Beyond Carbon: a case study of Cleantech and innovation for sustainable regional development in Central Queensland

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Abstract

The challenges confronting regional Australia include drivers such as climate change, uneven population growth, natural resource management and land use conflicts, liveability concerns and regionalization agendas. There is a need to explore ventures that simultaneously address these pressures if regional areas are to flourish and contribute to national targets in social, environmental and economic areas. One way to achieve this is to exploit the natural advantage that regional areas may have for innovation. 'Cleantech' refers to a range of technologies and processes that focus on improved efficiency, reduced environmental impacts and better profitability: cleantech is emerging as an innovative way to tackle sustainable regional development challenges.   Central Queensland (CQ) is a region that is well-suited for the development of cleantech: it has high cleantech demand; a suite of useful natural assets; advantageous infrastructure and waste products; existing professional skill and trade sets in relevant industries; a diverse economy and economic incentives to operate in cleantech; a cooperative and engaged regional University; supportive local Government and a core of businesses already dealing in cleantech. Most importantly, there is substantive human capital in the area.   This paper explores how innovation activity could be encouraged by engaging SMEs and other regional stakeholders to establish a Cleantech CQ hub. This hub could drive regional development and competitiveness, help resolve a range of regional environmental pressures and move the CQ region 'Beyond Carbon'.

Action agendas: regional competitiveness; productivity gains – opportunities in regions; cross sectoral community development and engagement; resolving contested economic development issues regarding land use, resources and sustainability.

Keywords: central Queensland, cleantech, cluster, innovation, regionalisation

Biographies

Dr Susan Kinnear is currently a senior research officer at CQUniversity Australia, where she leads a programme in sustainable regional development. Prior to this, Susan gained several years' experience working on diverse and multidisciplinary projects for the CQU Institute for Sustainable Regional Development, including those on weeds, climate change and the challenges of cyclical regional growth in the Bowen Basin. She holds a PhD in the experimental environmental sciences

and has undertaken a range of duties in postgraduate course writing, research student supervision and tertiary teaching. In 2007, Susan was named the Queensland Young Achiever of the Year (Environment). Her interests include the nexus between patterns of efficient resource use and re-use (water, energy and waste), environmental management and regional development in the central Queensland region.

Mr *Ian Ogden* has held leadership roles in Central Queensland for the past decade. He is currently the Innovative Regions Facilitator for the Federal Department of Innovation, Industry and Science. His background is diverse with senior local government roles at Ipswich City and as the CEO of Mornington and the former Duaringa Shire Councils. He has also worked internationally as an advisor in developing economies and has been a management consultant to the resources and business sectors. Ian conceptualised and led the creation of the Blackwater International Coal Centre. He has a firm commitment to social justice and sees innovation as the linchpin to the regions' continued prosperity. He is an artist and a musician. His qualifications include GradCert UrbanMan, GradCert Trng&Dev, DipMan and various professional certifications.

Introduction

Regional roles and drivers for sustainability

Australia's regional areas have strong drivers to be sustainable: they represent a nexus between climate change, population growth, regionalisation, NRM, liveability and land use conflicts. Agriculture and extractive resource development are typically at the core of economic growth in regional Australia (Courvisanos, 2009). However, where regional growth relies solely on finite resources, a region's economic position can only decline as those resources are extracted (Clement, 2000). Unfortunately, as regional communities are home to just one-third of the Australian population (ABS, 2010), their low population bases limit the potential for regional areas to trade in other non-resource areas, such as the education, skilling and services sectors. The population base also creates difficulties in resourcing and managing regional environmental problems, since these typically manifest on large geographic scales (e.g., issues of weed management across large land tenures). On the other hand, using regional-level approaches to tackle issues of sustainability is often logical, since many environmental problems manifest at that scale: consider, for example, issues of water quality (e.g., via basin or catchment management) and climate change (where effects and appropriate adaptation strategies can be highly variable between geographical locations). Regional communities are also physically closer to ecosystems with which they interact (Courvisanos, 2009), and this can bring advantages because of the heightened awareness of sustainability issues. This provides a strong human capital base on which environmental initiatives can be built, despite low population numbers: examples of this already exist in several regional population centres (e.g., Bergmann et al., 2008).

Increasingly, it is being recognised that regional areas sustain us environmentally, socially and economically, and that in turn, regional populations and economies must be managed sustainably if

they are to continue to provide national goods and services. Australia's regions areas are vital in helping to deliver national goals in social, economic and environmental issues. For example, regional areas, especially those that are rurally-based, are providing an increasingly wider array of ecological goods and services (Marsden, 2010). This indicates an important role for regions in the national plans for water and food security, targets for renewable energy and demand management, transiting to a lower-carbon economy, and improved health and liveability (wellbeing). However, if regional areas are to continue to prosper, they must look beyond extractive resource activities and towards other areas for economic stimulation.

Regions and innovation

The world's top competitors and collaborators are not states or countries: they are regions. Economic regions are defined not by political boundaries, but economic resources such as industry concentrations, labour markets, and common infrastructure. For example, the key competitor in India is not the country per se, but rather a growing high-tech region within the state of Bangalore. Similarly, it is the broader metropolitan areas including Shanghai and Guangzhou that are the key competitors, rather than the country of China or its provinces (Collaborative Economics, 2008, p7).

Innovation has a fundamentally important role to play in contributing to the prosperity of regional areas of Australia, but the reverse is also true: regional areas can play a key role in driving national innovation (Potts, 2010, Isaksen and Onsager, 2010). Innovation is distinguished from novel ideas by the fact that it combines inspiration with entrepreneurship to create new value – be it either commercial or social (Pool 2010). It is the realization of commercial value in the marketplace distinguishes an innovation from an invention (Chapple and Hutson, 2010), including not only products, but also processes and services.   The Australian Government has outlined the fundamental importance of innovation to sustain economic development in its policy *Powering Ideas – An Innovation Agenda for the 21st Century* (DIISR, 2009).   Innovation can promote growth, increase productivity and competitiveness and create employment (Mukkala, 2010)(DIISR 2009; Mukkala 2010): each of these are clearly aligned with regional development agendas. However, for many regional areas, innovation is more than this, as without it, business as usual may mean no business at all. Research by the Boston Consulting Group also supports the view that innovation has become an increasingly important factor in productivity growth (figure 1). According to their analysis, innovation has been growing in relative importance to other inputs, such as capital and labour, over time—and at a much faster rate beginning in the 1990s.
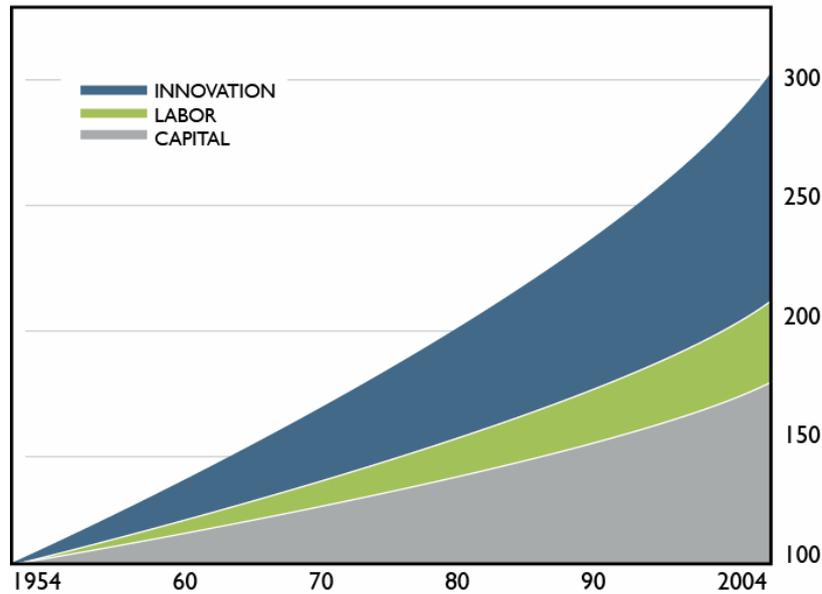
Figure 1   Productive Innovation – US productivity growth, output per hour (1954=100). Source: Boston Consulting Group in Collaborative Economics, 2008).

Enabling innovation is particularly important, but also particularly challenging, in regional areas that are challenged by low population densities and long distances.   For example, regional areas may lack innovation because of low market demand (Courvisanos, 2009). However, using innovation to create new value can help to introduce regions to national or globalized market places, and so grow these regions (both economically and socially).

Collaboration is a powerful enabler of innovation (DIISR, 2009), and the collaborative value of two or more organisations is greatest when their interests and expertise overlap, but are not completely matched (Cantner et al., 2010). Some regions of Australia feature the co-existence of a number of potentially complementary industries such as mining, agriculture, manufacturing and processing, and natural resource management. These sector share skill sets, transportation systems, common regulatory pressures as well as vie for the same resources. This signals the chance to share information and resources of mutual interest, as well as to better understand how different regional players can contribute to new initiatives (Potts, 2010). Ultimately, then, the mixture of industries and stakeholders that are present in regional areas means that those communities are well-placed to generate innovative, cross-sectoral approaches to resource use and sustainability.   The development of industry-focused or supply-chain clusters is of particular value to innovation in regional areas, especially where this strengthens existing relationships and interests whilst stimulating new possibilities (Mukkala, 2010). For example, successfully innovative regions are already being established based on regional food production chains in the UK.

Combining innovation and sustainability for regional (and national) outcomes

Regional areas are under increasing pressure to contribute to the long-term carrying capacity of Australia. However, ecological concerns and issues of resource depletion have been largely absent

from the management of regional economic development in Australia (Courvisanos, 2009, p. 256). There is now a need to change this trajectory, and establish new regional economies around ecosystem services which enable regional areas to recapture value and create market and consumption niches (Marsden, 2010). Ultimately, Australia's regional areas need to use innovation: to capitalise on the interconnectedness of their communities, and on the complementarity of their businesses and industries, to action a wide range of sustainability issues. Potts (2010) has already described how innovation and sustainability are complementary drivers, and how can they can be used in synergy to progress regional economic development. *Powering Ideas* also advocates investing in science and research to discover new ways of addressing environmental challenges without compromising liveability (DIISR, 20009). This will allow regional areas to move past reactive and defensive strategies, and instead pursue triple bottom line outcomes though regional growth (Clement, 2000, p. 20). It will also ensure that regions play a key role in addressing Australia's uneven performance in innovation (DIISR, 2009).

A Cleantech solution?

Cleantech refers to 'a diverse range of technologies, products, services and processes that measure, reduce, eliminate or remediate negative environmental impact, and/or improve the productive and responsible use of natural resources while returning a profit to the provider' (DEEDI 2010). Cleantech is also sometimes referred to as "eco-innovation". Garnaut (2008) has argued that transition to a low-emissions economy can only occur through technological solutions. New technologies set off a burst of innovation. Innovation, however, is not evenly distributed through time; it appears in groups or bunches (Schumpeter 1934). Given the national and global drivers for low emissions, it is unsurprising that clean technologies are rapidly increasing in the share of overall innovative activity (Chapple and Hutson, 2010). For example, in 2009, the Australian cleantech sector had a combined revenue exceeding $9 billion and employed over 13,000 people (ACT 2010b). Queensland's share of the industry is some $1.3 billion, with 10,000 skilled workers and 50 nations as export customers (DEEDI, 2010).

In Australia, regional locations feature many characteristics that logically link them with the establishment and growth of cleantech: these include the strong regional drivers for sustainability and the importance of regions in the national innovation agenda, as described above. The use of a regional approach also brings cleaner production and environmental gains almost by default: for example, regional-scale recovery, reuse and/or substitution of raw input materials with locally sourced alternatives will reduce transport emissions and encourage recycling (van Berkel, 2007). Furthermore, there is commercial merit in establishing local markets: Chapple & Hutson (2010) reported that innovative green businesses in California tend to be 'locally embedded'. That is, they are largely oriented to serve local markets for sustainable goods and services; and they typically rely on local networks to achieve innovation (Chapple and Hutson, 2010). In some cases, these networks can function beyond simple communication mechanisms, instead becoming 'clusters' that discuss,

lead, fund and monitor cleantech activities in a broader sense. This allows innovation can occur both 'incrementally' and 'radically' (AIC, 2010).

Successful cleantech clusters have a number of prerequisites:
- a critical mass of people and organisations to create leading edge knowledge transfer;
- the presence of people and organisations who set the standard for industry; and
- the existence of an extensive set of pilot/demonstration projects – experimentation to develop real-world improvements.

Often, these coalesce in geographically bounded areas – regions where like-minded individuals and organisations share similar a resource base, climate, markets, and drivers and barriers for business growth. International examples of successful, regionally-based clusters and networks are plentiful. These include:
- Eco-World Styria (a Greentech Cluster that has established the province of Styria as the location of choice for Austrian energy and environmental technology, employing 10,000 people – www.eco.at);
- the New England Clean Energy Council – 175 members of clean energy corporations, financial institutions, universities, industry associations and end-users, with clusters dedicated to innnovation, growth, education, adoption and policy (http://www.cleanenergycouncil.org/about/mission); and
- the Finnish, Stockholm & Copenhagen Cleantech Clusters, Cleantech Santiago, Cleantech Centre (Syracuse New York) and MaRS Toronto.

Australia is a developed and technological nation of strong economic standing, and one which has the ability to offer a stable operating environment. It is richly endowed with natural resources that are accommodated in diverse ecological habitats; and it also faces a number of key environmental challenges including those related to energy, water, waste and climate.   There are many regional areas that could host significant developments in the cleantech arena, thus exploiting the natural advantages that regions have for innovation and solving environmental challenges. Considering these points, there are remarkably few Cleantech clusters in Australia. Existing Cleantech groups include those in Sydney and Adelaide, which provide research services for investors, policy development and analysis, facilitation in industry clusters, and information dissemination (ACT 2010). A Clean Energy Innovation Centre has also recently been established in Newcastle, New South Wales' second largest city. However, no clusters have appeared in centres that are truly regional, rural or remote; and the absence of a Cleantech centre in Queensland – Australia's most decentralised state, and its economic and industrial powerhouse – is particularly notable.

Forming Cleantech CQ – a case study

Why Central Queensland?

Central Queensland (CQ) has a number of regional advantages and assets that could be harnessed through the development of a Cleantech hub in theregion. For example, the high demand for Cleantech in Central Queensland results from:

- a number of major heavy industries operating in the region, with ongoing growth expected in resource extraction and minerals processing. All of these are under pressure to perform sustainably whilst maintaining profits;
- the high carbon-intensity of the region: a recent report predicted that Fitzroy Division would bear costs twice as high as any other location state-wide if carbon trading is introduced (KPMG 2009);
- the region is directly upstream of the Great Barrier Reef and faces increasing pressure to optimise the water quality flowing through the Fitzroy catchment an onto the GBR lagoon;
- small businesses are on the lookout for ways to reduce operating costs, particularly given the extreme competition from the mining industry; and
- since CQ straddles Queensland, Cleantech development in the regional transport sector is particularly valuable because of the high costs of transporting goods throughout the region, and into the region from other areas.

The regional pressures of climate change is a further driver: desktop predictions for Rockhampton already point to rising temperatures, more hot days, rainfall decline, seasonal delays and more extreme weather events. The impact of these changes will be felt across all business sectors, as well as the local community and natural environment (Kinnear *et al.* 2009).

Central Queensland also houses numerous key physical resources and characteristics that are relevant to developing a Cleantech industry. For example, some of the assets already identified by stakeholders include:

- land availability, including rehabilitated industrial lands and lands strategically located near ports and other transport infrastructure (where these can be released for development);
- bountiful water supply behind the Rockhampton Barrage and other storages;
- existing power generators (e.g., Stanwell Corporation, NRG Power) and well developed electricity networks; including the Stanwell Energy Park complex; and
- natural energy resources including solar suitability and nearby gas fields, combined with several waste products suitable for adaptation into biofuels or other industrial inputs (e.g., methane, heated industrial effluent water (for algal fuel production), wood products, fly ash, carbon dioxide, meatworks biomass).

These assets can be developed through intelligent (and potentially shared) use of the existing transport (rail and ports), mining and agricultural infrastructure. This potentially represents a value-add scenario that would see new and innovative businesses work with existing industry to make

them more sustainable and profitable. The key factors that help in deciding where to site new plants include availability of transportation; labour; space for future expansion; proximity to markets; costs of land & construction, facilities for import and export (Clement, 2000), and CQ is well endowed with these.

The existing skill and trade sets in the CQ region (e.g., engineering and environmental professionals from the coal, gas, mining, minerals processing, agricultural and manufacturing sectors) are closely compatible with the burgeoning Cleantech sector. Technicians and trades workers comprise the largest occupation set in the Rockhampton region – some 17% of the labour force (OESR, 2010). CQ is home to a range of skilled professionals operating in key local business, industry and consultancies, such as the power, meat processing, aluminium, coal mining, coal power stations, transport, salt, cement, LNG, magnesium and agricultural sectors. This bank of expertise can also be used to help translate pilot work to other regions.

Central Queensland has a diverse economy built on a wide array of sectors including mining, agriculture, manufacturing and processing (e.g., two significant meat processing plants), education, tourism and a regional transport hub: each of these can contribute to the development of a Cleantech industry. Indeed, one of the key strengths of Central Queensland as a Cleantech destination is because the region is not solely linked to the resources sector: CQ also has a range of secondary industries (tourism, transport, SMEs). Thus, CQ Cleantech will not be vulnerable to downturns in the resources sector: in fact, Cleantech will be an important part of maintaining profitability during these periods.

Furthermore, there are many economic incentives to operate Cleantech in Central Queensland: the region is inexpensive for start-up in terms of land costs and rent when compared with the space-constrained South-East Queensland and elsewhere internationally. In addition, there is a chance to leverage the wealth of the mining industry in the region for Cleantech development: to use the economic stimulus of coal extraction as a window to develop Cleantech sectors that can continue operating in the region well into the future (as a legacy industry).

Central Queensland also features a regional university (CQUniversity Australia) that has a mission to become more closely engaged with regional industry and business. CQUni's Institute for Resource Industries and Sustainability (IRIS) hosts more than 160 academic and technical staff and students who work in multidisciplinary teams to meet the research needs of local industries and the community. Within IRIS, there are good opportunities for growing Cleantech services to industries in the areas of manufacturing; asset management; ground transportation; bio-fuels and energy efficiency; sustainability and environmental management; industrial safety and social and economic research. The University has the ability to be a portal for local industry and SME to access low-cost, intellectual inputs, for example, via sponsoring of research higher degree students. The University may also be able to assist in independently verifying new technologies and managing the commercialisation aspects of regional Cleantech.

Local government has shown their support for ongoing development of this region through the recent release of '*Rockhampton Region Towards 2050… a framework for our future*' (RRC, 2010) and the Gladstone regional environmental vision. In addition, the Central Queensland Local Government Association, which represents the five local governments of the CQ region, already has an excellent reputation for being proactive in the area of waste management. At the state government level, there are already plans to invest further in Central Queensland, under the newly announced Regionalisation Plan for Fitzroy Region. This plan recognises the mix of mature and emerging industries in the region, and the natural appeal for manufacturing, engineering and the environment sectors (Queensland Government, 2010).

Finally, Central Queensland already has a number of initiatives, and industries and business already developing and/or using Cleantech. Key examples including the CQ Carbon Network; recent discussions on building an Intermodal Transport and Logistic Hub; the Regional Integrated Recycling Program, ClimateSmart clusters in business and retail; the Innovative Regions Centre of Enterprise in Manufacturing, and the research higher degree program at CQUniversity. There continues to be strong regional interest in the issues of climate change, carbon, and environmental sustainability and how they apply locally.

Aligning with regional planning

A Cleantech CQ hub would achieve a natural fit with a number of existing regional planning mechanisms and agendas. These include the *Towards 2050* framework of Rockhampton Regional Council, the Strategic Environmental Vision that is currently being developed by Gladstone Regional Council, the Preferred Futures initiative on the Central highlands (Clermont), and the Regional Innovation Accord that is being sought amongst a number of leading regional stakeholders. Project work will align particularly closely with two key goals in the wider *Central Queensland Strategy for Sustainability*, namely:

- develop a diversity of economically viable industries that support vibrant regional communities and use the region's natural resources in an ecologically sustainable way; and
- Integrate natural resource and environmental management, economic development and community development within the region (FBA, 2006).

It also addresses a number of the CQSS2 subsidiary themes of responding to regional climate change; issues regarding carbon emissions, business resilience and competitiveness; social targets such as community awareness and adoption; and regional coordination.

Implementing CleantechCQ

Regional framework and targets

A structured regional framework will be necessary to implement a Cleantech programme across the central Queensland region. This begins with clarifying:

- the context: gathering relevant regional information and exploring the fit with existing regional planning instruments (as above); and
- the vision: a clear statement of purpose that is backed by a list of regional targets.

The latter could include the use of metrics such as energy consumption or carbon emissions per capita, uptake rates of new technologies, growth in patent and commercialisation activities – each of these are clearly with Cleantech outcomes. However, it will be equally important to measure progress towards more generic goals of regional development, such as the level of engagement with (and participation by) regional businesses, the attraction of research & development funds, behavioural and attitudinal change across regional communities, business confidence, and perhaps those some of the less-tangible objectives tied to liveability and the environment.

Regional engagement with SME and industry

It is SMEs and industry who will realise CleantechCQ for the region. Engagement and participation by a wide-cross section of businesses is essential.   Recently, van Berkel (2007) listed a range of motivating factors that encourage Australian small firms to embrace cleaner production: these included the desire for business growth, to reduce materials and utilities costs, bending to community pressure and/or market demand, overcoming capacity constraints and achieving occupational health and safety and legislative compliance.   Many of these issues become more acute when operating in a regional context. For example, regional businesses in Central Queensland face both higher operating costs (transport premiums, salary competition for skilled labour from the mining industry) and a low customer base (due to small regional populations and markets). However, where a regional culture of Cleantech can be established, then community pressure and (local) market demand would also be strengthened, and skills shortages may be addressed as a critical mass of employees are attracted into the region.   The sizeable existing knowledge base around Cleantech and ecosystem services in Central Queensland is also likely to help trigger the participation of small business in collective learning and innovatoin, particularly where different technical areas of specialty be can overlapped (Cantner et al., 2010). For example, this could be the case with waste management and renewable energy production, via regional waste-to-energy initiatives.

Communication and regional support activities

The tight networks of individuals and organisations that exist in regional areas represent an important way to drive innovation, by facilitating rapid information transfer (Cantner et al., 2010). Regional innovation systems (networks) typically involve the participation of universities, government, non-profit groups, utilities, and residents and local industry players including manufacturers, financiers, users and regulators all converging on a regional growth agenda (Chapple & Hutson 2010; Pool 2010). Universities in particular have a lead role in not only producing R&D knowledge, but also disseminating it, promoting links, providing regional leadership and investing in innovation infrastructure (Uyarra, 2010). A key support role in the region will also be to ensure regional players have the ability to communicate effectively. CQ covers a vast area, and this could be

a barrier, since social networks tend to work better where people, ideas and resources are in close proximity with each other. However, the knowledge base of CQ is already decentralised across the hubs of Rockhampton, Mackay, Gladstone and Emerald, and CQUniversity and other organisations (e.g., CQ Local Government Association, Qld Resources Council) can be used to initiate whole-of-region conversations.

Innovation is dependent on new ideas flowing through the region, and this knowledge should come from both internal and external sources (Molina-Morales and Martinex-Fernandex, 2010). For this reasons, supporting local businesses to cluster for Cleantech information exchange is particularly important. For example, Sternberg (2000, p. 394) noted that 'regional networks improve the access of small businesses to regional experience and knowledge pools, but their true strength lies in their ability to access global networks'. In CQ, an example of this may be for the large international organisations (e.g., global mining giants, CQUniversity) to partner with regional SMEs in their supply chain. This will help ensure that novel ideas flow into the region via the 'global pipelines of knowledge' (Cantner et al., 2010), and expose smaller regional businesses and allow them to participate in the knowledge economy (Potts, 2010).

Other examples of support activities which can be used to progress Cleantech in central Queensland include:

- introducing an online presence for cleantechnology, which would incorporate information on available funding programs, commercialisation hints, and expressions of interest for new projects or to join/collaborate on existing projects. Later iterations could also include a regional capabilities register, and a directory of regional inputs and outputs that would facilitate waste sharing for reuse across different sectors;
- establishing a physical 'innovation space' that could serve as a meeting point, an education and information hub, and a showcase for new technologies of regional origin;
- facilitating Cleantech clusters amongst regional industries or regional supply chains to stimulate collaboration and innovation; and
- establishing a suite of tertiary and/or dual sector (vocational education) programs in Cleantech, which would produce graduates with a mix of practical skills in engineering, sustainability/environmental science, community engagement, regional development, project management, and commercialisation of intellectual property.

Outcomes & benefits – moving 'beyond carbon'

A CleantechCQ hub will require the marriage of sustainability and innovation activities to address economic, environmental and social issues in regional areas.   More specifically, a successful a regional implementation strategy for Cleantech could:

- provide a platform for a critical mass of small, medium and large industries to collaborate around central themes with close access to relevant expertise and research capabilities;

- capitalise on local interest and expertise in climate, carbon, cleantech and the environment to promote innovation and entrepreneurship;
- contribute to regional planning for sustainability through intensive and coordinated information sharing, capture and dissemination;
- allow stakeholders move beyond the carbon debate – to embrace and address a broader suite of environmental issues in order to realise economic opportunities and build regional capacity, without waiting for the economic trigger that an emissions trading scheme would provide; and
- attract significant national and international interest and investment through the appropriate capture and dissemination of the strategic opportunities held by the region

Cleantech can be used as a niche marketing tool to attract further residents and industry, to improve liveability and resolve environmental issues, to boost local labour markets (by attracting critical mass that alleviates existing skill shortages) and will further diversify the region economy – thus making it more robust. Individual businesses and industry can benefit from cross-fertilisation and collaboration, and a culture of Cleantech being developed for profitability (e.g., reduced fees for water, energy and waste disposal).   Cleantech can also be used as an exciting career path to attract youth back to regions: this is particularly important in central Queensland, where the loss of youth from the community represents a major challenge, a does the shortage of skilled labour (Miles & Kinear 2008). Creating a regional culture of Cleantech will also help indirectly in achieving resource condition targets for water quality and biodiversity, addressing climate change (both adaptation and mitigation) and ameliorate the post-mine and cumulative effects of development in the region. This will occur by shifting the regional economy to become services- and information-based, thus reducing natural resource consumption (Polimeni et al. 2008).

 At the state level, the initiative can establish CQ as a portal and pilot region that delivers a return on investment and assists with the regionalisation agenda.   At the national level, combining a sustainability and innovation together will create a 'natural advantage' for regional areas (Potts, 2010). This will be characterized by benefits including cleaner production, modernisation, regional identity, the linking of environmental and economic planning, strong and innovative businesses, and a reduced regional footprint for pollution, waste, carbon and energy (Potts, 2010, p. 715). Finally, there is a ability for the characteristics of regional areas to be used to influence the overall innovation performance of Australia (Isaksen and Onsager, 2010).

Challenges and lessons for other regions

Eco-economies can take off in some places, but not others. Existing globally significant cleantech sites include Denmark (wind power), Jiangsu Province and Baoding in China (solar and biomass energy facilities), India and North Africa (solar power), and Abu Dhabi (a green/renewable energy consortium). Clearly, not every region is suited to Cleantech, because specific resource endowment, social capital and innovation are each important in providing energy for regional eco-economies to

grow (Marsden 2010). Clement (2000) has also suggested that regions can assess their suitability for different kinds of environmental and regional co-development by examining their spatial, sectoral and thematic attributes. This will include considering geographical and social boundaries and the natural assets contained within them, business and industry profiles, and fitting these with different types of R&D projects, communication and engagement activities and funding and investment initiatives.

A particular challenge for CleantechCQ (and any other regions with interests in cleantech development) will be to strike a balance between private and public investment in regional activities. For example, in China, the growth in cleantech industries has largely resulted from the Chinese policy shift towards clean energy technology, renewable energy targets and national fuel efficiency standards; together with more stringent enforcement of existing laws in pollution abatement, resource conservation and ecological management (Mead 2011). In high-sectors (such as the development of new energy efficiency technologies), there appears to be a case for high levels of government spending to both 'push' (i.e., to fund R&D) and 'pull' (i.e., to purchase new products and services) innovation through the marketplace (Prins et al., 2010). However, there is also clearly a place for new private investment to be attracted into regional areas, perhaps for lower-risk applications such as manufacturing or near-to-market commercialisation.

Other challenges facing regional areas intending to developed Australian cleantech include:

- how to best capitalise on Cleantech in the area of niche marketing, and how to develop Cleantech knowledge and skilling as an export product;

- scalability: is there room to cooperate with other regions (agglomeration) for co-benefits?

- how can regional communication and engagement strategies exploit existing 'communities of interest' to achieve high participation rates in wider sustainability initiatives?

- planning for Cleantech growth: social services shortages and soft infrastructure problems already plague the Bowen Basin's coal centres – can this be avoided as the cleantech industry develops and attracts a higher population base to regional areas?

- cultural issues: what role is there for Cleantech to help to restore social justice in the region, for example, through utilising local Indigenous knowledge? Since ecosytem services are intricately linked with understanding and managing local natural assets, there could be pathways for better Indigenous development through involvement in cleantech.

Future directions for policy and research

There are a number of potential new policy directions for encouraging the growth of both cleantech and innovation in regional settings. Chapple & Hutson (2010) have commented that stimulating the 'green economy' requires a focus on regulation and standards, business incentives (e.g. subsidies), market building and networking.   Potts (2010) also suggested supporting environmental education, developing local accreditation schemes, and integrating economic development, employment and

sustainability strategies. Benchmarking and profiling exercises are also perennial favourites in regional development circles, but these should focus on researching the strengths of regional inputs to more clearly identify the commercial cleantech opportunities regardless of current political drivers, and on identifying those technologies and options that are still 'over the horizon' (Huggins, 2009).

Regional policies have an important role in shaping and enabling innovation, particularly micro-economic policies that foster business entrepreneurship (Mukkala, 2010). Unfortunately, as Chapple & Hutson (2010) have commented, innovation is elusive – it remains very difficult to measure its progress. For example, an innovation chain may include R&D work to design and trial cleantech devices, manufacturers to produce them, retailers to commercialise them, and community or SME engagement to achieve implementation in the market.   Thus, capturing the innovation success of a region can be difficult, as is evaluating the effects of regional policy changes.

According to Mukkala (2010), the success of regional areas depends on a favourable business environment, strong networks and innovative behaviour. This paper has already demonstrated that Central Queensland offers a good operating environment for Cleantech. Innovation to support cleantech, however, needs to be facilitated through engagement programs with SMEs and other stakeholders in order to build on the existing human capital. For example, government, regional development groups and other agencies must provide for more effective networking opportunities to enable innovation, investment attraction and cultural change. Since the time it takes for new innovations to diffuse through communities is largely dependent on social processes (Miller, 2009), and since social learning appears to be most effective at the regional level (Courvisanos, 2009), understanding how to use regional social networks to understand, create, strengthen and exploit existing relationships, spillovers and collaborations likely to be very useful in driving innovation in the future.

Conclusion

A CleantechCQ hub is one way that regional Australia can simultaneously address goals of sustainability, productivity, innovation, regional competitiveness and strengthened communities. The development of a regionally-based Cleantech industry represents considerable current value and future potential value to government, industry, business, researchers and the community of Central Queensland. CleantechCQ can provide a pathway to consider, scope and implement much bold that seek to engage SMEs, industry and the community in a regional effort to reconfigure the use of regional resources, so that natural and human assets are used with the express purpose of achieving regional development. This begins by recognising the ways in which regional areas are different from urban ones, and then harnessing these qualities: for example, by exploiting strong social networks, by bringing regional businesses even closer to environmental agendas, and by using regions as of drivers of innovation.

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