Townsville

Townsville CBD: Smart Infrastructure and Sustainable Energy Framework

DECEMBER 2013 - UPDATE

city solar
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TOWNSVILLE CITY COUNCIL

Disclosure Statement

The purpose of this report is to provide an update on the *Townsville CBD: Smart Infrastructure and Sustainable Energy Framework* (created December 2012), which is an integrated framework representing key and innovative sustainability and resilient city initiatives linking energy and disaster management and recovery and is a *"City Building Model for Townsville"* in support of implementing the CBD Master Plan and associated Sustainable City Framework

The information herein is sourced and extracted from Townsville City Council Smart City Sustainable Future Committee Confidential Report (5 December 2013) which excludes the confidential information of which remains undisclosed in accordance with Sections 174 and 200 (5) of the *Local Government Act 2009* and remains confidential unless council decides otherwise by resolution.

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Attachments

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3. Citysolar Annual Report 2011-12
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Executive Summary

This progress report aims to collate and provide an update to Council and key stakeholders on the recent directions and activities being undertaken to support and implement the *Townsville CBD Smart Infrastructure and Sustainable Energy Framework* (Attachment 1).

It's objective is to also foster some clarity around a complex system based approach to up taking sustainability in our CBD to support city building and sustainable development – Townsville Smart City Solar City (refer to Figure 1 – a Vision of Achievements – 2008-2013). The framework represents a key and innovative city building and resilient city initiative linking energy and disaster management and recovery. The update provides insight into current directions with support from Council for synergistic directions in innovative financing measures. Many long standing and new partners or sustainability collaborators in energy efficiency, demand management, and renewables have contributed.

This framework builds on council's vision of the CBD becoming Townsville's centre point for a Sustainable Urban Tropical Capital (refer Figure 2, 3 and 4) and specifically:

1. Articulates the framework building activities that have been completed and those that are currently underway in order to achieve the key benchmark outcomes or goals of:

    a. Leading implementation of the first part of Stage One of a CBD District Cooling Master Plan (incorporating Thermal Storage) and adaptive framework approach for achieving Australia's first multi-stakeholder District Cooling project ;

    b. Establishing an interconnected CBD wide communications which supports green buildings and energy management; and

    c. Building a strong foundation for developing sustainable energy and smart local infrastructure in the CBD via a liveable and connected community that integrates innovative financing options.

2. Provides linkages and background of each of the 11 core sub-projects contributing to the development of the framework;

3. Contextualises Australian Government Local Government Infrastructure financing recommendations supporting the need for such a framework to achieve innovative practices and transformation against general status quo and/or transactional approaches, versus systems based transformative approaches sort to achieve active city building in sustainability and resilience;

4. Elaborates the management processes required to ensure actionable and emergent opportunities to progress delivering of this project with Transparency and Accountability, whilst maximising opportunity for innovation and enhancing Value for Money , along with Reducing Risk to both council and the public.

5. Identify an administrative and project delivery method to facilitate an innovative and collaborative approach in bringing projects to the CBD that are proven to provide energy and cost savings.

6. Articulate current and supporting Case Studies and achievements for each Framework sub-project via energy management initiatives undertaken by Council or city-wide partners and its project that underpin the project implementation

7. Provide some knowledge and insight on the future direction of the CBD Smart Infrastructure and Sustainable Energy Framework in building resilience for future events that can impact council and the community.

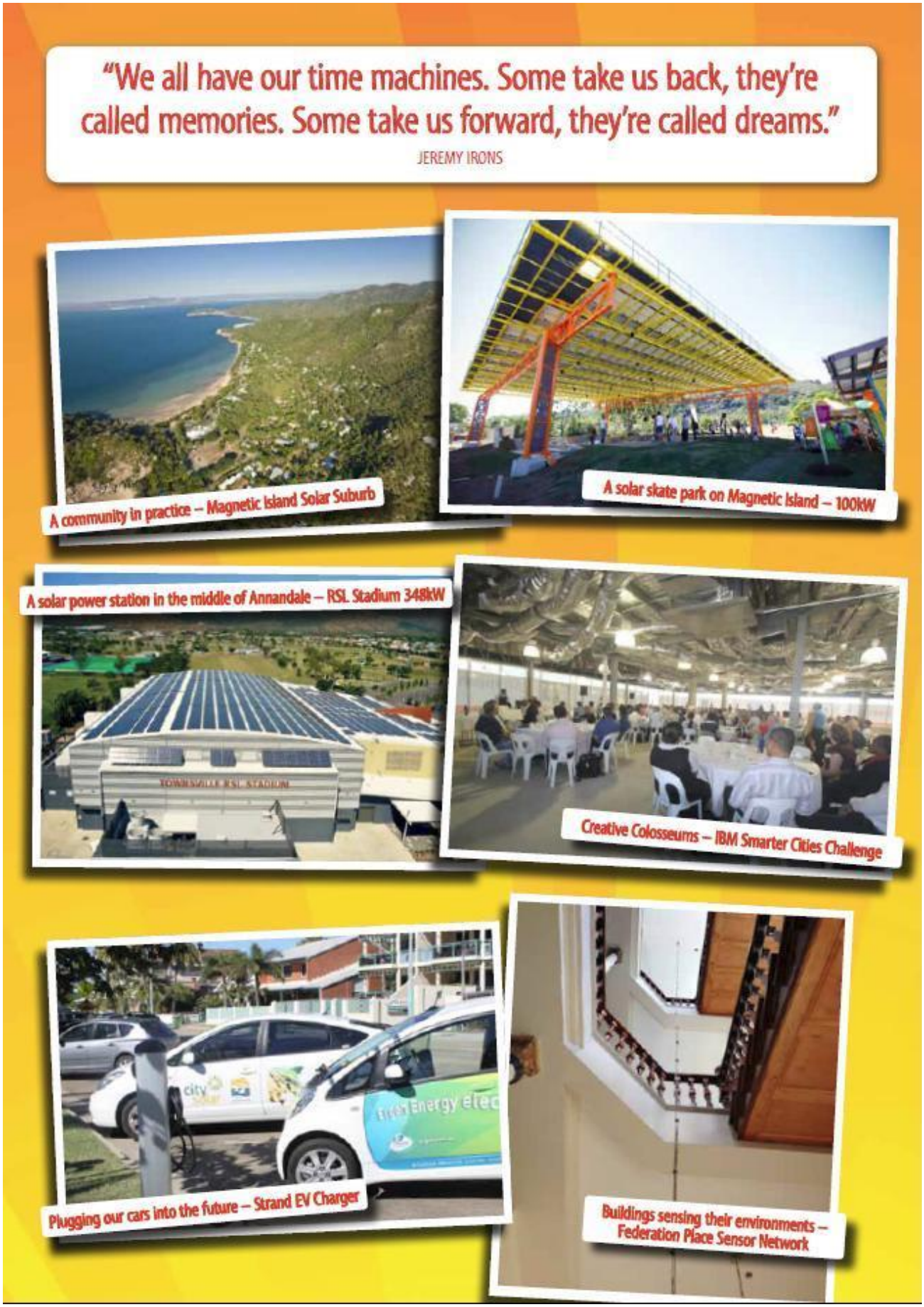

Figure 1: Community Achievements Townsville Queensland Solar City

The CBD Smart Infrastructure and Sustainable Energy Framework Concept

The *Townsville CBD Smart Infrastructure and Sustainable Energy Framework* is a "City Building Model for Townsville" created from both demonstrated practices, research and knowledge generated by Townsville City Council (TCC) working in partnership with Ergon Energy and various business and community based collaborations, including key projects of:

1. Townsville Queensland Solar City Project;
2. Townsville Network Demand Management (Commercial) Pilot;
3. CBD District Cooling Feasibility Study;
4. Townsville an Energy Sense Community; and
5. CBD Master Plan – Sustainable City Framework and District Cooling – City Building Project (Figure 4)

The sustainability framework concept is based on leveraging opportunities to create and build implementable projects and processes to achieve lowest cost, greatest gain - energy efficiency in Central Business District (CBD) of Townsville including lowered rents and national/international recognition.

In order to conceptualise the key high level concepts being embodied in the idea of Townsville as "Sustainable Urban Tropical Capital " (CBD Master Plan) it might help to take a leaf out of nature and learn about the other nature based 'Sustainable Cities' that surround and are embedded in some cases in our urban environments. These natural "cities" are ecological systems with links and relationships – understood as being powered by the sun, using only the resources they need, building their structures to fit their daily functions, recycling everything that that use, rewarding the cooperation and collaboration within their ecological communities and all use and using their local expertise (Janine Benyus on Biomimicry).

The natural "sustainable cities" neighbouring on part of our urban environments of Townsville include:

- Great Barrier Reef (Middle Reef);
- Wetlands (Greater Town Common);
- Rainforest (Paluma Wet Tropics);
- Tropical Savannas (surround hills, woodlands and grasslands ecosystems)

Image 1: Middle Reef (fringing coral reef)

Image 2: Townsville Sustainable City?

The CBD Smart Infrastructure and Sustainable Energy Framework will support and assist this vision by:

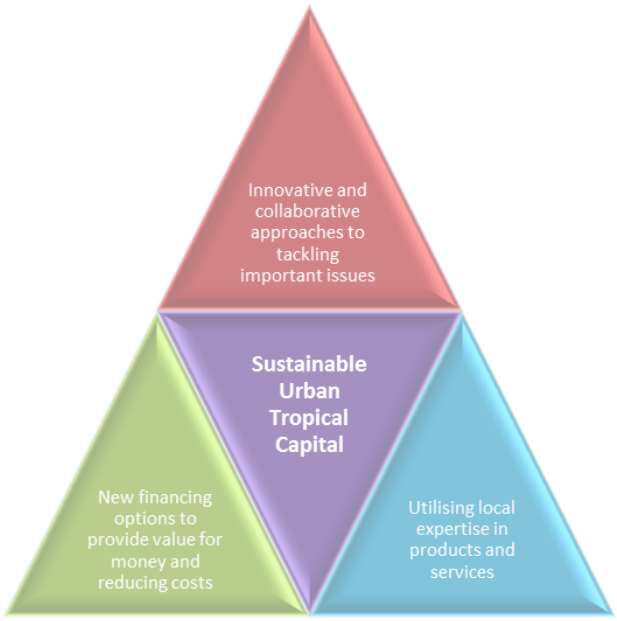

Figure 2: Sustainable Urban Tropical Capital

- Innovative and collaborative approaches to tackling the important issues of rising energy and infrastructure costs, energy security and resilience and improving commerce and liveability in the future of the Townsville CBD;

- Models for new financing options that provide value for money whilst reducing costs to council and the community;

- Ways to utilise local expertise in products and services in delivering energy efficiency and demand management initiatives to benefit the community.

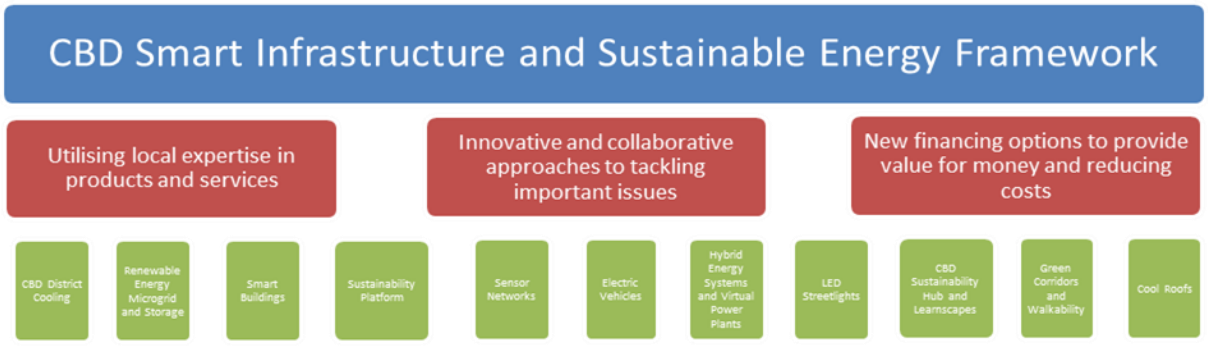

Figure 3: CBD Smart Infrastructure and Sustainable Energy Framework

The SISE framework draws together key challenges and opportunities of urban development and infrastructure management in cities including creating markets for sustainability, managing assets and renewals; bundling services and functions that achieve economies of scale (Attachment 2 **-** Ernst & Young – June 2012).

The Townsville CBD: Smart Infrastructure and Sustainable Energy Framework will deliver a procurement model underpinned by the key principles of:

1. Value for Money;
2. Transparency;
3. Accountability

The SISE Framework demonstrates 11 key sub-projects for the CBD of Townsville, each of which are designed (and trialled) to deliver an energy reduction and consequent cost reduction (compared to business as usual) whilst improving inner city living and commerce in the CBD in support of CBD Master Plan – Sustainability Framework and other City Building projects (Figure 4 below). These sub-projects have a capacity for integration to form a CBD wide (and eventually City-wide) system of interrelating and interacting projects that deliver compounding efficiencies and operational cost reduction when implemented together as a whole system.

The CBD Smart Infrastructure and Sustainable Energy Framework sub-projects include:

Sub-project A:	CBD District Cooling (Thermal Storage);
Sub-project B:	Renewable Energy Micro-grid and Storage (and Solar Farm);
Sub-project C:	Smarter Buildings and Analytics trials;
Sub-project D:	Sustainability Platform;
Sub-project E:	Sensor Networks;
Subproject F:	Electric Vehicle Infrastructure;
Sub-Project G:	Hybrid Energy Systems and Virtual Power Plants;
Sub- project H:	LED Street Lights;
Sub-project I:	City Sustainability Hub and Learnscapes (Visualisation);
Sub-project J:	Green Corridors and Walkability Project;
Sub-project K:	Cool Roofs.

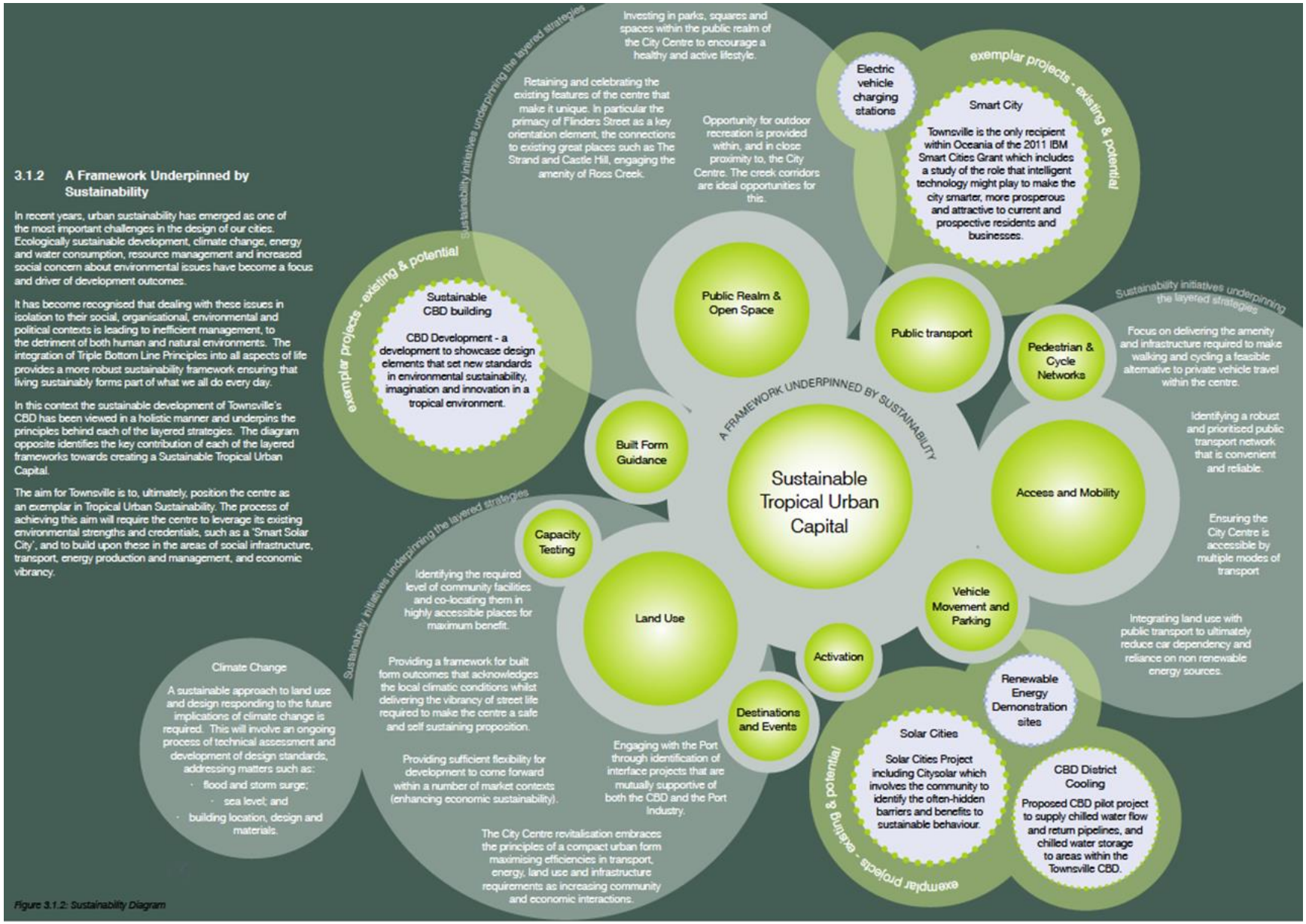

Figure 4: CBD Sustainability Framework (Source: Townsville CBD Master Plan – June 2011)

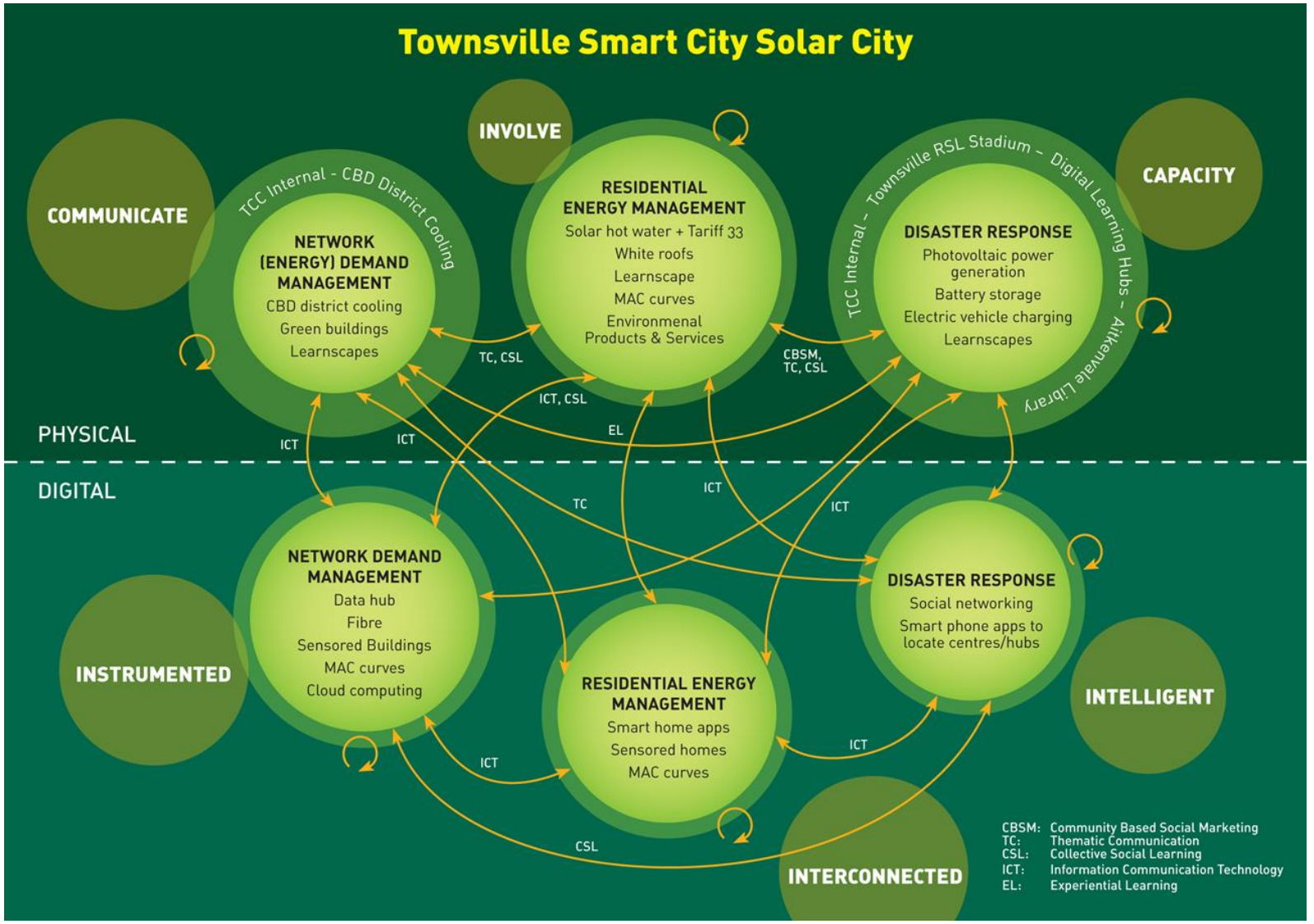

Figure 5: Townsville Smart City Solar City Framework

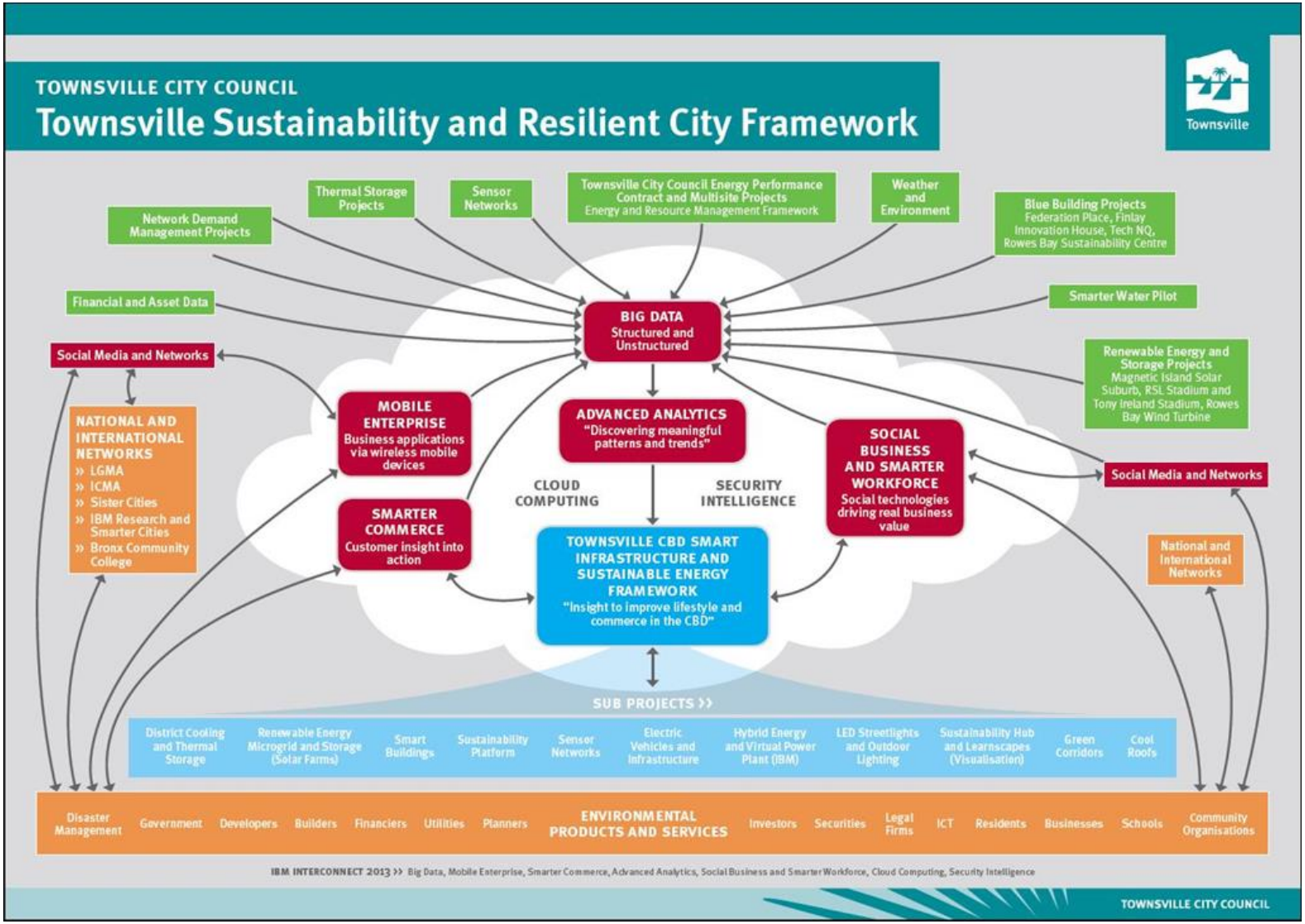

Figure 6. Integrated Smart City Infrastructure and Communications Pathway for Building city-wide Energy Management and Resilient, Sustainable City (includes Big Data/Analytics; Mobile Enterprise; Smarter Commerce; Social Business; Cloud Computing; and Security Intelligence combined with Sub-Projects

Priority Sub-Projects

The Priority Projects currently progressing are due to either emergent funding or research opportunities to progress Smart City Solar City – resilient and sustainable city and represent key current actions and project delivery including:

- Exploring opportunities for further energy efficiency and sustainability gains through the capture and analysis of consumption analytics, with a preliminary focus on "CBD Smarter Buildings", leveraging into an integrated pilot or research based "CBD District Cooling and Thermal Energy Storage" project for Townsville's CBD (See Case study). This multifaceted project has includes linkages with the Townsville Smarter Water Pilot as well as local initiatives in areas of big data and broadband (MiTownsville and Australian Urban Research and Infrastructure Network (AURIN)) - reference to Council Report – Confidential dated 7 Dune 2012 – Townsville Smart City Solar City;

- Evaluation and some implementation of LED Street lighting and outdoor lighting including:

    i. LED Roadway (Street Lighting) Project – Funding submission to former Australian Government Clean Energy Futures Fund – Community Energy Efficiency Program Round 1 (not funded);

    ii. Outdoor Lighting Project implementation as part of Townsville City Council Energy Transformation Townsville Project (part funded through former Australian Government Clean Energy Futures Fund – Community Energy Efficiency Program Round 1);

    iii. "Collaborative research trial of Adaptive LED Street lighting trial – funding submission to former Australian Government Clean Energy Futures – Clean Technology Fund;

    iv. Current installations of LED solar lighting at Rossiter Park and Boat Ramps, University Drive (TCC Infrastructure Services), and Rowes Bay Sustainability Centre;

    v. Installation of best practice LED street and park lighting in the Jezzine Barracks redevelopment.

    vi. "Participation in global research and innovative financing and/or commercialization projects.

- Ongoing investigation into Renewable Energy Microgrid and Storage and combined Solar Farm (up to 100MW at TCC council land at Woodstock/Calcium or Ross River Catchment) including:

    i. *Up to 100MW Solar Thermal Project at TCC site at Woodstock/Calcium (2013);

    ii. *30MW Solar Farm (2012);

    iii. *500MW Solar Farm at TCC site at Woodstock/Calcium (2012);

    iv. *100MW Solar Farm at TCC site at Woodstock/Calcium - CBD Taskforce and Integrated Sustainability Framework for CBD and ECO-City Action Plan (2012);

    v. *30MW Solar Thermal Project at TCC site at Woodstock/Calcium (2010);

    vi. *Townsville NDM Pilot site investigation for Solar Thermal (2008/09)

*NOTE: Commercial in Confidence details not included

- Networked storage (batteries, district cooling and thermal storage) and electric vehicle infrastructure including:

    i. Tony Ireland Stadium Network integrated Battery Storage (500kWh) and Solar Array (40kW)

    ii. Ergon Energy Electric Vehicle (EV) Trial (including Strand EV Charger – Council Hosted, and three other public EV chargers)

    iii. CBD District Cooling (CBD Master Plan – Key City Building Project No. 7) – refer Case Study and below.

- Thermal Storage Project at Townsville City Council Walker Street Buildings and local precinct – former Australian Government Clean Energy Futures Fund – Community Energy Efficiency Program Round 2 – awaiting notification and arrangements in new Australian Government). This project can initiative the wider CBD District Cooling vision.

Framework Background

Over the past seven years, Townsville has – through the action-based, learn by doing leadership of Council in partnership with a diverse range of industry and community stakeholders – embarked on a strategic pathway to energy sustainability and city resilience, disaster recovery, the framework for which was originally laid out in the 2006 *Citysolar Demand Side Management Report* (**Attachment 3**).

The overriding objectives of this strategic orientation are to achieve:

- A reduction in total energy consumed (per capita);
- A reduction in peak energy consumed; and
- An increased proportion of energy needs met by sustainable generation, thereby reducing the city's overall carbon footprint.

This strategic pathway derived from Citysolar Community Capacity Building has involved a number of key pilot and pre-feasibility projects aimed at road-testing strategies and plans to:

- Promote energy efficiency in household energy consumption behaviors through extensive community awareness raising and capacity building (**Attachment 4-** Citysolar Annual Report 11-12);
- Reform the baseline of energy generating technologies through the progressive adoption of solar technologies in both residential and commercial contexts (**Attachment 5** *Solar Cities Report*);
- Practice and collaborate on Townsville Network Demand Management (NDM) pilot initiatives; Smart Grid Smart City consortium EOI; and evolution to Townsville Energy Sense Community (refer Figure 7 below);
- Evaluate opportunities for the adoption of energy saving technologies.

These various projects have contributed to the development of the Townsville *Smart Infrastructure and Sustainable Energy Framework* (SISE), which lays out a project vision for the development and scaling up of these initiatives.

Townsville City Council (TCC) has experienced considerable success in gaining funding support for previous activities associated through the TCC Citysolar Program and city wide Townsville Solar Cities Project. It has also been successful in gaining funding for allied initiatives in areas of leveraging fast broadband (NBN) and big data analytics (*TCC MiTownsville*).

In part on the basis of the successes of these projects, Council has actively pursued funding and collaboration opportunities to enable the implementation of the SISE sub-projects. [Council Report dated 3 April 2013] including Thermal Storage.

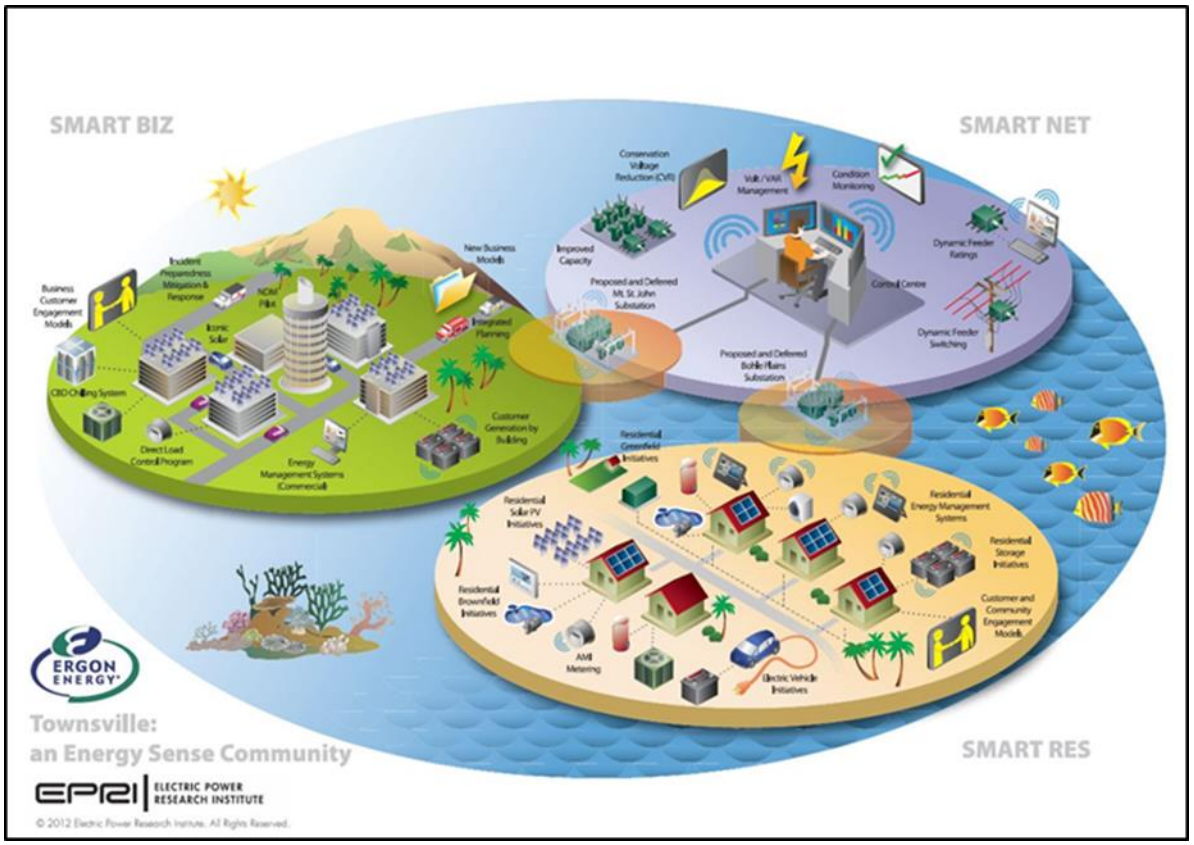

Figure 7: Townsville an Energy Sense Community (Source Ergon Energy 2012)

Government Context

The CBD Smart Infrastructure and Sustainable Energy framework was developed and submitted to the former Local Government Policy Section (of then Department of Regional Australia, Local Government Arts and Sport) as a response to the former Australian Government commissioned Ernst and Young Report (2012) 'Strong Foundations for Sustainable Local Infrastructure'. The purpose of the Ernst and Young Report (2012) was to set out recommendations for future local infrastructure needs which included 'improving council's access to finance'. The framework is also used as an important implementation tool for consideration when developing, upgrading and retrofitting both public and private infrastructure in the CBD and wider city.

The SISE Framework is structured with particular focus on the recommendations to:

- 'Create value through the procurement process, where local governments could explore procurement models involving private financing and/or risk allocation'.

  The ability for local governments to accelerate new investment in sustainable infrastructure is constrained by the limited access to capital. For this reason, council's should consider achieving procurement efficiencies through alternative delivery models including those that involve the transfer of some project elements and risks to private sector partners'.

  Currently there is little private investor involvement in local government infrastructure as there are usually insufficient economies of scale and lack of commercial return. By demonstrating trial projects that aim to develop replicable markets and pipeline future projects, it was recommended that it is the Australian Government's role to support the generation of private finance in public infrastructure.

  - Ernst and Young 2012

This has focused on identifying possible avenues for non-government funding or project support, which can deliver increased long-term public and commercial value and reduce costs whilst mitigating public risk. A *Commercialisation Pathways Report* (Transpac 2013 - Commercial in Confidence**)** outlining a structured, strategic approach to this focus of activity was prepared to assist in this activity.

The need to identify and evaluate potential sources of innovative funding solutions has become increasingly urgent and widely recognized as critical to the future development of critical city-building resiliency initiatives.

Ernst and Young 2012 concludes that the main challenge for local government going forward is "how to meet its infrastructure obligations without relying solely upon increased funding from the states, territories and Australian Government" (p. 1). It goes on to recommend that "councils need to look towards innovative funding, procurement and financing solutions without which their ability to accelerate new investment in infrastructure will continue to be limited" (p. 5).

In particular the report observes local government can give greater consideration to methods of procurement outside the traditional approach, and to investigate the full spectrum of infrastructure procurement options available. Such alternative delivery models particularly include "those that involve a degree of project and financing risk transfer to private sector partners" (p. 7).

These observations have recently been reinforced by a presentation made by the Chairman of the Business Council of Australia.

In this context, it can also be noted that significant work is being undertaken globally to identify innovative ways to source capital through initiatives such as social impact bonds (SIBs). SIBs are

ways in which the interests of not-for-profit organisations, private investors and governments can be aligned (**Attachment 7 -** Rockefeller Foundation 2012 A new tool for scaling impact: how social impact bounds can mobilize private capital to advance social good – **Appendix 7**). This report concludes that: "The Social Impact Bond is a promising new product within the impact investing sector, with potential to become a multi-billion dollar source of growth capital to fund effective social programs" (p. 5).

Considering the recommendations of *Ernst and Young 2012* along with others, the *Commercialisation Pathways Report 2013* identifies key funding principles and a process to drive the innovative funding strategy forward. The funding principles will underpin a business case for what can be generally termed 'risk-mitigated bankable transactions', which delivers commercially viable (high value and low cost) outcomes for stakeholders, while ensuring the realization of measurable public value and risk-avoidance for the public. The principles also focus on ensuring that the SISE Framework is 'optimised as a whole'. Collaborative participation will contribute to the entirety of the vision, rather than just those elements that are immediately "bankable".

Administration and Management Processes

This project is administrated and activated by ISS through Council' Project Management Framework and due to requirements for combination of innovation and risk reduction will be delivered and managed in with maximum transparency and accountability integration of each project, research element or outcome process including the following:

- Energy Transformation Townsville - TCC project– Australian Government funded (internal and external components of both smart city technology integration);
- IBM Smarter Cities Challenge and inkind support from IBM Research Lab (to date);
- Townsville Smart Water Pilot (IBM, Taggle and TCC) and scale project options (subject to project report and business case for regional water conservation);
- Low Income Energy Efficiency Program (not yet funded) ;
- Integrated Energy and Carbon Management Framework (TCC); and
- Integrating energy management with disaster management, climate change adaptation and resilient city-building processes (Townsville City Council's Rockefeller Foundation 100 Resilient Cities submission 2013).

Administration of Innovative and Collaborative Approach

Funding strategies must also ultimately deliver self-sustainability and resilience in the SISE funding model. By this it is meant that the SISE vision would be realizable in ways that necessarily make least imposts on the medium or long term budgetary position of Council in both operational expenditure and capital expenditure (unless business case for operational expenditure is a fiduciary duty due to clearly identified and articulated return on investment opportunities). They are then 'cost neutral' as minimum or preferably revenue positive to both Council and our community. Opportunities for 'city building projects' to be funded should not be excluded and potentially these projects contribute to their viability and environmental performance/achievement anyway. In broad terms, the *Commercialisation Pathways Report* recommends three stages for this funding process.

These are:

a. Market sounding – focused on locating and engaging with the right partners. Some of these partners have already been engaged over the past seven years on a collaborative platforms basis. Other partners will be identified during this phase;

b. Feasibility – this phase will focus on identifying and articulating the drivers and values that are important is key to a successful outcome;

c. Transactions phase – this phase focuses on closing the transaction in a method that is sound and legislatively compliant.

The Integrated Sustainability Services (ISS) department in working with other council departments (Planning and Development, Infrastructure Services, Knowledge Management and Property Services) with support from Ergon Energy, James Cook University and Environmental Products and Services have (under Council's approval to pursue sustainable funding opportunities for SISE projects) progressed project development opportunities within this three-stage process specifically in the areas of CBD District Cooling (and Thermal Energy Storage), Smarter Buildings, LED street lighting and Renewable Energy Micro-grids (and combined Solar Farm) for the CBD of Townsville.

This also included engagement and collaboration with international partners and possible stakeholders.

Supporting Case Studies

Work to date and associated research for each Townsville CBD Smart Energy and Sustainable Energy Framework Sub-Project

The following presents case studies representing not only the bricks and mortar for the framework but also the key relationship building projects to catalyse a transformative CBD.

Case Study A: CBD District Cooling (and thermal storage);

Case Study B: Renewable Energy Micro-grid (and Solar Farm) and Storage;

Case Study C: Smarter Buildings and Analytics trials;

Case Study D: City Sustainability Platform;

Case Study E: CBD Sensor Networks;

Case Study F: Electric Vehicles;

Case Study G: Hybridised Energy Systems and Virtual Powerplants (IBM 2012);

Case Study H: LED Streetlights;

Case Study I: City Sustainability Hub and Learnscapes (Visualisation);

Case Study J: Green Corridors and Walkability;

Case Study K: Cool Roofs

Case Study A: CBD District Cooling (Thermal Energy Storage)

The most energy consuming (and costly) activity in the operation of buildings in the CBD (and Townsville City) is inefficient air-conditioning. The CBD Master Plan identifies District Cooling as a City Making Project (No. 7) and is the iconic opportunity for Townsville to not only achieve major environmental, economic and social sustainability in CBD, but seen as a leading centre for sustainability in Australian and even the world for multi-stakeholder energy efficiency and demand management . Through the delivery of a *CBD District Cooling* (and combined Thermal Energy Storage) System significant reduction of cooling costs (operation and maintenance) can be achieved for building tenants/owners generating commercial and social benefit for the CBD making it more affordable.

"*One of the cities in Australia will do it, as soon as one decent sized city has done it, everyone will want to do one – it's a matter of culture, not financing*" – Gerard Nelson.

Smaller scale Thermal Energy Storage systems are important building blocks for a multi-stakeholder District Cooling System. Thermal Energy Storage systems provide key lessons for the design, implementation and integration (networks) of larger scale district cooling systems.

A number of medium to small scale, single stakeholder Thermal Storage and/or District Cooling Systems have already been installed in Townsville thanks to Townsville Solar City and Energy Sense Community partnership of Ergon Energy and collaborators with support of Townsville City Council.

These include:

1. Reef HQ – National Education Centre (PV and Thermal Storage);
2. Australian Institute of Marine Science (AIMS) – District Cooling System with Thermal Storage
3. Cleveland Bay Youth Detention Centre – PV, District Cooling with thermal storage;
4. Good Shepherd Home (District Cooling); and
5. James Cook University (5 mw demand reduction through district cooling and thermal storage);
6. St Anthony's Catholic College (District Cooling System)

These systems mean the knowledge and expertise for District Cooling and thermal storage with PV and other energy conservation measures is being built.

Based on current knowledge it is understood that all projects have proven to be commercially viable and forecasted to generate significant energy and cost savings over the life of the system (see link to Ergon's Commercial Demand Management Pilot case studies, including James Cook University).

https://www.ergon.com.au/energy-conservation/demand-management/electricity-demand-trials/townsville-commercial-demand-management-pilot

Ergon Energy through previous State Government's Office of Clean Energy and Townsville Energy Sense Community Feasibility Study identified the viability of the Townsville District Cooling Project – yet not from a purely utility perspective, due to a number of constraints (cost for piping). District Cooling has only ever worked as retrofits as a staged progression as is proposed in Townsville, where opportunities exist, specifically including:

1. Townsville Entertainment and Sports Centre;
2. Northern Rail yards Revitalisation Project; and
3. Major new green field sites on South bank.

From a City Building perspective (CBD Master Plan – City Making Project No 7) a multiple stakeholder, multi-site opportunity can be built opportunity by opportunity. Some size increases may be accommodated to allow for linking with other close by buildings as per Townsville City Council site and submitted proposal to Australian Government (February 2013). This proposal is still awaiting notification by Commonwealth.

> Townsville City Council submitted a Thermal Storage Project funding proposal in February 2013 to the then Australian Government Clean Energy Futures Program (Community Energy Efficiency Program Round Two) - awaiting notification and program transition arrangements. (See ***Attachment 8***: TCC Thermal Storage Project Plan and ***Attachment 9****:* Full Council Action Item – Townsville City Council Thermal Storage Project – 26 March 2013).

Whilst the announcement of some unsuccessful applications was made earlier this year prior to the election, Council's project was not notified and remained in assessment phase, pending on the transitional arrangements under apparently under consideration by the new federal government. Townsville City Council staff (ISS) have been in contact with the new department where submissions now sit, and were informed that the submission is still under consideration. This could result in possible funding opportunities through the new Australian Government 'Direct Action Plan'.

The localised TCC project submission was deemed 100% feasible with subsidy and with other partners potentially available as State Government building arrangements are under review, could incorporate other stakeholders.

If successful as a start-up project, a local thermal storage project could activate a multi-party district cooling project in Townsville and would greatly enhance Townsville's national and international credentials in energy demand management, energy efficiency and renewable. Importantly a local project centred on Walker St Administration Building would provide valuable lessons will build future business cases for other thermal storage projects on other council buildings and community infrastructure in the CBD (and wider community), staging and catalysing a CBD wide District Cooling System.

Example - JCU District Cooling Project

In 2009, James Cook University (JCU) completed a 'district cooling' retrofit to significantly reduce baseline operating and maintenance costs across the campus. The JCU District Cooling System is the largest central chilled water generation and storage system in Australia. The project has now been running for over 3 years and has annually delivered savings of around 40 per cent in operational and maintenance costs, 27 per cent in energy consumption and 47 per cent in demand reduction.

The Townsville CBD Cooling project is about taking the learning's of the JCU project and applying them to a multi-customer, public access context.

Case Study B: Renewable Energy Micro-grid (Solar Farm) and Storage

This project envisages the opportunity for a combination of roof mounted and building integrated photovoltaic (PV) systems (of approximately 1.5MW) and storage (in the form of batteries, electric vehicles and thermal storage) in the CBD. A CBD Micro-grid would be combined with up to 100MW of solar power (Renewable Energy Facility) and storage on council land at Woodstock/Calcium (SISE Framework Figure 6) to form a Renewable Energy Micro-grid and Storage Project that would provide an important renewable energy resource for the community and load curtailment capability for the stressed CBD and Townsville wide electricity network.

Townsville City Council has facilitated community and industry engagement workshops to build multiple stakeholder approaches to design and deliver a Renewable Energy Micro-grid and Storage Project for the CBD.

These include the following examples:

a. 100MW Solar Farm at TCC site at Woodstock/Calcium - CBD Taskforce and Integrated Sustainability Framework for CBD and ECO-City Action Plan (2012);
b. *30MW Solar Thermal Project at TCC site at Woodstock/Calcium (2010);
c. *500MW Solar Farm at TCC site at Woodstock/Calcium (2012);
d. * 30MW Solar Farm (2012);
e. * Up to 100MW Solar Thermal Project at TCC site at Woodstock/Calcium (2013)

"Confidential information not included

A number of solar and storage projects have been trialled and delivered across Townsville to investigate demonstrate concentrated PV and battery integration with the network including:

a. Tony Ireland Stadium Solar and Battery Storage Project (Network-Integrated Photovoltaic (40kW) and Battery Storage (500kW) system);

b. Magnetic Island Solar Suburb Concentrated PV Trial (Ergon Energy, Businesses and Residents) including residential and commercial battery storage trials;

c. Townsville Airport PV and Battery Storage trial;

d. Townsville RSL Stadium 348kW Solar installation; and

e. 15000 individual and commercial PV systems in Townsville (up to 30 kw).

Further studies are underway in a number of locations for Solar Farm, Storage and Load Curtailment Project Investigation and Commonwealth Funding Opportunities.

Although not in the CBD, The Tony Ireland Stadium PV and Battery Project (June 2013), is providing valuable lessons on how council can reduce demand on its buildings through innovative shifting of renewable energy, stored energy and energy from the grid. This project will provide further learning opportunities on how we can transform council/community facilities into 'Energy Resiliency Community Hubs' of which the community can have access to a vital energy source in times when the electricity network is down e.g. after cyclones and floods.

As part of the Townsville Solar City Project - Magnetic Island Solar Suburb, 720kW of PV was installed across the community to trial the impact of concentrated PV on the electricity network. Along with energy efficiency and demand management, this achieved a reduction in energy demand of 46 per cent and energy consumption of 40 per cent leading to the capital deferral of a third expensive under-sea electricity cable to the island. These lessons are important in informing how concentrated PV (Micro-grids) can interact with the electricity network across the CBD of Townsville.

A 'Solar Power Station' was then built in the middle of Annandale, with Ergon Energy and Townsville City Council installing 348kW at RSL Stadium, which is currently Townsville's largest PV system. The RSL Stadium has also undergone a Load Curtailment Trial to reduce its impact on the local network.

These initiatives now provide opportunities to investigate the integration of energy storage to build energy resilience for a council building and the community.

Townsville City Council is investigating possible funding opportunities through the Australian Government's Australian Renewable Energy Agency (ARENA) for up to 100MW of Solar Thermal and Storage at council's Calcium/Woodstock land parcel. This project will investigate commercially viable ways to reduce energy costs to council and the community through a council, energy utility and research collaboration (**Attachment 10** – Solar Thermal Plant Collaboration).

Note: A city wide renewable energy micro-grid can help achieve sustainable energy Data Centres for North Queensland in Townsville (e.g. JCU Innovation and Research Tropical Data Hub and/or utility/government) and compliment base load power opportunities.

Case Study C: Smarter Buildings and Analytics trial

Buildings consume around a third of the world's energy, thus is one of the largest costs for any organisation. The Townsville CBD vision of being a thriving urban centre with an expected growth of around 20,000 residents by 2030 (CBD Taskforce 2012) means that it will need to deal with the impacts of the activities and services associated with this growth. This vision will need to guide and support new building design and retrofits as well as accounting for quality of life improvements through the whole life cycle of building occupancy.

As buildings are the building blocks of our CBD, they are the convergence points for public and private transportation networks, health care and security and safety for our community. A Smarter Buildings trial in the CBD will combine architecture with energy efficiency based on our previous experiences whilst understanding the future impacts of the decisions that the community and business will make in the pursuit of improved commerce and lifestyle. Commercialising understanding and opportunities for tropical urban buildings through applied research and design can generate new knowledge for Townsville efficiency and effectiveness.

By leveraging our existing ICT networks and knowledge and bringing in advanced technology, a Smarter Buildings trial in the CBD will give people the tools to better manage their own behaviours and the performance of their buildings to deliver cost savings associated with maintenance and operations through energy efficiency and service optimisation.

Smarter Buildings trials will integrate data and information systems with visualisation to provide control, efficiency and insight so that operations can respond to changes in the physical environment (such as climate change and weather) as well as changes in market conditions associated with rising energy costs and economic downturns.

The approach of Council's Smarter Buildings Trial is through an 'Intelligent Network of Disciplines' where energy efficiency is achieved in combination with comfort, safety and security. This means that our buildings will be 'networked, intelligent, sensitive and adaptable' through the instrumentation of sensor networks and using people as sensors, interconnecting the buildings through integrated building management systems and mobile devices where people 'plug and go', and using advanced analytical software to find meaningful patterns in data sets to optimise business operations and predict future trends and anomalies so that important planning and responses can be undertaken.

As buildings are not islands, a Smart Buildings trial will form 'building clusters' that learn from one another similar to 'Knowledge Network Clusters' that people use to solve complex problems through collective learning (**Attachment 11**– Cluster Connections).

Townsville City Council's Property Services, Integrated Sustainability Services, Infrastructure Services and Knowledge Management Departments are working together on delivering the following activities:

- Implementation of an **Energy Performance Contract** (EPC) on Council's Walker St and Thuringowa Drive Administration Buildings;

- The development of a framework for an **Energy and Sustainability Control System** (**Attachment 12** – Energy and Sustainability Control System);

- The development of an **Enterprise Energy Management System** (EEMS).

Through the delivery of Building Management System upgrade, Energy Efficient Lighting, Window tinting and smart air-conditioning controls, the Energy Performance Contract has delivered energy savings of approximately 24 percent on the Walker St compared to the same time prior to project implementation.

An Energy and Sustainability Control System has been developed to integrate the Building Management Systems (BMS) across council buildings with energy, water, waste, asset and financial data (FEAMS) to apply advanced analytics to generate a tool to provide insight for council staff to make more informed choices and optimise to increase operational efficiencies as well as reduce operational costs.

An Enterprise Energy Management System (EEMS) is being developed to streamline the collation of data and reporting of the consumption of resources and development of benchmark metrics across Council business units and associated services. The access to accurate and real time information will allow Townsville City Council to drive operational efficiency and cost savings through the development of reporting platform which uses analytical tools to assess improvement scenarios. The opportunities to evaluate system processes and upgrading scenarios will decrease operational costs, reduce waste and identify priorities for future project expenditure.

How the Commercial and Residential Fabric of our buildings tells us about the way we live and work and contributes to building smarter cities through sensors, data integration and analytics.

Example - Townsville City Council Walker St Administration Building (Energy Performance Contract) including indicative performance achievement for energy and cost savings through implementation of EPC and to be verified through the EPC process in time.

	Townsville City Council Walker St Administration Building	**Thuringowa Civic Centre**
Business as Usual		
Building Floor Area	40 year old office building (5,153m^2)	Office built in three stages from 1978 to 1995 (6,375 m^2)
Annual Energy Consumption in 2011/2012 FYR (kWh)	1,454,877	1,779,155
Annual Electricity Cost in 2011/2012 FYR incl. GST ($)	$ 311,573	$ 337,965
Features - differences	360 building occupants. Public occupancy areas.	370 building occupants. Public occupancy areas including customer service centre and public library
Features - similarities	Two storey, concrete construction, high % of external glazing, large external overhangs, and metal sheeted roof	
Improving Performance		
Energy Audit and Reporting ($)	20,000 excl. GST	20,000
Capital Expenditure excl. GST ($)	$ 405,000	$ 530,000
Guaranteed Electricity Savings (kWh)	c. 430,000 (weather adjusted)	650,000kwh
Guaranteed Cost Savings excl. GST ($)	c. $ 70,000 (energy only cost avoidance, and does not include demand tariff excess charges)	$ 119,000 (energy costs and excess demand tariff charges)
Achieved Demand Reduction (kVa)	215	184 (Achieved maximum)
Features - similarities	Upgraded lighting, Building Management System (BMS), Additional Sub metering, Improved HVAC Control Strategies, and Heat Reflective Coatings to Roof and Windows Optimisation of Energy Consumption within Building from analysis of Metering and BMS data	

Note: does not include previous savings generated by installation of 23 kw of solar pv and white reflective roof and will improve the ROI as EPC factors in future price increase on electricity.

Effect of Peak Demand Events

- Demand based tariffs have a cost component determined by the monthly maximum demand event.
- From historical data peak demand events were visible and occurring outside the normal energy consumption trend driven predominantly by effect of weather and the building cooling demand requirement.

Finding the Cause

- All major plant and equipment individually sub-metered for electricity consumption.
- BMS System control points across all lighting and HVAC Control Systems.
- Ability to generate large number of reports based on electricity meters and control points installed in the building.
- Ability to track energy usage on a day to day basis, forecast energy consumption, make decisions about how you run your building, or use as a starting point to find out why your building is performing the way it is.
- Early Detection of energy consumption anomalies or faults delivers operational cost savings and provides maintained interior and service conditions for building occupants.

Real Time Opportunities for:

- Identifying Anomalies
- Optimising operations
- Responding to occupants complaints
- Accuracy in measurement of Building Improvements

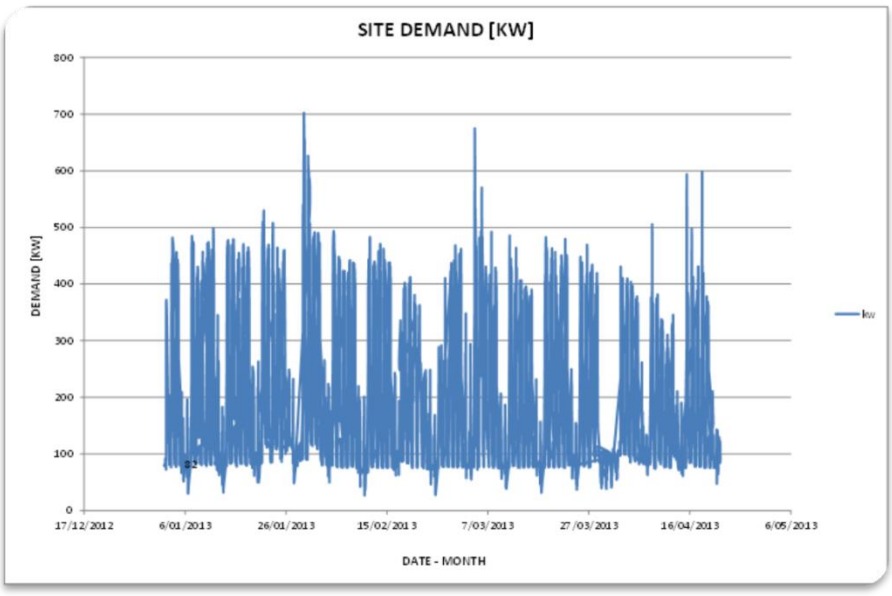

Figure 8: Example of Anomaly for failure in air-conditioning that can be identified by BMS and Smart Technology integration

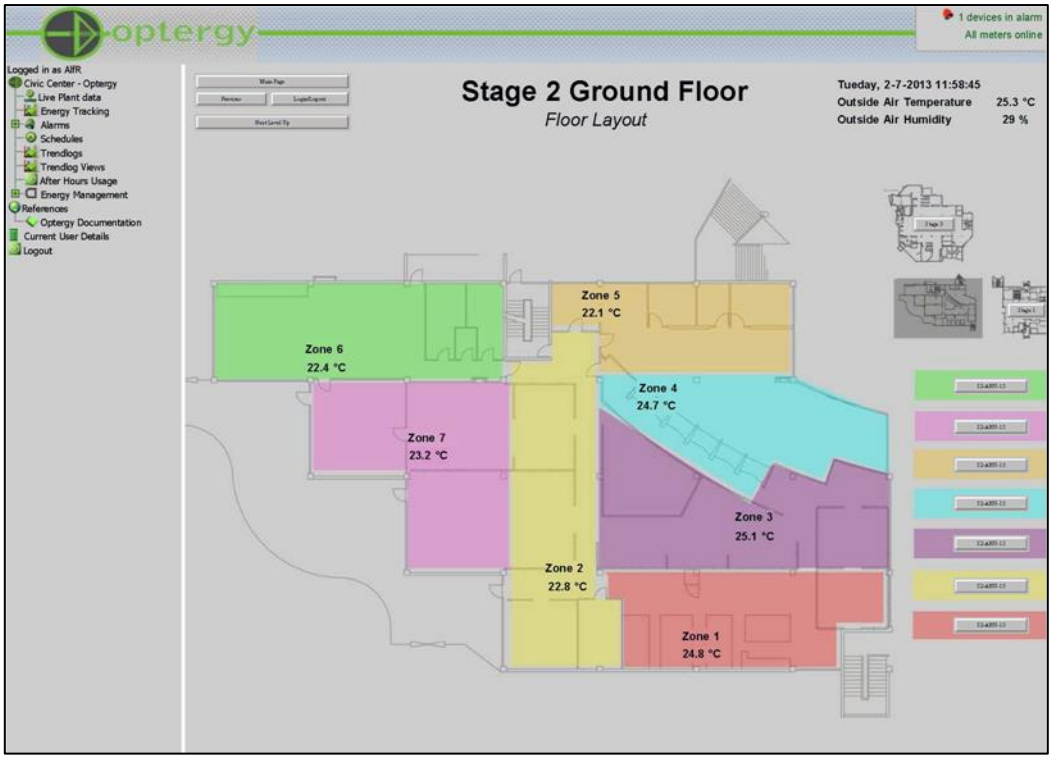

Figure 9: Visualising Opportunities to optimise operations

Realising Potential:

- Utilisation of the Data collected by BMS and Sub metering requires technical expertise.
- It does not change the behaviour or predict the behaviour of your building occupants.
- Implementing energy efficiency measures with monitoring and smart controls delivers savings in energy consumption and energy demand.
- Lowering daily operational costs can enhance the building's value to owners and tenants.
- Utilisation of City Whisper type advanced analytics will assist with the wider adoption and utilisation of the data available now.

Case Study D: CBD Sustainability Platform

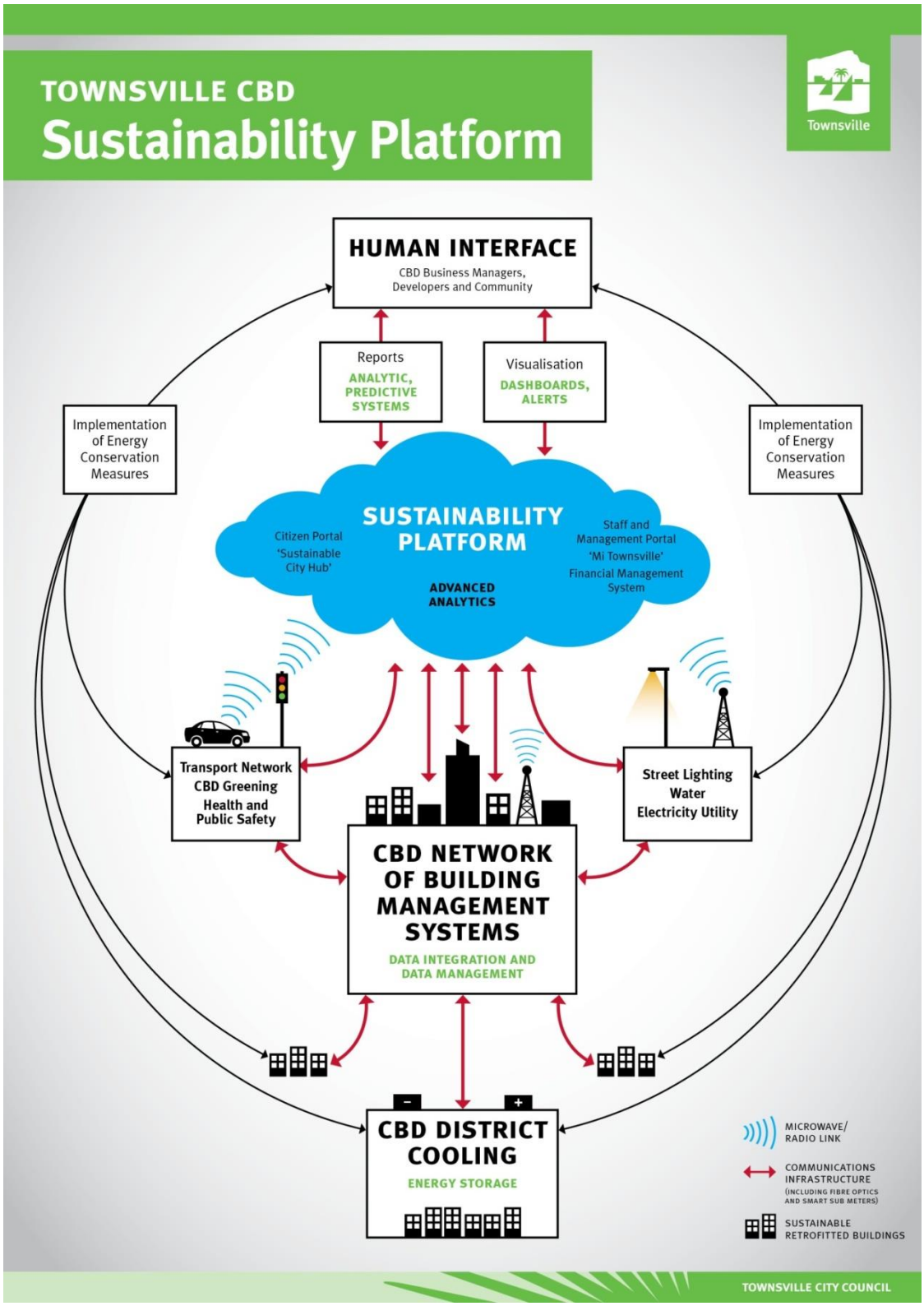

Figure 10: Townsville CBD Sustainability Platform

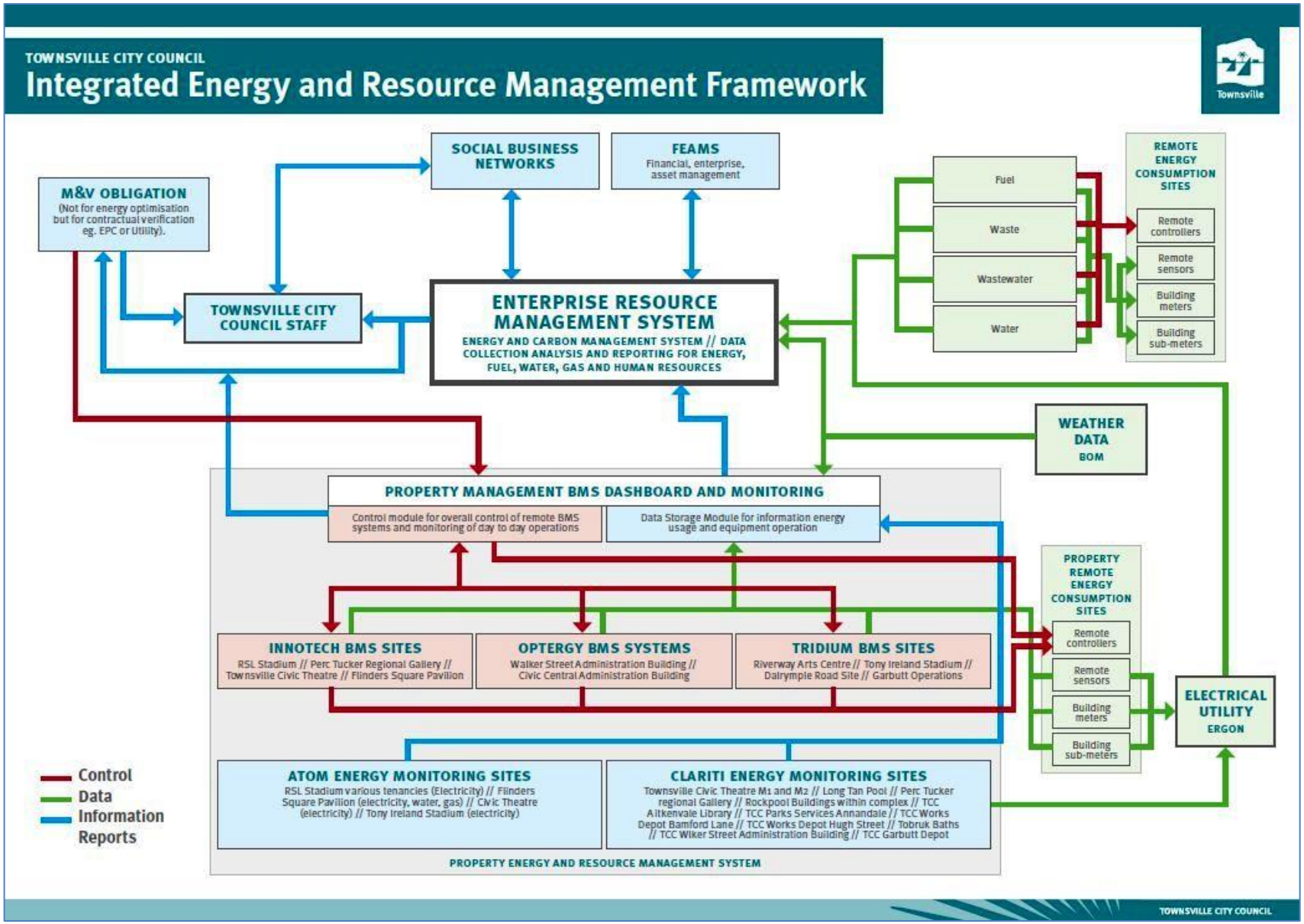

Figure 11: Integrated Energy and Resource Management Framework

Case Study E: CBD Sensor Network trials

Sensor Networks open opportunities for increased clarity and innovation by connecting the physical world (buildings, roads, environment) with the internet, providing a CBD that the community can better understand and make more informed choices to reduce energy and the cost of living and doing business.

Council is working in collaboration with James Cook University (JCU) and ScienceMob Inc to investigate, develop and deploy affordable sensors on council and community buildings and infrastructure to gather physical data such as temperature and humidity and integrating it with other data sets so that advanced analytics can be applied to generate information that building users can understand and use encouraged them to act more sustainably whether it be to reduce energy and water use or save money on their bills.

This included:

- Low Cost Sensor Network Development - Rowes Bay Sensor Network trial
- Sensing a Retrofitted Heritage Listed Building in the CBD - Federation Place Sensor Network trial
- Finlay Homes Innovation House Project

The Low Cost Sensor Network Project at council's Rowes Bay Sustainability Centre was the pilot project to develop low cost, scalable, easy to deploy, purpose built sensor arrays developed by James Cook University and ScienceMob Inc to collect data and measure the relationship between roof colour, temperature and energy use (and then later built to measure soil moisture in the garden) in the home and the data is streamed open sourced through the internet for the community to view (**Attachment 13** – Rowes Bay Sensor Trial). This allows building owners and tenants in the CBD (and everywhere for that matter) to learn in real time the effects of roof colour on their buildings. The 'sensor framework' piloted in the Rowes Bay Sustainability Centre project is now used in the implementation of sensor network projects across the city and the CBD.

The Federation Place Sensor Network in the CBD is measuring temperature differences at different levels in the building which has multi-tenant occupancy. This data is used to communicate to other building owners and occupants in the CBD to help inform them around the impact of roof coatings on the comfort and energy consumption of their buildings.

The Finlay Homes Innovation House project is trialling sensor networks to communicate the tenant about the microclimates in the home to predict and influence human behaviour and sustainable living. The information gathered will be shared with products and services businesses in Townsville to provide information to allow for the development of innovative energy efficient products for the residents of Townsville.

The TCC Walker St Administration building (through the Energy Transformation Townsville project and Smarter Buildings Project) will have a sensor network deployed to measure different micro-climates and building surfaces, including the white roof, and integrate data with the BMS system to create insight into how buildings in the CBD can learn from what has already been done to optimise operations and future energy efficiency and demand management.

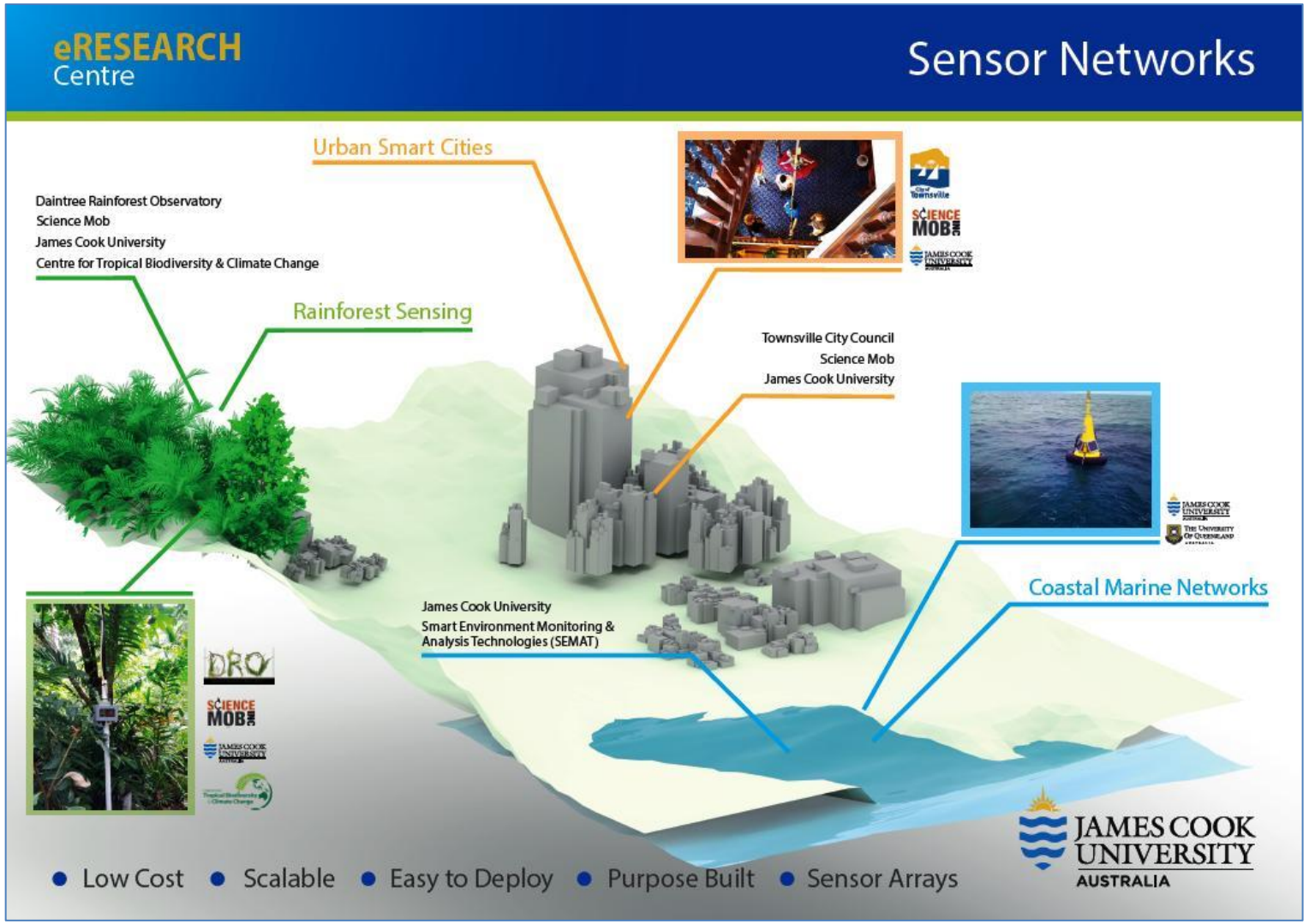

Figure 12: Townsville Collaborative Smart Sensor Network Project (Source eResearch James Cook University, Townsville)

Case Study F: Electric Vehicle Infrastructure

The growth of Townsville's CBD is important to the vitality, sustainability and resilience of our local economy. This growth will bring about an increase in demand for energy and resources which will and is impacting on the electricity network. Knowledge right across the world is increasing around understanding the benefits of how Electric Vehicles (EVs) can support a 'Smarter Grids' and better manage how electricity is used and distributed in an ever increasing complex network.

Ergon Energy's Townsville Energy Sense Community project is now understanding the role EVs play in addressing these challenges through the Townsville Electric Vehicle Trial. Other trials include the Ausgrid EV Trial in Sydney as well in Perth, Denmark, Israel, USA and Canada.

The Townsville opportunity is helping the community to better understand when they need to charge?, where they need to charge?, and how much electricity is needed to provide sufficient sources of energy? The Townsville trial investigated the opportunities to linking electric cars a smart grid to charge EVs when electricity is cheapest to produce and to help manage our network and cater of the certain growth of electric cars in the market.

There are currently four public EV charging stations in Townsville which are important building blocks to community wide adoption and practise in EV transportation (Figure 10).

Example 1 – Ergon Energy EV Trial Townsville

Ergon Energy's electric vehicle (EV) trial which is part of Ergon's Townsville Energy Sense Community program was implemented to better understand how motorists in Townsville could use and charge EVs and to see how a possible large-scale uptake could affect the electricity network. It found that it takes about seven hours for the EVs to fully charge costing around $3.20 and providing enough electricity to travel 90km.

The Ergon Energy Electric Vehicle (EV) Trial has now been completed.

The trial included:

- Installation of Queensland's first public roadside EV charger on the Strand in partnership with Townsville City Council through a hosting agreement. Townsville City Council is now in negotiation with Ergon Energy for the retainment and ownership of the Strand EV Charger as per *Council Action Item 27 March 2012.*

- An installation of a 4kw solar-powered EV charge station at Townsville Airport – a first of its kind in Australia covering six car park

- Trial at Mt Low which provided a real life picture of what Townsville could look like if EV sales suddenly took off. The trial has found each household drives their EV about 360km a week, recharging about two to three hours a night at a total cost of around $13 in electricity a week.

- Replicated Trial at Mysterton following the successful Mt Low trial.

Extract from Ergon Energy Media Release 2012 (Source: https://www.ergon.com.au/about-us/news-room/archived-media-releases/2012/northern/mt-low-electric-vehicle-trial-provides-glimpse-into-the-future)

"Our participants love driving the EVs and find them so simple and easy to charge," said Glenn Walden, Group Manager Emerging Opportunities and Technology Development.

"We thought motorists might be put off by them because of their limited range of 100km, but that hasn't been the case at all."

Mr Walden said the trial is giving network planners a real insight into motorists' charging habits.

"One of the key findings is that the charging options need to be as flexible as possible, otherwise motorists won't use them," Mr Walden said.

"Our participants most commonly use the EVs during the day and charge late at night when they go to bed, which is great for the network too as it helps to take pressure off the grid during the morning and early evening peaks."

Mt Low was selected for the trial because it contains a mix of old and new network infrastructure providing researchers with a realistic example of "the average network".

"By keeping the vehicles together in the same area, we can build a picture of how a high concentration of EVs might affect the network," Mr Walden said.

"Over the next few months we will be simulating what it might be like if 60 per cent of the neighbourhood had an EV plugged in at the same time."

"We will be doing this by using a combination of EVs and hi-tech lithium-ion batteries to simulate the same draw on the network as 20 EVs would belonging to 36 neighbouring homes."

"The EV trial will also examine a wide range of charging options and incentives to encourage customers to charge off peak, while allowing the customers to still grab a top up if needed."

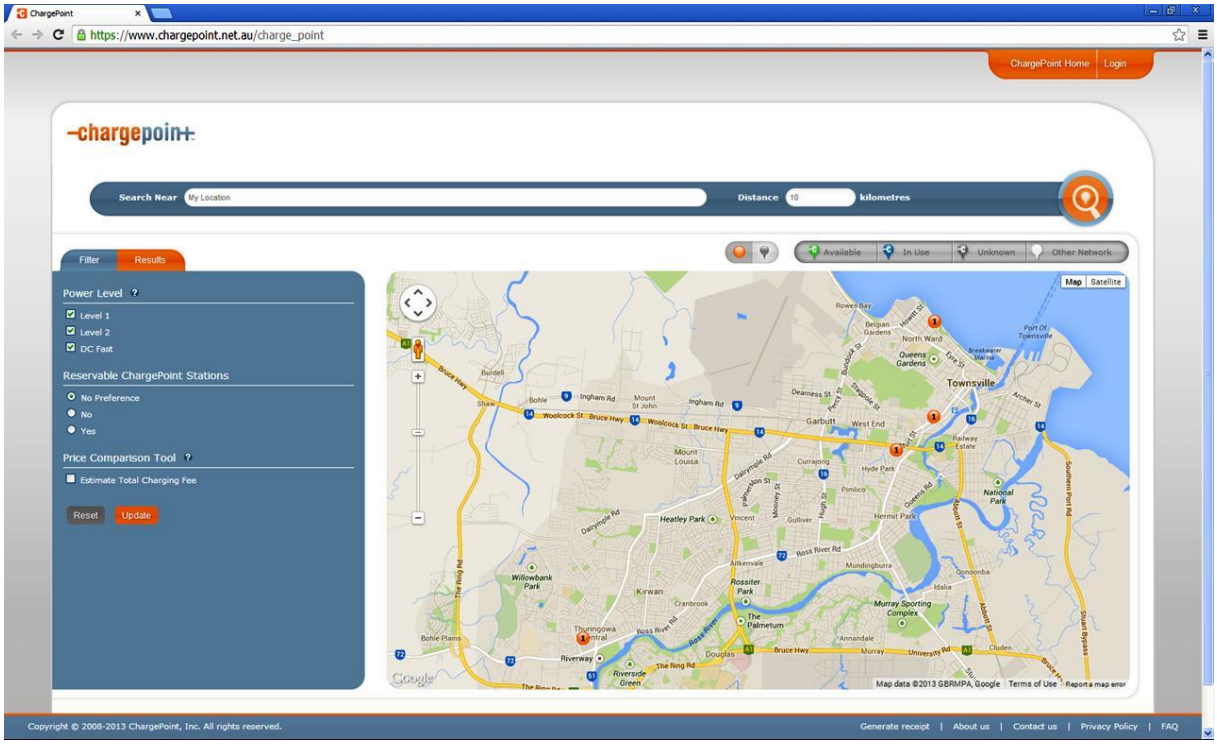

Figure 13: Townsville Public EV Charging Station Locations

Example 2 – Ausgrid EV Trial

The Ausgrid EV Trial saved 33 per cent on energy costs.

As part of the Ausgrid *Smart Grid, Smart City* program 20 Mitsubishi iMiev electric cars were introduced to fleets in Sydney, Newcastle and the Central Coast. Each car was fitted with an electronic logbook that tracks how the cars are driven and recharged. The trial hoped to better understand:

- The benefits of electric vehicles
- The affect electric vehicles will have on the grid
- The affect electric vehicles will have on the environment
- When and where users are most likely to charge their vehicles

The electric vehicle (EV) trial is now complete with data successfully collected from two road trials, fleet use (business) and “typical household” use. The fleet of 20 EVs totalled more than 150,000kms with 260 drivers. Both user behaviour and charging information was captured with the objective of assessing the future impact of the rollout of EVs on the electricity grid (See Figure 14 below). (Source: *Smart Grid, Smart City Monitoring and Measurement Report IV – Executive Summary*)

2.5 Electric Vehicles (EV)

Background

The increasing cost of fuel and a growing awareness and concern for the environment has caused strong growth in hybrid vehicles over the past decade. With vehicles such as the Toyota Prius leading the way, many other manufacturers are now introducing their own hybrids and plug in hybrids. As battery storage technologies improve in capability and reliability and costs reduces, pure electric vehicles are expected to become a reality.

For the trial, 20 Mitsubishi i-MiEV electric vehicles along with 6 fast and 46 standard charging points were deployed and are collecting data. Vehicles are in two groups; 12 home users and 8 in a vehicle-pool. BetterPlace is the electric vehicle trial partner responsible for public charge stations.

A parallel research activity looking at transport statistics and demographics is underway to estimate the potential electric vehicle uptake rates over the next three decades. The research results combined with gathered field data (from electronic vehicle logbooks, telemetry units and charge stations) will be used to formulate the assumptions in a forecast of the future effects electric vehicles will have on the electricity network.

Purpose

Studying electric vehicle charging and load modelling with fleet and home users will inform the industry of the potential impact on the electricity grid from large-scale uptake of plug-in battery-only electric vehicles and plug-in hybrid electric vehicles. Driver behaviour models will inform analysis of charging patterns, effectiveness of charging forms and technical impacts on the grid.

Results

- 46 standard charging stations are installed in Ausgrid, partner and public locations each with 2 charge points providing a simultaneous charging capability for 92 EVs
- 6 fast charging stations are operational along the Sydney to Newcastle corridor, including the F3 Freeway
- Charging infrastructure is provided by Better Place and accessed via a smartcard linked to an individual account for recording and billing purposes
- The electricity costs include a premium as may occur in a viable commercial operation

Vehicle	Mitsubishi iMiEV	VW Polo Diesel
Cost/km[3]	$0.02	$0.07
Weight	1,116 kg	1,140 kg
Purchase Price	$48,000	$21,490
Fuel Price	$3,162	$9,729
Total Lifecycle Cost [4]	$54,762	$43,219
Total Lifecycle CO (tons)	37	26

[3] Based on 12 cents per kWh for electric (off peak) and $1.50 per litre for diesel

[4] Total Lifecycle is based on a 10 year period for cost and CO^2 emissions

Figure 14: Results of Ausgrid EV trial (Source: *Smart Grid, Smart City Monitoring and Measurement Report IV – Executive Summary*)

Case Study G: Hybrid Energy Systems and Virtual Power Plants (IBM 2012)

This project is currently under investigation through the a combined study into the integration of Big Data Analytics, Cloud Computing, Social Business, Intelligent Security, Mobility and Smarter Commerce (IBM Interconnect 2013) applied to District Cooling, Smart Buildings and Photovoltaic Superhighways (PV Micro-grids and Plants) that powers the booming future of Townsville.

Case Study H: LED Street Light Project

At a global level it is estimated that lighting generates 6% of global CO2 emissions. This equates to 1.9 billion tons of CO2 per annum or 70% of the world's passenger vehicles.

Townsville has over 24,000 streetlights accounting for a major portion of council's electricity costs.

It has been found that LED lighting can cut costs by an estimated 40–70% depending on the technology being substituted. LED lighting is being increasingly used in a range of environments and applications ranging from public lighting contexts through to industrial, commercial and residential applications. This is being driven by a number of major considerations that are relevant for Townsville.

These considerations include:

- Rapidly escalating energy prices. While recent State and Federal election campaigns have promised improvements in the overall cost of electricity, it is unclear that either level of government has a viable proposition to deliver on this promise. Even with the removal of the carbon tax, it is expected that electricity prices across Australia will continue to increase well above inflation. It is understood that Queensland faces electricity price increases of over 20% per annum across each of the next 3 years;

- LED lights have a significantly longer operational life than alternatives, allowing for a longer replacement cycle and significantly reduced labour requirements to maintain and replace;

- LED lights can also provide a more aesthetic solution in many applications due to their more flexible design, and more controllable nature (as identified by residents in Ausgrid LED lighting trial). This allows for enhanced public safety, improved colour options, reduced light pollution and with effective controllers, easily variable outputs to suit different times of day, etc. This often provides improved visibility with less light

This project highlights significant progress in developing innovative funding solution opportunities that mitigate public risk and realize public value, particularly in the area of scoping and implementing a pilot LED street lighting project through partnership arrangements.

Council in collaboration with project partners through the *Smart Infrastructure and Sustainable Energy Framework* are currently undertaking an evaluation of the opportunities for the adoption of energy saving technologies in street (and public lighting), particularly focused on evaluating the benefits/costs of implementing an LED street lighting initiative.

This has involved:

- Funding submission to former Australian Government Clean Energy Futures Fund – Community Energy Efficiency Program Round 1.

- Outdoor Lighting Project implementation as part of Townsville City Council Energy Transformation Townsville Project (part funded through former Australian Government Clean Energy Futures Fund – Community Energy Efficiency Program Round 1)

- Collaborative research trial of Adaptive LED Street lighting trial – funding submission to former Australian Government Clean Energy Futures – Clean Technology Fund

The TCC Integrated Sustainability Services department has (under Council's approval to pursue sustainable funding opportunities for SISE projects) progressed project development opportunities in the area of LED street light for the CBD.

The business case opportunity for LED lighting has become evident and significantly more robust in recent times. This has seen the significant deployment of LED lighting by governments and institutions around the world as the business case and justification improves to support this material change. For many organisations the initial stage is through a low cost, high value pilot project to allow for relevant key factors to be properly assessed and addressed prior to the commitment of a full-scale change.

Projects enhancing a Townsville CBD LED Street lighting project:

Townsville projects include:

- Jezzine Barracks Redevelopment – Car Park and road LED Lighting;
- Townsville Hospital Car park and street LED lighting;
- JCU Discovery Drive Solar LED pathway lighting;
- Royal Australian Air Force (RAAF) car park and road LED lighting;
- Jupiters Hotel and Casino car park LED lighting;
- Public outdoor LED lighting (currently underway)

Other projects in Australia include:

- Townsville City Council (as well as Brisbane City Council) are progressing a multifaceted approach to energy reduction. This includes the gradual replacement of traffic signal lights with high intensity LED lights to improve safety and reduce energy consumption;

- Ipswich City Council Dumpy Bridge LED Lighting Trial – 60% reduction in current costs associated with street lighting, saving 1.86 million in electricity and maintenance costs per year;

- Ausgrid LED Lighting Trial - $300,000 in energy savings and reduced energy use of more than 25% through their roll out of 2,600 LED street and park lights (figure. 15);

- A number of major outdoor public features have already had LED lights installed, including a number of parks and the lighting on the Story Bridge;

- The Port of Brisbane commenced replacement of external and street lights with LEDs in 2010. This has seen the Port work through a gradual replacement resulting in improved visibility and reduced operating costs;

- The Port of Brisbane provides a useful indicator to the requirements for high visibility and a strong focus on safety that LED lights have been able to deliver.

Energy Use

Replaced lights were a mixture of mercury vapour and flourescent globes. A total of 62 lights were replaced across the different locations in the trial.

Location	Total energy use of old streetlights (Watts)	Total LED energy use (Watts)	Energy saving
North Bondi Ramsgate Ave	391.6	168	**57.1%**
Cronulla Coast Ave & Arthur Ave	812.8	451.8	**44.41%**
Mosman Medusa Street	529	174	**67.11%**
Balgowlah Heights Bareena Dr	1053.8	552.2	**47.6%**
North Ryde Betty Hendry Pde	562.8	290	**48.47%**
Wiley Park Shadforth Street	342.2	168	**50.91%**
Georges Hall Oak Drive	392.8	224	**42.97%**
Noraville Irene Parade	574.8	174	**69.73%**

Figure 15: Results of AusGrid Trial in Sydney 2013 (Source: Ausgrid 2013)

International projects include:

- New York City to replace 250,000 street lights with LEDs by 2017. This will enable the city government to save $6m in energy costs and $8m in maintenance costs per year due to the more efficient and longer lasting design of LED lights;

- City of Los Angeles LED Street light retrofit (figure. 16)

    - 141,089 Streetlights over 4 years.
    - 63.1% reduction in energy
    - Savings of over $7 million annually
    - The proposal generated enough in savings to pay for the loan within 7 years with no impact to the general fund.

- Guangdong Province – China
    - By the end of 2011, 200,000 street lights had been installed on 2,000 kilometers of provincial streets and roads, including 100,000 in the provincial capital, Guangzhou. Installation of another three million LED street lights has been set as a medium-term goal for the Province (The Climate Group (2012) *Lighting the Clean Revolution: The rise of LEDs and what it means for cities).*

- Townsville's Sister City of Port Moresby in Papua New Guinea (PNG) (through its City Administration - National Capital District Commission) has installed LED streetlights to around 3kms of highway.

- Buenos Aires LED Streetlamp Retrofit — 125,000 Streetlamps being replaced with LEDs

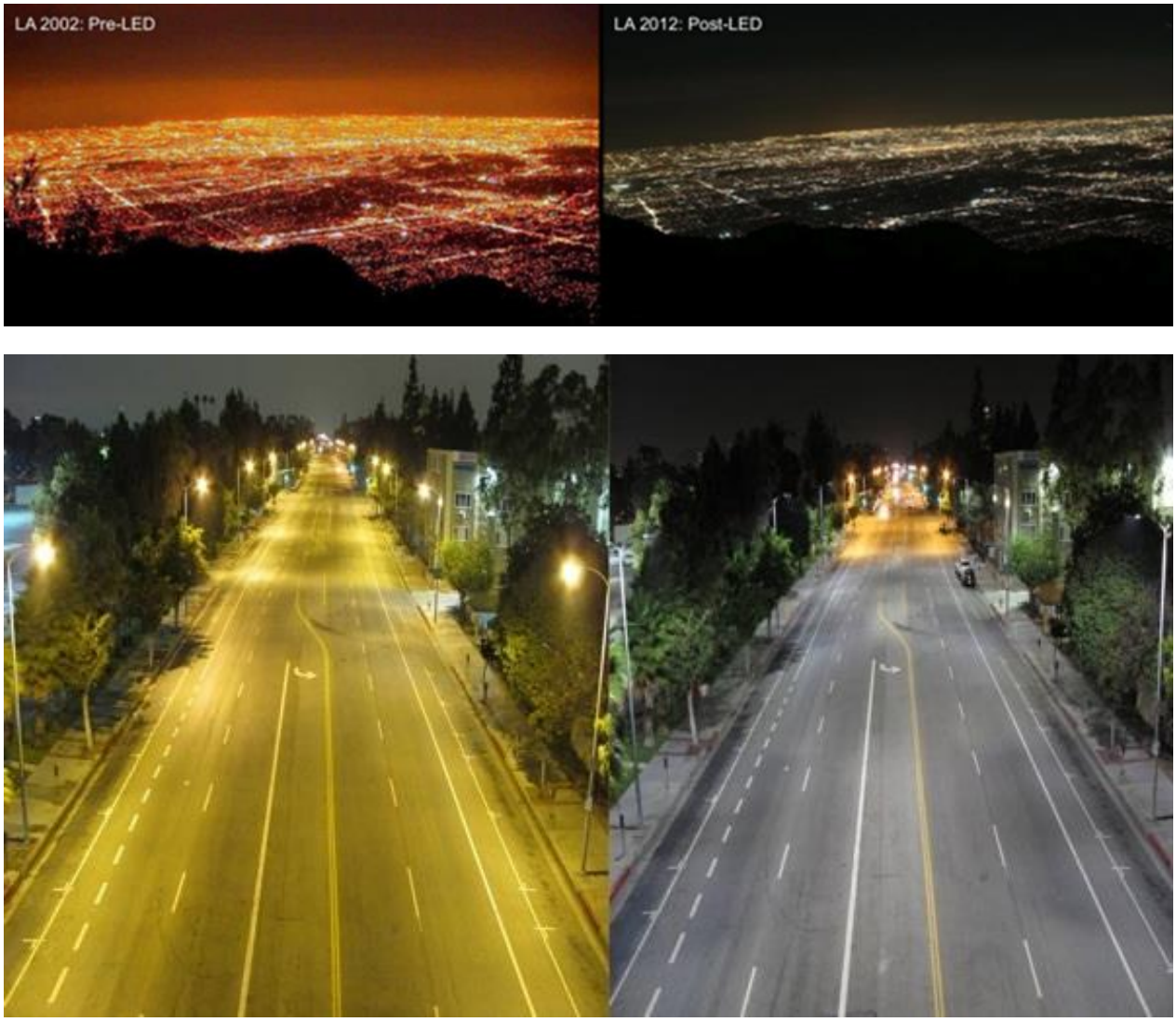

Figure 16: A visual perspective of the energy savings from the Los Angeles LED street light project (Source: LA Lighting Bureau)

"The importance of the LED Conversion Program cannot be overstated. It is a shining example of how green technology can be both environmentally responsible and cost effective. With the LED program, we have transformed the night landscape of the City of Los Angeles, made our city safer and pedestrian friendly at night, and have exceeded our initial program goals on both energy efficiency

and CO2 reductions. Angelinos have embraced the new white LED Light, as we have received many positive comments from citizens, community groups, the Los Angeles Police Department and even the Dark Skies Association for the reduced sky glow at night, reduced light pollution and trespass."

- Director of the Bureau of Street Lighting for Los Angeles Ed Ebrahimian

These drivers are seeing a global trend towards the use of LED lights in a range of applications, including in street lighting.

In many locations the reconfiguration of street lights is also being used as a prime opportunity to embed distributed sensor networks cheaply and easily through the community which builds on the current Townsville Sensor Network Trial (Townsville City Council, James Cook University, ScienceMob, Federation Place and Finlay Homes).

The factors often cited that prevent take up of LED lighting, especially at an institution level include:

- Technology risk aversion;
- Concerns regarding lighting standards; and
- Capital investment.

While in the past there were some concerns regarding the validity of the performance claims, the significant and growing number of major installations of LED lights into urban and suburban environments provides confidence that the technical risks are easily managed through effective lighting specification, use of reliable equipment and effective warranty provisions. In effect the number and quality of LED light producers has significantly improved and high quality products that are reliable and well proven are now readily available in the market, backed up by significant organisational capability.

This provides an effective management of any concerns regarding technical risks.

Questions have been raised and well answered in terms of lighting standards. LEDs have demonstrated through numerous trials that they provide light suitable for any environment and will often exceed standards in terms of luminosity and reliability of performance when compared to numerous other technologies. This can be seen with many more traditional street light mechanisms that will often cycle in luminosity requiring additional lights and areas of reduced visibility.

Funding Opportunities

As noted above, perhaps the most challenging area has been the capital investment required. While the case is now well understood, well proven and well documented, the reality is that it requires a change in funding approach. LED lights by their nature are more capital intensive, but come with a significantly longer life (often 3 times) and reduced running costs.

Many councils, however, do not have the budget flexibility to afford the capital roll out necessary to harness the longer-term benefits. This is why entities such as the Climate Group have taken a role in organising appropriate funding support. Similarly in Brisbane, federal government funding has been used and in Sydney, Ausgrid are supporting the ongoing rollout.

As is well understood within Council (and supported by Ernst and Young 2012) that there is limited capital available to invest in these energy reduction endeavours even when there is a strong business case. This has been well articulated through numerous reports that have identified the need for

councils to expand their thinking and embrace new opportunities to generate revenue and new opportunities to deliver value through partnering with the Energy Utility (Ergon Energy) Townsville businesses and organisations.

The Integrated Sustainability Services department has pursued its Council approval to source appropriate funding avenues on the basis that the project's feasibility is premised on no adverse net impact on Council's capital budget. That is, for the project to warrant positive consideration, no Council provisioning of additional capital is required.

Sister City Opportunity – Changshu

As one option for exploring innovative opportunities to leverage Council's long-term investments, preliminary discussions have occurred between businesses in Townsville's Sister City of Changshu (China) for potential for importing sophisticated LED street lights into Townsville and potential to support a local research trial and innovative financing and capital investment to overcome barriers to LED street light costs and risks. A local firm has already been importing PV (solar panels) from CSI (Canadian Solar Industries) as a direct result of the 2010 Townsville Solar City delegation (Cluster Connections) to China including Changshu, Dezhou and Beijing.

As a sister city Changshu encompasses a number of reputable experienced LED light manufacturing firms. These firms have an established track record of supplying domestically and internationally. Building on the ongoing dialogue between business connections in Townsville and representatives of the City of Changshu and businesses in Changshu - an opportunity for a partnering approach via an assisted non-capital purchase mechanism as emerged. This approach could see a research pilot of LED lights produced in Changshu and implemented in Townsville. This opportunity would leverage off the existing business and government relationships between Townsville and Changshu and possibly provide an excellent showcase for Changshu technology to be demonstrated in a tropical environment to build the relationship further. Whilst the technology and its application are well understood, application in a modern tropical regional urban environment such as Townsville is limited.

Case Study I: City Sustainability Hub and Learnscapes (Visualisation)

There is a growing trend of Businesses and Residents of the Townsville CBD learning from one another through conversations and workshops to achieve more energy efficient business practices and lifestyles. This however is largely constrained by time and space.

A City Sustainability Hub is a platform that aggregates digital services and products that mirror, extend and accelerate current capabilities within Townsville. Visitors, residents, businesses and communities are able to easily connect, learn, organise and collaborate in ways that can encourage individual and group behaviour. Collaboration supports our community in learning and working towards more sustainable systems of energy, water and waste in our homes and private and public buildings.

A City Sustainability Hub would aggregate information and knowledge from private and public sources to provide insight and data to the local business community and entrepreneurs as they look for opportunities to provide new products and services.

The Townsville CBD is a social space where common usage patterns are often based on context and personal comfort and requirements. A City Sustainability Hub will allow residents and businesses to contribute, read, comment, rate, like, share and aggregate data, information, pictures, videos, ideas and knowledge.

A CBD-based 'social hub' would be a way to keep energy efficiency in the day-to-day consciousness of residents and businesses in the CBD, to continue to tap creativity, to leverage data, information and feedback loops creating a personal and community sense of place relevant to their interests in business and lifestyle.

Key to the delivery of a CBD Sustainability Hub is the availability of a CBD-wide fast-broadband wireless network coupled with data storage and mobile device friendly visualisation platforms that interconnect with Smart Building technology and a Smarter Commerce and Social Business framework.

Activities underway include:

- MiTownsville Project (Townsville City Council Knowledge Management)
- AURIN Demonstrator Project (Townsville City Council, Ergon Energy, James Cook University (JCU), Queensland University of Technology (QUT) and Queensland Cyber Infrastructure Foundation (QCIF)).

Townsville City Council's Knowledge Management Department have developed and are delivering the MiTownsville Project which is made up of six priority workstreams that when developed and implemented holistically will deliver significant benefit for the local community. The workstreams include video conferencing (MiF2F) streaming communications and engagement (MiHub), big and open data and analytics (MiCloud), online services, payments and tracking (MiProperty), community online collaboration (MiHall) and personalised web with one ID (MiCouncil) – *MiTownsville Business Case 2012*.

Townsville City Council's Integrated Sustainability Services, Property Services and Infrastructure Services Departments are working with Knowledge Management to leverage from the MiTownsville Project to integrate the 'Smarter Buildings trial' and 'Sensor Networks' to develop 'end-to-end' visualisation.

Case Study J: CBD Green Corridors and Walkability Project

In collaboration with some students undertaking a short course in smarter cities a small scale walkability project was undertaken. In return for Townsville City Council, Integrated Sustainability Services sharing information about Townsville's Smarter city Initiatives and learning's from the IBM Smarter Cities Challenge, the students shared the results for their mini project examining the "Integration of Smart Technology and people as sensors to improve Comfort & Walkability in the Townsville CBD" (fig. 17). The students have had recent discussions with the staff of Integrated Sustainability Services about redoing this project and updating with relevant summer information.

- Townsville CBD rates highly in the walkability score total 85 from http://www.walkscore.com/score/townsville-cbd mentioning most errands can be run on foot. Current methods of walkability scale are representative of the proximity of goods and services within a defined area. This method while an extremely worthwhile tool based upon improving people's lifestyle, does not take into account the climatic factors that affect different regions, the study being based on living in Townsville. With Townsville being a tropical city with over 300 days of sunshine with temperatures reaching between 30 & 40 degrees centigrade and humidity often between 80 – 96% in summer the idea of walkability could be very different in reality.

- The survey looked at how comfortable people felt when walking the CBD and how easy they felt it was to walk. The survey aimed to use people as sensors by providing a tool that utilised the prevalence of smart phones in peoples everyday lives.

- Utilised the yomstar survey tool that enabled colour coding and notification when people provided responses below the wanted levels. Also enabled a low cost sensor network which respects privacy while enabling people to share their own experiences and provide feedback. As it was only a small project scale (1 week project design, 2 weeks implementation and write-up total – 3 weeks) it was designed to get the minimum amount of information from people so they would complete the survey once started.

- Aimed also at looking what people thought could improve an area and what they may do if they felt uncomfortable i.e. energy usage etc. – energy loads and movement through a city.

- At the time of the survey majority of people thought it was comfortable to walk in summer they thought it would be tolerable and that the CBD was an easy / moderately easy place to walk.

- Feedback received from the participants of the survey indicated that an increase in shading (trees, green walls, covered walkways, cooling stations) would be beneficial as a way to improve how comfortable they felt when walking in the CBD.

This last point supports the green frame strategy and key principles identified in the Townsville CBD Master Plan : Vision and City Making Projects, which enables the CBD to leverage the success of Townsville's diversified regional economy and would showcase the Townsville CBD as an:

- Exemplar model for sustainable living in the tropics;

- Liveable city: exemplary contectually designed streets, spaces and buildings make a comfortable and relaxed tropical centre all year and;

- Sustainable city: a sustainable centre internationally representing achievable elements of a futuristic EcoCity: through the use of sustainable initiatives that can be measured and

enhanced.

This builds on previous Green Wall and Building workshops held in Townsville in 2007-8.

Such green spaces would enable the CBD to respond to changing temperature gradients and in connection with green walls would increase the comfort of the CBD area.

Figure 17: CBD Walkability Project (Source: Townsville City Council 2013)

Case Study K: Cool Roofs CBD Project

It has been identified through Ergon Energy Marginal Abatement Cost (MAC) Curve Analysis and Solar Cities Community Based Social Marketing (CBSM) along with extensive research done by Roof Seal, Dulux and Smart Grid Partners, that painting the roof of a building white reduces the amount of heat entering that building and consequently reducing costs whilst improving comfort.

This is important for the buildings in the CBD as cooling accounts for most of the energy consumed and within the buildings and consequently the costs.

The implementation of a CBD Cool Roofs Project:

- Builds on the success of the Townsville Solar City Cool Roofs Townsville Program where a pilot program involving 11 Townsville homes participated in the monitoring and evaluation of the performance of painting their roofs white;

- Through the Energy Transformation Townsville Project, will apply the lessons learned from

the Solar Cities Program, research and implementation conducted by Ergon Energy, Smart Grid Partners and QUT as well as the knowledge and findings from the City of Melbourne and Townsville project partners including Roof Seal and Roof Guard;

- Townsville City Council's Walker St and Thuringowa Drive Administration buildings have had the roofs painted white to reduce the temperature of both buildings resulting and cost savings associated to reduced cooling costs. Through the Smarter Buildings Trials, both buildings will have advanced sensor networks deployed and data from both sites will be integrated with BMS, weather and economic data to find meaningful patterns to generate actionable information to support the optimisation of services on council buildings and other buildings in the CBD.

In building on these projects, a series of focus groups have been conducted within the community of Townsville and the results have been used to design a community wide survey to identify the barriers and benefits to the activities leading to the adoption of cool roofs in the CBD. This survey will inform the design for a CBD Cool Roofs work plan to identify and deliver tools to promote the Cool Roof adoption.

Testimonial – Cool Roofs Townsville Pilot Program

"We had the roof painted in November when the weather was starting to warm up. We could not believe how much cooler the house was the day after it was painted. The house is normally all locked up during the day and use to be quite hot when we got home in the afternoon. After the painting the house was cool to walk into at the end of the day. Our carport and patio are just the bare metal colorbond roof. You can put your hand on the underside of the colorbond in the middle of a hot day and the metal is not hot at all, where before it would have burnt you. We found that when home we did not put the fans on until later in the day and there was reduced use of air-conditioning during the day, as it was only needed on the really hot, humid days. I have certainly passed the word onto friends and know of a couple that have had their roofs painted."

- Pilot Program Participant with a single story 1980s era low-set bessa-block house in Condon

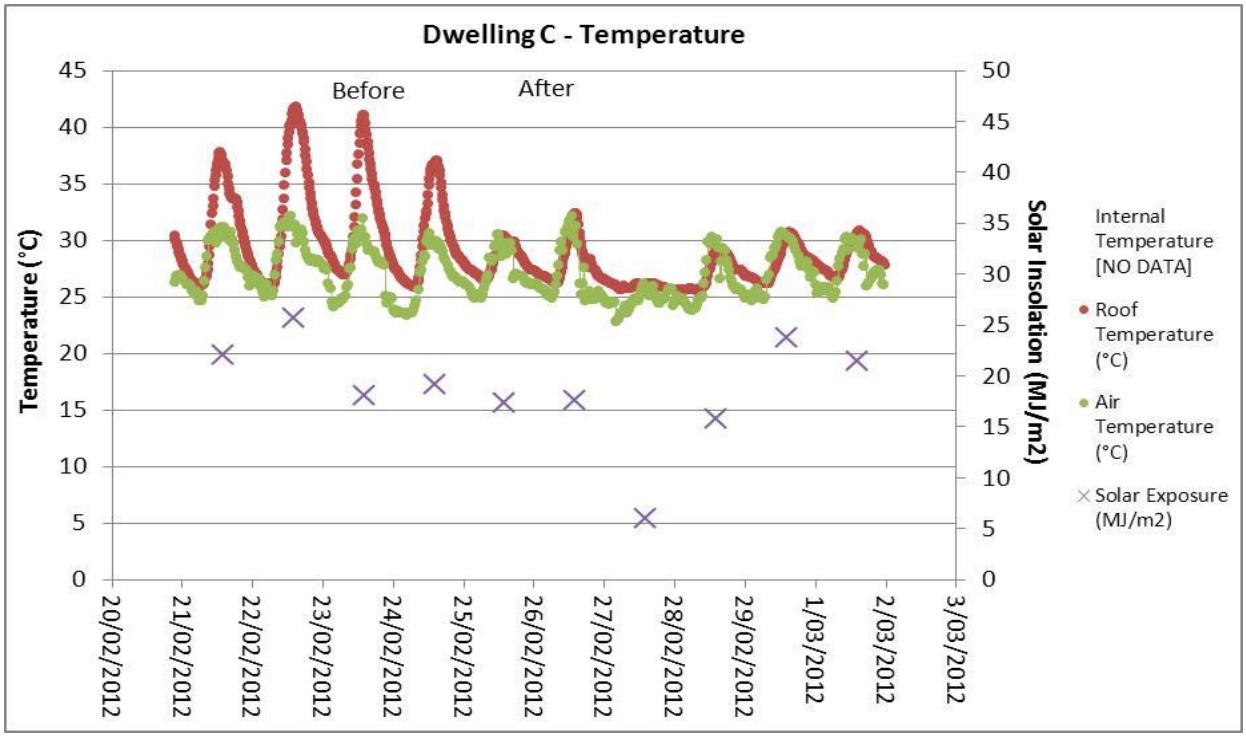

Figure 18: Results from a Cool Roofs Townsville Pilot Program Participant

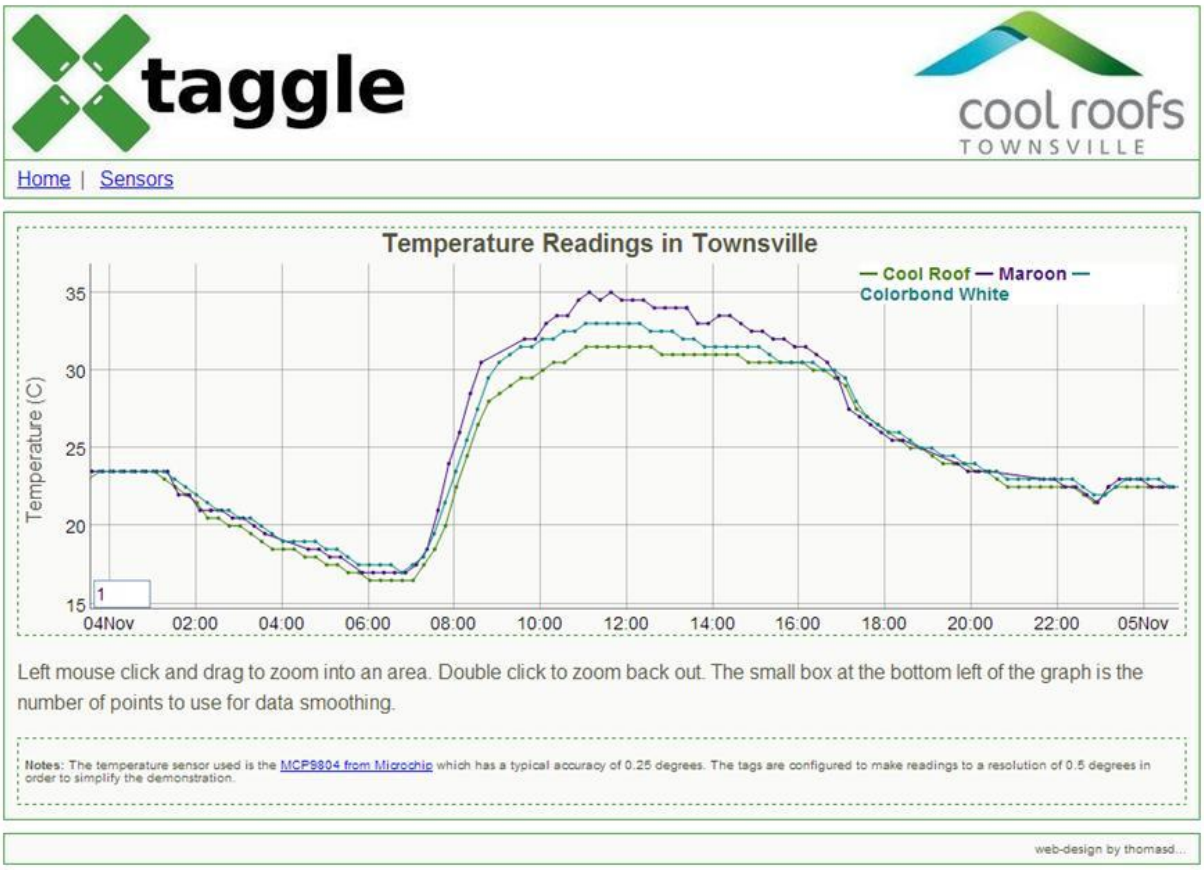

Figure 19: Cool Roof Comparison – Rowes Bay Sustainability Centre Trial (Source: Taggle and Townsville City Council 2013)

Acknowledgements

- Townsville City Council (Mayor, Deputy Mayor, Councillors and CEO)
- Townsville City Council (Knowledge Management and Property Services)
- Ergon Energy
- IBM Corporation (Smarter Cities Research and Smarter Planet Initiatives)
- James Cook University (eResearch)
- CBD Taskforce (Craig Stack)
- Guided Innovation Alliance
- Environmental Products and Services
    - Horan and Bird
    - Tropical Energy Solutions
    - AllSafe
    - Revere Projects
    - The Natural Edge Project
    - Electric Vehicles Queensland
    - Smart Grid Partners
    - ScienceMob Inc
    - TechNQ
- Professor Emeritus Sam Ham - University of Idaho, Department of Conservation Social Sciences
- Emeritus Professor Valerie A. Brown – Australian National University
- Community University of New York (CUNY) – Bronx Community College (BCC)
- Dr Joseph Fiksel - Ohio State University, Centre for Resilience
- Institute of Sustainable Communities (ISC)
- John Williams - Department of Science, Information Technology, Innovation and the Arts (DSITIA)
- City Links (ICMA Washington DC USA)