be stored and harnessed on demand (QDSDMIP 2019) and has highlighted the need for a second power line to accommodate potential solar farms and wind generators in the Charters Towers Region.

Bioenergy is also slated for growth in the region, with plans under way to develop a fully integrated sugarcane farming, processing and ethanol distillation facility near Charters Towers called the Pentland Bioenergy Project (ARENA 2019). Feedstock will be grown onsite and controlled within the project (ARENA 2019). The potential of electric vehicles (EVs) is also high, but largely untapped. This is likely to change as EVs become more affordable, and with greater choice in vehicle types, for example, utes and 4WDs are preferred in many regional and rural centres (Colmar Brunton 2017). In addition, infrastructure for EVs is expanding across the state. The recently completed Queensland Electric Superhighway enables the use of EVs from Coolangatta to Cairns and from Brisbane to Toowoomba. It provides a number of fast chargers in convenient, safe locations with existing amenities, such as cafes, restaurants and shops (QG 2017).

Water availability and waste management

The city of Charters Towers and the smaller towns of Greenvale and Ravenswood access water from the Charters Towers weir on the Burdekin River 14 km north of Charters Towers. The weir also supplies water for agriculture, local manufacturing, engineering and other commercial operations including Pajingo Mine. The weir relies on seasonal filling cycles and continual inflows from the Burdekin River, which are generally sufficient for around six or seven months, but then the weir level is slowly reduced through a combination of water use, evaporation and natural seepage losses. Late and low yielding wet seasons pose a risk to supply security (QDEWS 2016). The weir has no recorded water supply shortfalls since it was raised in 1996, although water levels have fallen to low levels several times since then (QDEWS 2016). Level 1–4 water restrictions are introduced across the region in response to drought or other temporary water shortage events and lifted when conditions return to normal (CTRC 2015). The Federal Government recently committed \$54 million towards Phase 1 of the Hells Gates Dam Irrigation Project, a large, irrigated agricultural and power project (SMEC Australia Pty Ltd 2018). The project aim is to provide long-term water security and hydropower for the region, and ultimately facilitate the development of 50,000 ha of irrigated land for high-value crops (e.g. avocados, citrus and capsicums).

Within the region, up to 20% of households have no kerbside collection and are serviced by self-haul sites. There are four landfill sites within the region located at Greenvale, Pentland, Ravenswood and Stubley Street, Charters Towers (QG 2014). The Queensland Government's waste management strategy aims to increase recycling and create new waste-related jobs, products, industries and markets. The strategy's waste disposal levy – which at present does not apply to the more remote parts of the state, including Charters Towers – will reduce the incentive to dispose of waste to landfill, and provide opportunities to create new industries based on recycled materials. The Waste Reduction and Recycling Amendment Bill (2017) enabled a container refund scheme introduced into Queensland in 2018. This provides an opportunity for community organisations to make money from collecting bottles and cans and at the same time significantly reduce litter. The program also encourages social enterprises and potentially creates new jobs and regional business opportunities (Boomerang Alliance 2018).

4 Vision, aspirations, values and goals

Values

The first workshop produced a clear consensus on values that show a strong sense of community, connectedness, liveability, and a sense of place based on heritage, culture and education. Community aspiration identified include:

- Equipping young people with skills to keep them in the region, address skills shortages, grow the population and adjust the composition of the work force – all critical factors for economic growth.
- Balancing old with new to try to ensure the region stays sustainable into the future.
- Building a centre for creative industries and as a major region for service, transport, storage and distribution hub for rural north Queensland.

Vision and goals

The regional vision cast in 2011 in the document *Charters Towers: Our Region, Our Future 2035* (CTRC 2011) states that the region is recognised and respected for its ability to embrace change and overcome challenges to ensure long-term health, prosperity and sustainability and has:

- A resilient economy with diverse, innovative and knowledge-based businesses and industries, highly skilled local professional, trade and labour workforce and in synergy with the region's environmental and lifestyle values and priorities.
- A progressive and cohesive community with an attractive, secure and affordable lifestyle, excellent regional facilities, services and resources, a strong sense of community pride and participation within a healthy, caring and inclusive society.
- An environment that will be a valued reflection of the region's past, an appreciated expression of the region's present and a strong stimulus for the region's future; a secure, healthy and attractive place for fauna and flora, people, business and industry to be nurtured and have a range of opportunities to prosper and develop; and resilient and responsive to changing technologies and the impacts of climate change (CTRC 2011).

The vision provides a broad goal of building an innovative, diverse and resilient economy and a cohesive and inclusive community with an attractive, secure and affordable lifestyle underpinned by a healthy and sustainable environment.

5 Priorities and pathways

Regional challenges and opportunities

To develop a transition roadmap, it is important to consider the challenges and opportunities that the region could face now and into the future. There is inherent uncertainty around some of these challenges and opportunities, how they interact, and how they

may change over time. This uncertainty requires that transition pathways that are developed are robust yet flexible in order to build a prosperous, sustainable and equitable region into the future.

Workshop participants identified current and future pressures, challenges, strengths and opportunities for the region (Table 1).

Table 1. Current and future pressures, challenges, strengths and opportunities identified for the Region.

CURRENT PRESSURES AND FUTURE CHALLENGES	CURRENT STRENGTHS AND OPPORTUNITIES
<ul style="list-style-type: none"> • Low recognition as an investment destination • Small local market • Competition from Townsville for residents, investment and recognition • Low numbers of people in working age groups (20–65) compared with the rest of Queensland • Strong dependence on external labour • Below average literacy, numeracy and adult learning • Need more services (services with Townsville are not well coordinated) • Many older buildings are difficult to access which is a barrier for retail and tourism • Indications of weak connectivity/communication among key Federal/State governance domains • Currently weak links between social and economic development planning efforts 	<ul style="list-style-type: none"> • Stable economic base from mining (13.7%), education and training (11.1%) retail (10%) and health care (10%) • Opportunities in Big Rock Weir Irrigation Scheme – for agricultural growth and development • Great natural assets for diverse economic activities – steady water supply, abundant mineral deposits, abundant solar energy • Opportunities to explore new sectors, e.g. light industry, energy, service industry • Excellent schools and good access to James Cook University • Local Traditional Owners hold key information about country and culture • Charters Towers central location • High quality of life for many residents – affordable, safe, friendly, pleasant climate • High numbers of retirees – good opportunity for community involvement • High proportion of residents have rooftop solar • Strong history of connected leadership and increasingly strong capacity within and across Council planning systems • Strong governance associated with catchment and landscape planning

Priorities

Based on discussions of current strengths and future opportunities and taking into consideration some of the challenges identified earlier, the workshop participants identified seven linked priority areas for building broad pathways to a prosperous and resilient region. These priority areas are shown in Figure 4.

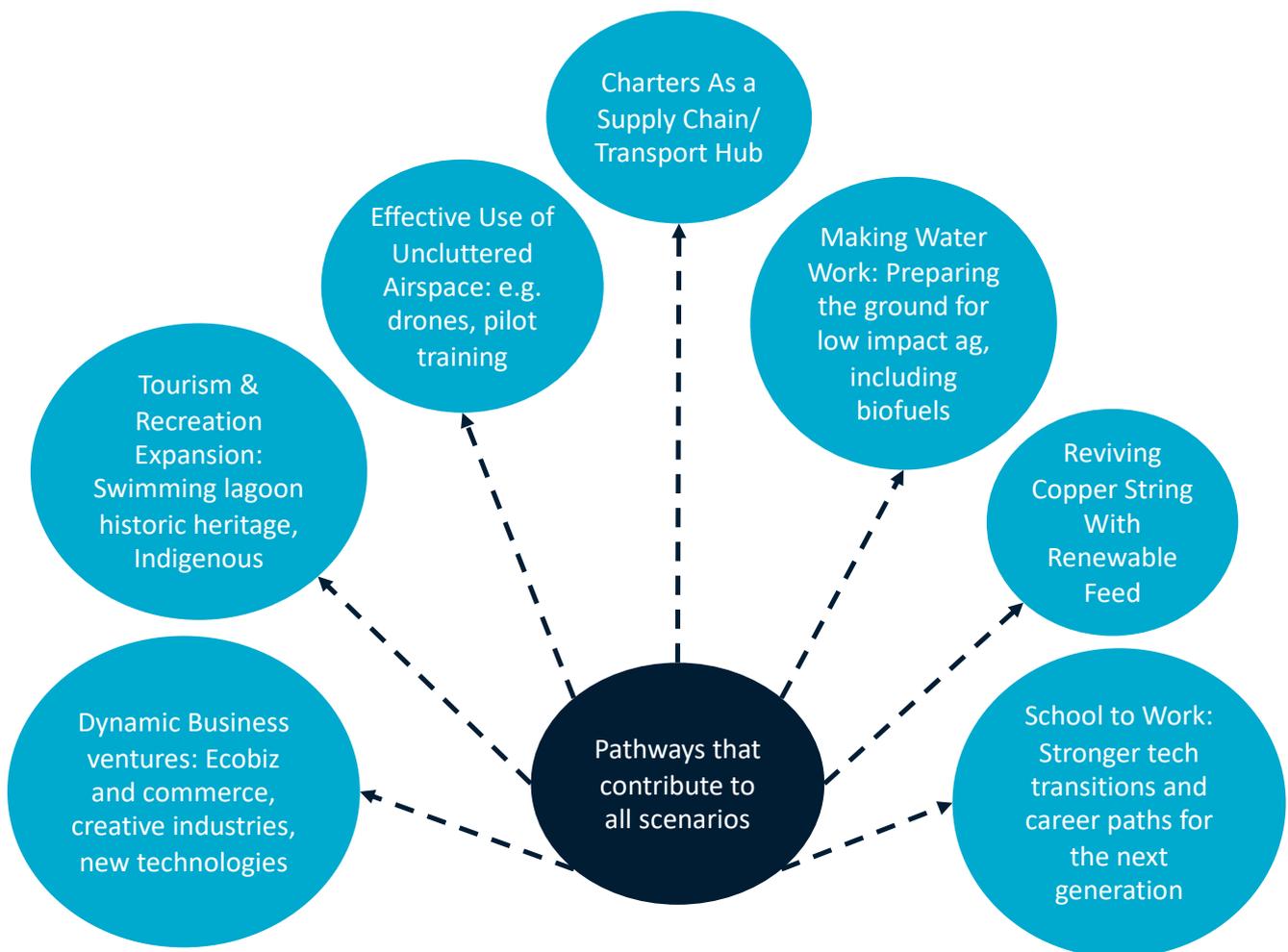


Figure 4. Priority areas for building broad pathways to a prosperous and resilient region.

Broad pathways

The priority areas were refined and merged into two major pathways and a third that supports and underpins the first two:

- Charters Towers as a supply chain/processing/transport hub and a centre for low-impact agriculture (derived from the Making Water Work theme).
- Dynamic business ventures and sector development.
- Supporting school-to-work transition by building stronger technology transitions and new career paths for the next generation (Figure 5).

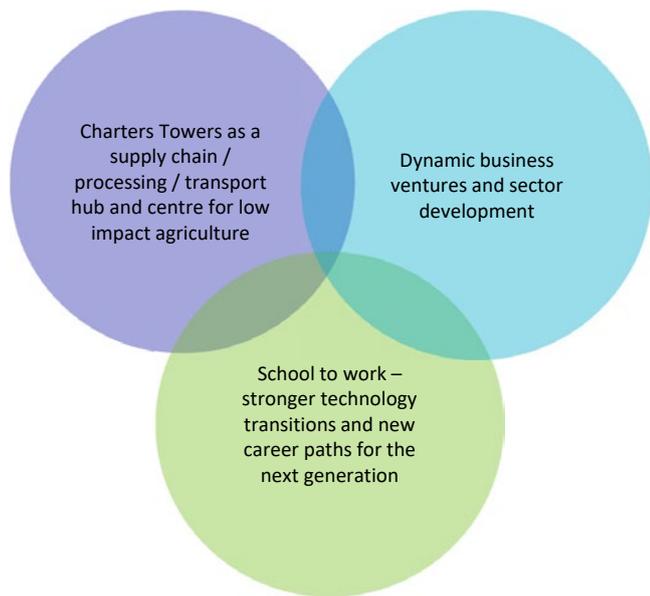


Figure 5. Three areas of focus towards building a prosperous, sustainable and equitable region.

1. Charters Towers as a transport/processing/supply and low-impact agriculture hub

This pathway will focus effort on improving efficiency and resilience of existing and new supply chains particularly in the context of creating new opportunities for expanding high-value agricultural production and processing initiatives. The Charters Towers Region is central for road, rail and air transport across north Queensland, and is therefore well positioned as a supply chain, transport and processing hub. The city of Charters Towers sits at the intersection of major roads heading north-south and east-west. Transport by trucks is critical for the ongoing viability of several industries, and the location of the city to the airport is important for disaster management. The road heading south from Charters Towers is flood-proof and not much work is needed to flood-proof the roads heading north. The most important part of the road upgrade is from Charters Towers to Greenvale – especially given new agricultural potential (CGCC 2019).

This broad pathway also involves the Making Water Work theme – preparing the ground for low-impact agriculture including biofuels – making Charters Towers Region a hub of low environmental impact, high-value and diversified agriculture. Increasing water allocations would provide crop diversification and enhance the grazing industry. This would build on plans for the Hells Gates Dam Irrigation Project on the upper Burdekin River, which is planned to include irrigated agricultural and power supply, potentially worth of \$5.35 billion (SMEC Australia Pty Ltd 2018). The project aim is to provide long-term water security and hydropower for the region, and ultimately facilitate the development of 50,000 ha of irrigated land for high-value crops (e.g. avocados, citrus and capsicums) (SMEC Australia Pty Ltd 2018). The Federal Government has committed \$54 million towards the construction of Big Rocks Weir as part of the Hells Gate development. This multibillion-dollar project will be subjected to a comprehensive risk assessment, including new regulatory requirements to protect the Great Barrier Reef and to achieve ‘no net decline’ in the reef water quality (Queensland Parliament 2019). For the project to deliver a direct and enduring positive impact on the economy, society and the environment of Charters Towers and North Queensland, the design, implementation and assessment of the project will need to apply principles of circular economy and systemic innovation. Among other things this will mean strengthening demand-driven sustainable supply chains (from production, transport, processing, value adding, retailing and export preparation) that deliver greater energy and nutrient use efficiency, less waste and a low emissions profile.

2. Dynamic business ventures and sector development

This pathway is expected to work with urban renewal of Charters Towers as well as regional agriculture, tourism and mining. One key focus of the pathway is expanding existing and developing new lines of tourism. This will be assisted by a Charters Towers Regional Council Tourism strategy. The strategy is expected to emphasise historic tourism (e.g. heritage trails, museums, buildings), outback and agritourism (e.g. Texas Longhorn Tours and Safaris), Indigenous tourism and nature-based tourism, including ‘dark sky’ experiences (CGCC 2019). Charters Towers Region also has significant potential for new social service businesses including health and aged care as increasing numbers of retirees come to the region because of the pleasant weather, relative liveability and affordable housing. The transport/supply/processing hub and low-impact agriculture pathway will also expand the scope of business and investment in the region including vertical integration of existing businesses and resources providing agritech and digital opportunities, emerging ecosystem services, advanced manufacturing and mining services as well as disaster resilience services.

3. Improved school to work transition via stronger technology transitions and new career paths for the next generation

This pathway is considered fundamental to the success of the preceding two pathways and is critical for reversing a negative population growth trend, increasing the available work force and reducing high levels of unemployment. Given digital disruption, this needs to be done in a way that addresses changes in the nature of jobs in the future. One proposal is to build a local centre of excellence that leverages the region’s schools and links with a new trade training centre and JCU. These links are a strength that can be further developed to include exchange students from and to overseas especially from trading partners. The centre can also help to prepare a workforce for digital disruption and new employment business opportunities. Due to its uncluttered airspace the region may also be a testing site for some digital technologies (e.g. drones) and a training centre for pilots.

Options and project ideas

The second stage of the program involved further community conversations and an online survey of stakeholders to elicit preferences of options and project ideas within the three pathways. The list of options and project ideas for each pathway that were identified are:

Charters Towers as a transport, supply chain, processing and agricultural hub

- New infrastructure (road, rail and air transportation networks and dams and irrigation schemes) and supply chain development.
- Engineering solutions and new infrastructure to enable water recycling.
- Effective water trading and local management.
- Visionary land use and infrastructure planning to reduce costs and impacts.
- New forms of zero emission aquaculture, including macro algae to treat wastewater.
- New protected cropping systems for agriculture (e.g. greenhouses, shade structures).
- Low-carbon energy – new forms of local, secure, affordable, dispatchable and low-carbon energy to drive agricultural growth.
- Best management and monitoring practices, including regional composts and nutrient management.
- Stronger digital data hubs and value chain resilience and innovation.

Dynamic business and sector development

- Dynamic tourism products, marketing and enterprise.
- EcoBiz in support of more circular small business and not-for-profit enterprises.
- Building small business innovation capacity.
- Stronger human services sector together with cultural services and community liveability.

School-to-work via stronger technology transitions and new career paths for the next generation

- Linking schools, vocational education, universities and private enterprises in driving workforce development and new career paths for local residents.
- Establishing a centre of excellence for digital and next generation skills for emerging businesses and industry sectors.

6 Dynamic Roadmap for the future

Types of change pathways

Each pathway will build and enhance existing resource use and livelihood systems in the region in the short term, modifying some aspects gradually and even transforming other aspects by radically changing and/or adding some significant new components into the regional economy. Therefore, it is possible to envisage

each proposed pathway as having different stages or aspects to maintain, modify and transform the region that will require different types of interventions (Figure 6).

Table 2 is an example of how possible interventions for each of the three focus areas could be implemented to maintain, modify or transform aspects of the region without precluding work that could be initiated for the other stages as part of the dynamic roadmap

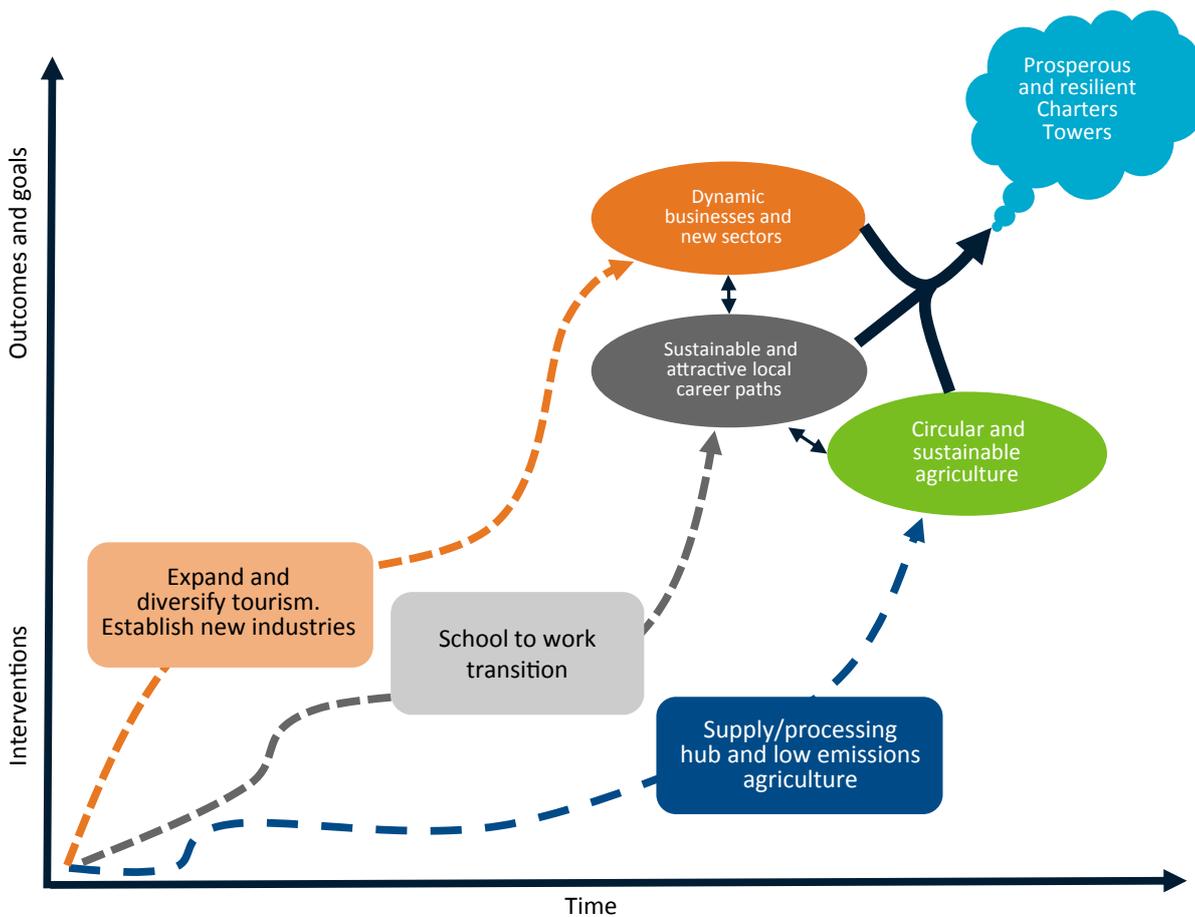


Figure 6. Broad pathways and priority interventions for a prosperous, equitable and resilient region.

Table 2. Three proposed pathways and potential interventions/stages to ‘maintain,’ ‘modify’ and ‘transform.’

BROAD PATHWAY	MAINTAIN	MODIFY	TRANSFORM
A supply chain/ processing/transport hub and a centre for low-impact agriculture	<p>Maintain and expand existing livestock and crop industry and rural lifestyle.</p> <p>Maintain existing road, rail and air transport.</p>	<p>Expand intensive and diverse irrigated agriculture and supply chains.</p> <p>Expand and diversify transport networks.</p>	<p>Instigate low emission and circular agriculture.</p> <p>Establish new high-value horticultural products and food value chains.</p> <p>Develop a new and well-networked transport/supply/storage and distribution hub that also provides services to build disaster resilience.</p>
Dynamic business ventures and sector development	<p>Maintain and promote natural and cultural assets foundational to tourism and other industries.</p> <p>Improve efficiencies in water, energy and other input use and reduce waste from businesses and industries.</p>	<p>Implement diversified tourist experiences.</p> <p>Build on existing beef production to intensify and diversify agricultural production and value chain businesses.</p>	<p>Integrate new lines of tourism with natural and cultural experiences.</p> <p>Build dynamic transport, supply, storage and agricultural value chain businesses and new supporting sectors.</p>
School-to-work transition via stronger technology transitions and new career paths for the next generation	<p>Support and strengthen current linkages between schools, tertiary institutions with businesses and sectors providing mentorship, training and employment opportunities.</p>	<p>Establish a centre of excellence that attracts and builds a digitally literate, reliable local workforce for existing and new businesses and sectors.</p>	<p>Create new career paths and a workforce that generates digital and other new generation businesses.</p>

To aid visualisation of the broad pathways, Figure 7 shows sets of strategic intervention options that would maintain, modify and transform aspects of the region to realise the vision and goals.

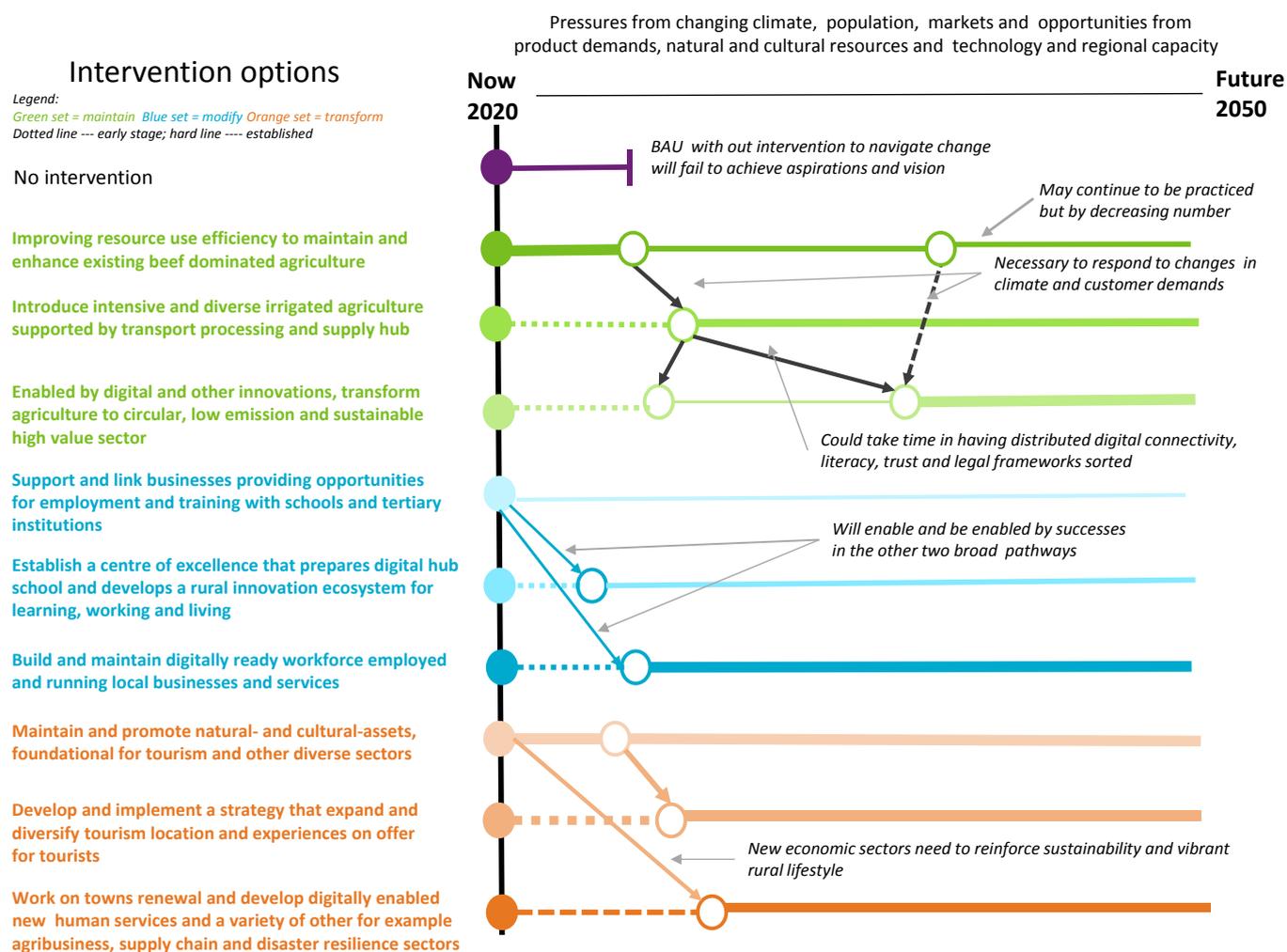


Figure 7. Sets of intervention options and their interdependencies, to ‘maintain’, ‘modify’ and ‘transform’ aspects of the region.

Interventions across pathways

There are three cross-cutting intervention domains identified in the participant workshops and working group discussions that could enable the realisation of the pathways. These are:

Feasibility studies and research

Feasibility studies for select project ideas are needed to confirm each proposed business case. It will be important to take stock of what has been done so far in Charters Towers and elsewhere and how much each project will likely contribute to each pathway.

Digital connectivity

Digital technology is expected to offer significant opportunities to improve efficiencies in existing businesses, industries and services as well as supporting the emergence of new ones. Digital innovation will also replace low skill and repetitive jobs. This will require preparing and building digitally literate workforces and businesses.

Affordable, secure and renewable energy

Low-impact agriculture, dynamic businesses and diverse sectors will require expansion of affordable and renewable energy from different sources and across the region. This will be important for the region and the different industries to contribute to emission reductions. The construction and maintenance of these energy resources will require the development of local skills and will provide employment opportunities.

Table 3 is a matrix of the cross-cutting interventions and the three broad pathways.

Table 3. Project ideas and potential benefits from a matrix of broad pathways and cross-cutting interventions.

BROAD PATHWAY	TRANSPORT, SUPPLY, PROCESSING AND AGRICULTURAL HUB	DYNAMIC BUSINESS AND SECTOR DEVELOPMENT	SCHOOL-TO-WORK TRANSITION
Cross-cutting intervention domain	Develop a supply chain/processing/transport hub and a centre for low-impact agriculture.	Dynamic business ventures and sector development.	School-to-work – stronger technology transitions and new career paths for the next generation.
Feasibility studies and research	Detailed feasibility study on making the region a transport/supply/distribution hub and a centre of low-impact agriculture.	Conduct research on what it takes to create business dynamism and new and diversified sector development.	Take stock of existing and potential workforce requirements to service expanded and new businesses and industries.
Digital connectivity	Supporting digitally enabled transport, agriculture and value chains.	Supporting digitally enabled tourism and other diverse businesses, services and industries.	Digital ready workforce and businesses including businesses providing digital services.
Affordable, secure and renewable energy	Making hubs energy efficient and effective. Contributing to circularity of hub operations and lowering the impacts of agriculture.	Cost and emission reductions for existing businesses and industries in new and diverse sectors. New renewable energy installation, operations and maintenance businesses.	Create new skills and employment opportunities.

7 Development of prefeasibility business cases

Of the three broad pathways proposed by the Charters Towers workshop participants and working groups, two were selected for the development of prefeasibility business cases.

1. Dynamic Business and Sector Development initiative

The Charters Towers Region and community is building on its economic, human and natural assets to create a stronger and more resilient economy for the future. It seeks to tackle multiple pressures and opportunities, including significant transitions in workforce and population, ever increasing cost pressures, and the need to reduce the environmental cost of production while increasing the social benefits that it provides. At the same time, new approaches to older industries are possible in addition to new economic opportunities. The region seeks to successfully navigate these challenges.

On the back of a broad assessment of regional pressures and potential options for securing future economic resilience for Charters Towers, a priority development pathway was identified that acts to strengthen the capacity, innovation levels and workforce of several revitalised, new and emerging industry sectors. These sectors include: a) tourism and cultural services, b) agritech (including digital) opportunities, c) human services and education, d) mining services, energy and advanced manufacturing, and e) emerging ecosystem services. The most significant challenge for building economic resilience in the region involves strengthening these individual sectors, their constituent businesses and the associated human capital. This approach also involves building stronger cross-sector linkages and ensuring the required workforce is available to sustain effective economic momentum and innovation within and across these sectors. The Dynamic Business and Sector Development initiative will explore, scope and deliver into four key areas of strategic effort, including:

- Building Collaborative Industry Clusters: supporting the identification of key leaders and participants in the supply and value chain of each priority sector, the development and monitoring of an industry benchmark, and the development and active delivery of cohesive and implementable collaborative action strategies for developing each sector.

- Creating a Stronger Innovation Platform for Emerging Businesses: working across the priority sectoral clusters, the Regional Council, industry, State agencies and universities to identify appropriate mechanisms to support locally based business innovation and expansion.
- Cohesive Workforce Forecasting and Coordinated Response: across each of the priority sectors, developing more cohesive workforce forecasting and targeted strategies (from workforce development to strategic migration) to secure the required workforce, and the coordination of appropriate service delivery models across the education sector.
- Strengthening our Economic Governance: scoping and establishing stronger, locally based governance arrangements to facilitate economic development in the region.

Priority outcomes from the progression of this approach are intended to include:

- Targeted and sustained growth in each of these key sectors over the next five years.
- A reversal of population decline and the loss of key workforce capacities from the region.
- Improved retention of younger people and existing skills within the region.
- Greater integration across new and existing economic sectors within the region.
- Improved business confidence, skills, investment and innovation across the region.
- A demonstrable and reduced cost/environmental footprint against existing business models.
- Other key benefits of adopting the Dynamic Business and Sector Development initiative, include:
 - The chance to grow upon a stable economic base from mining (13.7% of economic activity), agriculture (11.1%), education and training (11.5%), retail (10%) and health care (10%).
 - Better utilisation of new water-based opportunities in Big Rocks Weir irrigation scheme and the growth of an allied service sectors (e.g. light industry, energy and agri-service industries).

- A higher number of retirees becoming mobilised to help increase civic capacity (e.g. arts and crafts, youth mentoring, volunteering in schools, libraries, parks and gardens).
- The transition of many prospective attractions for new/potential residents, including affordable housing and land, excellent schools and access to universities, a high quality of life (safe, friendly communities and a pleasant climate) and strong energy self-sufficiency.
- The promotion of great natural assets to enhance diverse activities, including steady water supply, abundant mineral deposits, abundant solar energy and nature-based tourism.
- The creation of opportunities for Indigenous tourism and environmental services through local traditional owners who hold the keys to information about country and culture.
- Continuing to build a strong history of connected leadership and an increasingly strong capacity within and across the council planning system (CGCC 2019).

2. ‘Making Water Work’ for Charters Towers: delivering greater benefit from agricultural water, supply and value chains

The Making Water Work initiative will focus effort on the creation of new opportunities in the agricultural production and associated processing sectors. It will do this through improving demand-driven approaches to supply chain analysis, planning and development, while also monitoring the expected growth and resource use efficiency benefits. The Hells Gate Dam Project will have a direct and enduring positive impact upon the economy of Charters Towers and North Queensland.

The multimillion-dollar project, however, will be subject to a comprehensive risk assessment, including proposed new regulatory requirements to protect the Great Barrier Reef and to achieve ‘no net decline’ in reef water quality (Queensland Parliament 2019). At the same time, increasing water prices and declining water availability are driving renewed interest from other irrigation regions in northern Australia. Recent related supply chain analysis for the region suggests significant unmet demand for typical agricultural products across key markets, including South East Asia, China and the Middle East. Of relevance to Charters Towers, that work identified five priority products, including intensive beef cattle, legumes and pulses, with nearly \$3 billion of currently unmet demand in global markets (KPMG 2019). Consequently, the most significant challenge for the development of agriculture will be effective management of water allocations to enable higher value and much more efficient, low-impact agricultural ventures and supply chains, whether they be large or small in scale. This pathway will explore, scope and strategise:

- The required agricultural supply chain visions and potential production system models.
- The visionary land use and infrastructure planning that can deliver on this water promise, including innovative road, airport, port and communication solutions.
- Integration with reliable, affordable and low-carbon energy and integrated waste options to service this development.
- The potential for protected cropping, small scale farming and farm services innovation.
- Next generation sub-catchment approaches and production system practices that will be needed to meet the proposed new Great Barrier Reef regulations.

Focusing on strengthening all aspects of the supply and value chain, the project will deliver greater economic benefits, energy and nutrient use efficiency, less waste and an improved emissions profile relative to the region’s gross domestic product.

8 References

- AEC Group Limited. 2013. *Charters Towers Region Economic Development Plan 2012-2017*. Prepared for Charters Towers Regional Council, Charters Towers.
- AGCER (Australian Government Clean Energy Regulator). 2018. Postcode data for small-scale installations. Australian Government Clean Energy Regulator. Retrieved 01 August 2019 from: <http://www.cleanenergyregulator.gov.au/RET/Forms-and-resources/Postcode-data-for-small-scale-installations#Smallscale-installations-by-installation-year>.
- AML (Australian Mines Limited). 2017. The Energy Metal You Have Never Heard Of: Demand Set to Increase by 800%. Australian Mines Limited. Retrieved 01 August 2019 from <https://www.nextminingboom.com/energy-metal-never-heard-demand-set-increase-800/>
- AML (Australian Mines Limited). 2018. Bank feasibility study supports strong commercial case for developing SCONI cobalt-nickel scandium project located in North Queensland. Australian Mines Limited. Retrieved 01 August 2019 from https://australianmines.com.au/brochures/downloads/BFS_supports_strong_commercial_case_for_developing_Sconi1.pdf
- ARENA (Australian Renewable Energy Agency). 2019. *Pentland Bioenergy Project*. Australian Renewable Energy Agency. Retrieved 2 March 2020 from <https://arena.gov.au/projects/pentland-bioenergy-project/>
- Aussie Broadband. 2018. *2018 Regional Telecommunications Review – Regional Telecommunications Independent Review Committee*. Aussie Broadband. Retrieved from: <https://www.aussiebroadband.com.au/wp-content/uploads/2018/08/Aussie-Broadband-submission-Regional-Telecommunications-Review-2018.pdf>
- Boomerang Alliance. 2018. Queensland's Container Refund Scheme Launched 1st November 2018. Boomerang Alliance. Retrieved 5 September 2019 from <http://www.boomerangalliance.org.au/c4cqlid>
- Bradford, N. Caffery, L., Smith, A. 2015. Awareness, experiences and perceptions of telehealth in a rural Queensland community. BMC Health Services Research 15:427. <https://doi.org/10.1186/s12913-015-1094-7>
- Business Queensland. 2017. *Rare earths and strategic metals*. Business Queensland. Retrieved 10 August from <https://www.business.qld.gov.au/industries/mining-energy-water/resources/minerals-coal/outlook-statistics/rare-earths>
- Carter, M. 2019. Competition and Profit Margins in the Retail Trade Sector. *Reserve Bank of Australia Bulletin, June 2019*. Retrieved 21 August from <https://www.rba.gov.au/publications/bulletin/2019/jun/competition-and-profit-margins-in-the-retail-trade-sector.html>
- CGCC (Clean Growth Choices Consortium). 2019. *Assessing the Charters Towers Region's Resilience in Supporting Communities in Transition*. Unpublished report prepared for the Queensland Department of Environment and Science.
- Colmar Brunton. 2017. *Queensland Household Energy Survey*. Prepared for Energex, Ergon, Powerlink, Virginia, QLD.
- CTRC (Charters Towers Regional Council). 2011. *Community Plan: Charters Towers – Our Region, Our Future 2035*. Charters Towers Regional Council. Retrieved 10 November 2018 from <http://www.charterstowers.qld.gov.au/documents/41682213/41768443/CTRC%20Community%20Plan-%202011-2035>
- CTRC (Charters Towers Regional Council). 2015. *Drought management plan*. Charters Towers Regional Council. Retrieved 1 December 2018 from <http://www.charterstowers.qld.gov.au/documents/41682213/41928106/Drought%20Management%20Plan-%20August%202015>
- CTRC (Charters Towers Regional Council). 2019. *Charters Towers Regional Council Investment Opportunities*. Charters Towers Regional Council. Retrieved 15 September 2019 from <http://www.charterstowers.qld.gov.au/investment-opportunities>
- FutureBeef. 2018. Feedlots. FutureBeef. Retrieved 10 October 2019 from <https://futurebeef.com.au/knowledge-centre/feedlots/>.
- Greenwood, P., Gardner, G., Ferguson, D. 2018. Current situation and future prospects for the Australian beef industry – A review. *Asian-Australas J Anim Sci*. 31(7): 992–1006.
- Hossain, D.; Gorman, D.; Chapelle, B.; Saal, R.; Mann, W.; Penton, G. 2014. Chapter 3 Assessing the Mental Health Issues of Climate Variability Affecting Rural and Remote Communities in Southern Queensland. In S. Brumby, A. Kennedy and B. Todd (Eds), *Sowing the Seeds of Farmer Health*. Mt Helen, Victoria: VURRN Press, pp 34–54.
- KPMG. 2019. *North Queensland Agricultural Supply Chain Study*. Townsville Enterprise Ltd, Townsville.
- Maru, Y. Doerr, V., O'Connell, D. 2018. Adaptation Pathways and Transformation Approach (RAPTA) based Clean Growth Choices Framework, unpublished manuscript written for the Clean Growth Choices Project.
- MITEZ (Mount Isa to Townsville Economic Development Zone). 2019. *MITEZ Looks to 2019 as Year to Advance the Region*. Mount Isa to Townsville Economic Development Zone. Retrieved 30 January from <http://www.mitez.com.au/mitez-looks-to-2019-as-year-to-advance-the-region/>
- NQ Dry Tropics. 2019. *Our Region*. NQ Dry Tropics. Retrieved 29 August from <http://www.nqdrytropics.com.au/about-the-region/>

- O'Connell, D., Abel, N., Grigg, N., Maru, Y., Butler, J., Cowie, A., Stone-Jovicich, S., Walker, B., Wise, R., Ruhweza, A., Pearson, L., Ryan, P., Stafford Smith, M. 2016. Designing projects in a rapidly changing world: Guidelines for embedding resilience, adaptation and transformation into sustainable development projects. Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility (GEF), Washington D.C., p. 112.
- Perry, D. 2017. A movement has begun to change the way we grow our food. World Economic Forum. Retrieved 18 August 2019 from <https://www.weforum.org/agenda/2017/06/how-consumer-demand-and-new-technologies-will-drive-sustainable-agriculture/>
- Proactive Investors. 2019. *Australian Mines jumps 21% as Sconis given Prescribed Project status by Queensland Government*. Proactive Investors. Retrieved 30 August from <https://www.proactiveinvestors.com.au/companies/news/213304/australian-mines-jumps-21-as-sconis-given-prescribed-project-status-by-queensland-government-213304.html>
- QDAF (Queensland Department of Agriculture and Fisheries). 2019. Disaster-declared areas Far North and North Queensland monsoonal floods January-February 2019. Queensland Department of Agriculture and Fisheries. Retrieved 25 March 2019 from <https://www.daf.qld.gov.au/business-priorities/agriculture/disaster-recovery/natural-disaster/declared-areas>
- QDEHP (Queensland Department of Environment and Heritage Protection). 2016. *DRAFT Climate change in the North Queensland region*. Queensland Department of Environment and Heritage Protection. Retrieved 2 July 2019 from https://www.qld.gov.au/data/assets/pdf_file/0023/68153/north-qlld-climate-change-impact-summary.pdf
- QDEHP (Queensland Department of Environment and Heritage Protection). 2017. *Pathways to a clean growth economy: Queensland Climate Transition Strategy*. Queensland Department of Environment and Heritage Protection. Retrieved 11 August 2018 from <https://www.qld.gov.au/environment/assets/documents/climate/qlld-climate-transition-strategy.pdf>
- QDERM (Queensland Department of Environment and Resource Management). 2011. *Dalrymple National Park Management Plan*. Retrieved 2 March 2020 from <https://parks.des.qld.gov.au/managing/plans-strategies/pdf/mp008-dalrymple-national-park-mgtplan-ginc-approved-2011.pdf>
- QDEWS (Queensland Department of Energy and Water Supply). 2016. Charters Towers Regional water supply security assessment. Queensland Department of Energy and Water Supply. Retrieved 2 December 2018 from https://www.dnrme.qld.gov.au/__data/assets/pdf_file/0006/338739/charters-towers-rwssa.pdf
- QSDMIP (Queensland Department of State Development, Manufacturing, Infrastructure and Planning). 2019. Kidston Pumped Storage Hydro Project: Project overview. Queensland Department of State Development, Manufacturing, Infrastructure and Planning. Retrieved 20 May 2019 from <https://www.statedevelopment.qld.gov.au/assessments-and-approvals/kidston-pumped-storage-hydro-project.html>
- QG (Queensland Government). 2012. Townsville Region: national parks, conservation parks and State forests – visitor guide. Queensland Government. Retrieved 14 December 2018 from <http://www.townsvilleinfo.com/townsville/accommodation.1/bowling-green-bay-national-park.1303/downloads/106/>
- QG (Queensland Government). 2014. *NQ Regional waste reduction and recycling plan 2014 – 2024*. Joint initiative of Townsville City Council, Burdekin Shire Council, Charters Towers Regional Council, Hinchinbrook Shire Council and the Queensland Government. Queensland Government. Retrieved 15 December 2018 from http://www.charterstowers.qld.gov.au/documents/41682213/41713331/NQ%20Waste%20Reduction_Recycling%20Plan.pdf
- QG (Queensland Government). 2017. *Queensland leads the way on energy storage*. Queensland Government. Retrieved 12 December from <https://reneweconomy.com.au/queensland-leads-way-energy-storage-47053/>
- QGSO (Queensland Government Statistician's Office). 2019. *Queensland Regional Profiles*. Queensland Government Statistician's Office. Retrieved 20 November 2019 from <https://statistics.qgso.qld.gov.au/qlld-regional-profiles>
- RAI (Regional Australia Institute). 2016. *The Future of Work: Charters Towers Case Study*. Regional Australia Institute. Retrieved 24 May 2019 from http://www.regionalaustralia.org.au/home/wp-content/uploads/2016/11/The-Future-of-Work_Charters-Towers-Case-Study.pdf
- Skirrow, R.G., Huston, D.L., Mernagh, T.P., Thorne, J.P., Dulfer, H., Senior, A.B. 2013. *Critical commodities for a high-tech world: Australia's potential to supply global demand*. Geoscience Australia, Canberra.
- SMEC Australia Pty Ltd. 2018. *Hells Gates Dam Feasibility Study Final Feasibility Report – Chapter 1; Revision No. 02*. SMEC Australia Pty Ltd. Retrieved 14 September 2018 from https://s3-ap-southeast-2.amazonaws.com/os-data-2/townsvilleenterprise-com-au/documents/hells_gates_dam_-_executive_summary.pdf
- Solar Citizens. 2018. *How does solar score in your electorate?* Solar Citizens. Retrieved 21 November 2018 from <http://solarscorecard.org.au/>

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Unlocking a better future for everyone.

Contact us

1300 363 400
+61 3 9545 2176
csiroenquiries@csiro.au
csiro.au

For further information

Land and Water
Dr Yiheyis T Maru
Principal Research Scientist
+61 2 6246 4171
yiheyis.maru@csiro.au
research.csiro.au/eap