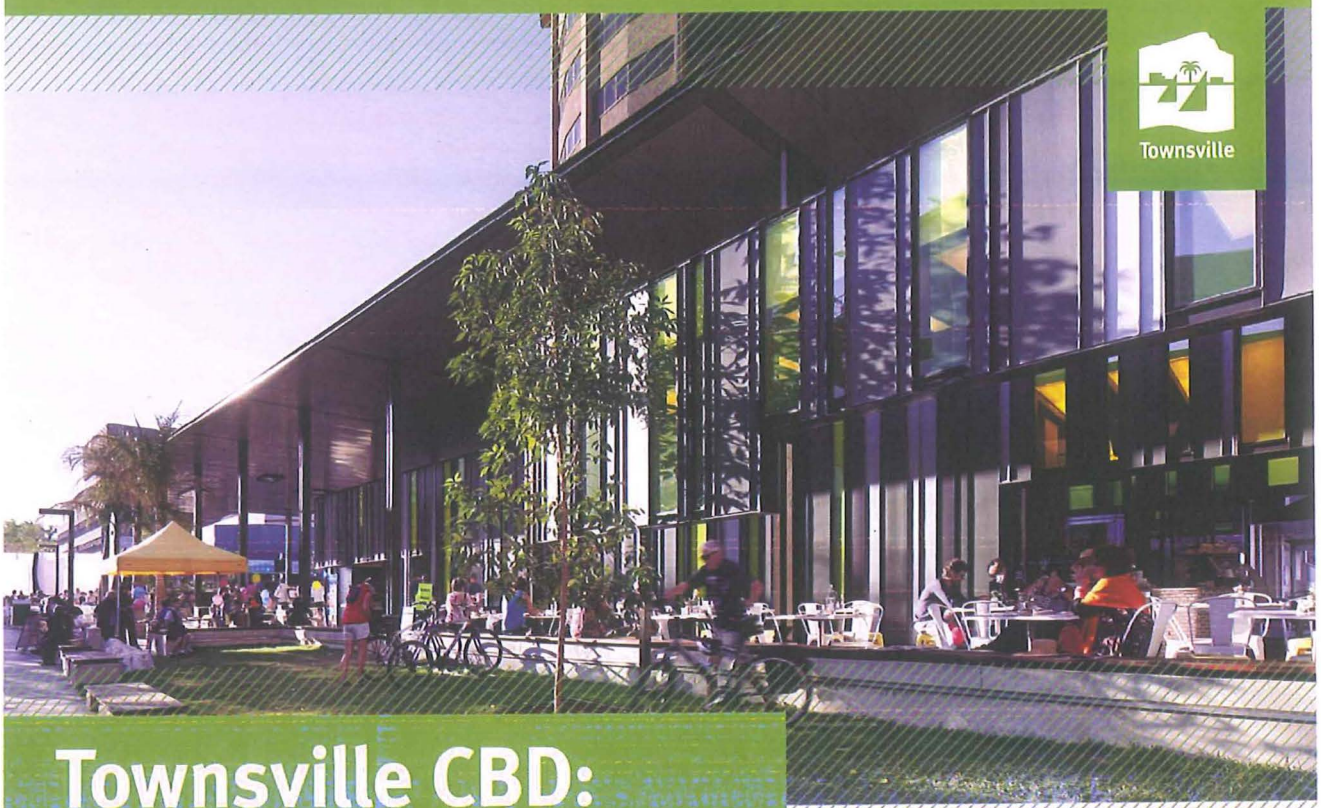


Townsville

Townsville CBD: Smart Infrastructure and Sustainable Energy Framework

IMPROVING LIFESTYLE AND COMMERCE IN THE CBD

Acknowledgements

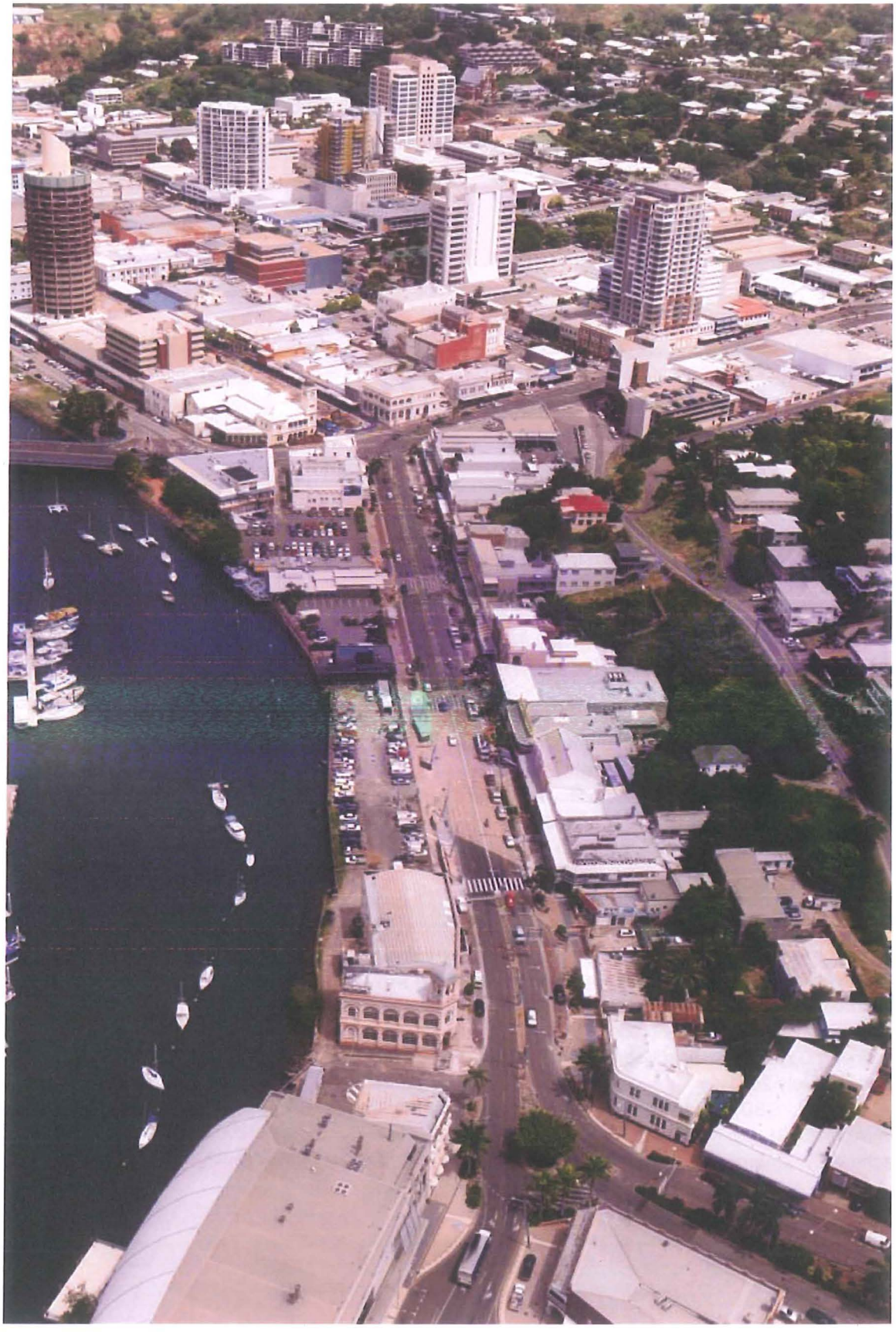
- Mayor, Deputy Mayor and Councillors
- Townsville City Council (Knowledge Management)
- Ergon Energy
- IBM Corporation (Smarter Cities Research)
- James Cook University (eResearch)
- CBD Taskforce (Craig Stack)
- Guided Innovation Alliance
- Environmental Products and Services
  - Horan and Bird
  - Tropical Energy Solutions
  - AllSafe
  - Revere Projects
  - Electric Vehicles Qld
  - Smart Grid Partners
  - ScienceMob
  - TechNQ

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Appendix 1: Townsville CBD – Smart Infrastructure and Sustainable Energy Framework (Project)
Sub-Project A – CBD District Cooling
Sub-Project B – Renewable Energy Micro-grid and Storage
Sub-Project C – Smart Buildings Pilot
Sub-Project D – CBD Sustainability Platform
Sub-Project E – CBD Urban Sustainability Sensor Network Pilot
Sub-Project F – Electric Vehicle Infrastructure (Bike, Car, Motorcycle and Bus)
Sub-Project G – Hybridised Low Carbon Energy Systems (Virtual Power Plant)
Sub Project H – LED Street light Project
Sub-Project I - CBD Sustainability Hub and Learnscapes
Sub-Project J – CBD Green Corridors Pilot
Sub-Project K – Cool Roofs CBD Project

Attachment A: Townsville CBD Cooling Project – TCC Overview May 2012 – Ergon Energy
Attachment B: Integrated Urban Energy Systems Infrastructure for the CBD (Spreadsheet)
Attachment C: IBM Smarter Cities Challenge Report (IBM August 2011)
Attachment D: MiTownsville Business Case – Townsville City Council
Attachment E: CBD Sustainability Vision – an Economic and Lifestyle Revolution (TCC 2012)
Attachment F: IBM Supporting content for TCC (Including IOC Architecture Dec 2012)
Attachment G: Commercial Green Buildings Design Charette - IBM Smarter Cities Challenge Townsville (July 2011)
Attachment H: CBD Taskforce and Integrated Sustainability Framework for CBD and Eco-City Action Plan (April 2012).
Attachment I: Emergent Business Practise Workshop – IBM Smarter Cities Challenge (July 2011)



A pathway to the CBD

1. Executive Summary

In Townsville, we face a wide range of challenges that interact and influence the sustainability of the city's support and governance systems such as transport, water, energy, communications, healthcare and social services[i].

The Townsville City Council is working with the energy utility, private enterprises, educational institutions and community organisations to 'figure out' new, innovative and collaborative ways to reduce the impact of the challenges whilst building resiliency to change and connecting people and organisations through the integration of these support and governance systems.

The Townsville CBD is a catalytic focal point for the transformation of the city to a *Smart Infrastructure and Sustainable Energy* future where a number of synergistically complimentary sub - projects are underway and embedded in the progression of the city through the partnerships and strategic direction of council (Figure 2).

By improving quality of life, lowering energy costs, attracting human capital, raising the city's global profile and reducing costs to the community, Townsville has the potential to be a catalytic driver for economic development in Queensland and Australia. "*Cities are increasingly evaluated by potential residents and industries on their ability to provide greater liveability; large scale business and investment networks, streamlined and integrated government services and sustainable solutions which are suitably subsidised*" (IBM Smarter Cities Australia[ii]) or where financial instruments that are practical, implementable and accountable exist.

Acting in ways that are connecting the community and the world and making it relevant to the way we all live and do business

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2. Introduction

No longer can we continue to exist as we have done in the past. As a society, we must continue to look for ways to do things smarter and more sustainably.

As Australia's largest tropical city, Townsville is embarking on a journey of change that is transforming the local community through the building of their capacity to behave more sustainably.

Townsville City Council's *CBD: Smart Infrastructure and Sustainable Energy Framework,* is an infrastructure project that is unlike any other undertaken before.

With a District Cooling and Renewable Micro-grid Infrastructure project at the foundation, the project builds on this bricks and mortar initiative with the objective of creating a world-leading, Smart, Sustainable, Tropical Urban Capital. The project 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 (Ernst & Young – June 2012).

How is Townsville doing this? Aligning with the city's Strategic Plan, CBD Master Plan[iii], Digital Economy Strategy[iv] and building on the Australian Government Townsville Queensland Solar Cities Project[v] and IBM Smarter Cities Challenge Townsville[vi]; the *Townsville CBD: Smart Infrastructure and Sustainable Energy Framework* works with key partners including energy utilities, global tech giants, local businesses and property owners, residents and other levels of government, to deliver a unique project that delivers on the three anchor pillars of economic and commercial value, community expectations and sustainability.

Cloud computing mixed with tangible underground infrastructure can combine to catalyse green buildings with smart metering, advanced analytics and photovoltaic superhighways that powers the booming future of Townsville. Through fostering a creative and energised work force, Townsville plans to increase the population of residents living in the CBD by 20000 by 2030 (CBD Taskforce 2012).

By building a smart, resilient and sustainable city, Townsville will become a model for the rest of the world to follow (Figure 1).

A key challenge remains... How do we leverage investment partnerships, utilise innovative financing and/or generate a return on investment (ROI) in combination with fundamental city building processes and development? A key question of the Ernst & Young Report (June 2012) – Strong Foundations for Local Sustainable Infrastructure.

What is the balance between obtaining an ROI on a sustainability project (or series of linked projects as is proposed in this case study) that needs a wide source of funds and contributes to community building of social capital, economic development and vibrancy of inner cities?

This project provides an excellent opportunity to investigate and showcase integrated financial models; grants and partnerships to achieve replicable and transferable sustainable city building demonstrating how to achieve financial cost reductions, city-wide energy efficiency in retrofit/new buildings, energy demand reductions and increased liveability that improve city-wide viability, resilience, adaptability including response to natural disasters.

- Townsville City Council - December 2012

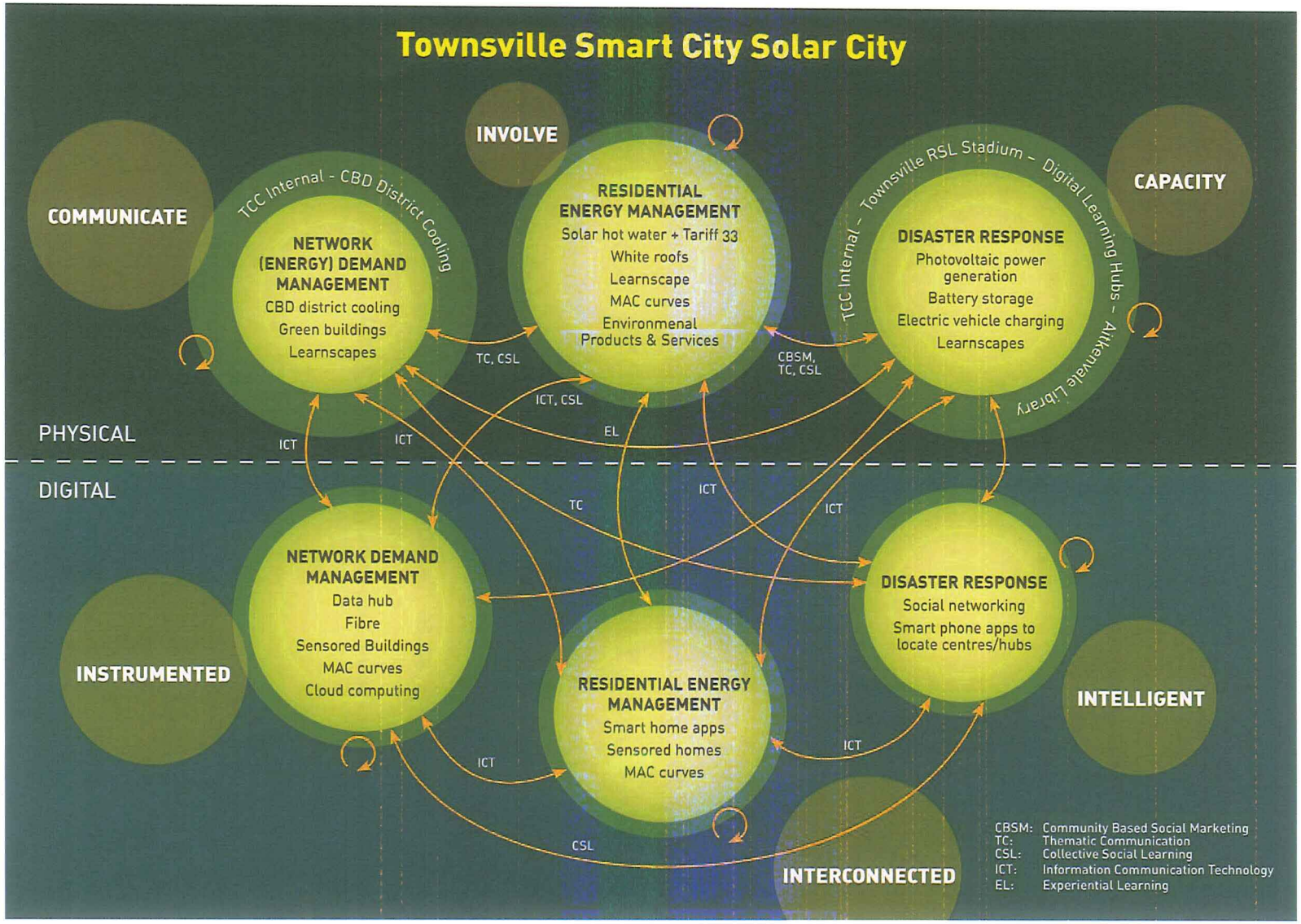


Figure 1: Emergent Townsville Smart City Solar City Framework

3. Business Opportunity

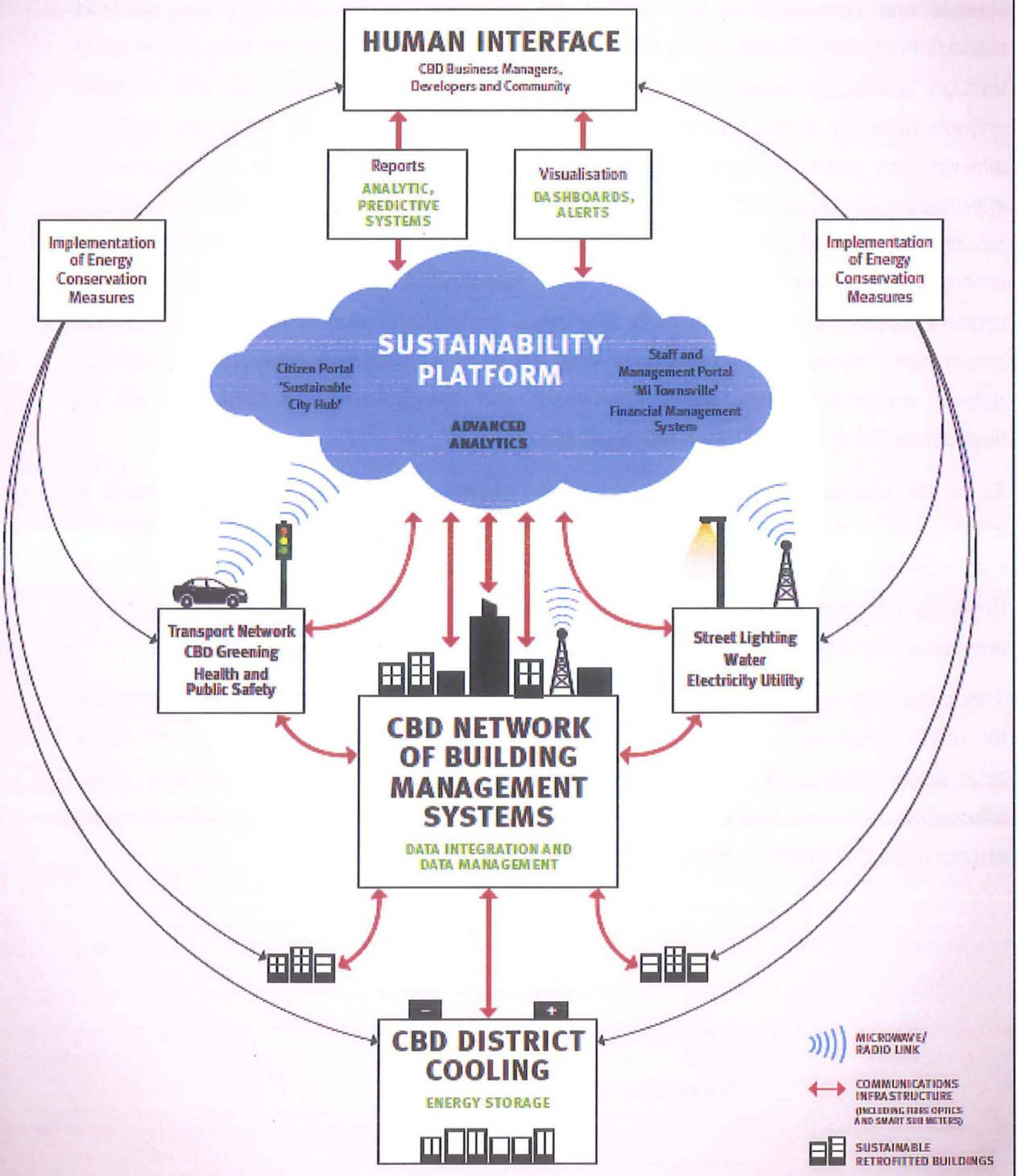
The *Townsville CBD: Smart Infrastructure and Sustainable Energy Framework* for improving lifestyle and commerce in the CBD is an integrated energy efficiency and demand management model incorporating bundled services/functions to create an economy of scale through leveraging investment partnerships utilising innovative financing and in some projects generate a return on investment. It can provide a "*seamless symphony" (IBM) of infrastructure asset management and investment, creating a "ecosystem of instrumented, integrated and intelligent devices which bridges the digital world with the physical world in a seamless way*" (IBM Smarter Cities, Townsville Smarter City Challenge Report 2011 and the emergent Townsville Smart City, Solar City Framework – see Figure 1 which integrates citizen engagement with the physical and digital dimensions). Potentially creating a "*virtual power plant*" combined with "*smart energy solutions and infused analytics that optimise natural resources*" (IBM), human behaviour and empowerment to think and act for themselves (TCC Citysolar Annual Report 2012).

To better enable sound business solutions, energy efficient and low cost leasing in commercial premises combined with industrial strength and sustainable energy infrastructure solutions such as Multi-stakeholder District Cooling, Renewable energy Micro-grids, Green Buildings and Smart - Technology integration using "*predictive analytics*" leading to the concept of "*foresight as a services*" (FAAS – IBM Research Laboratory 2012).

This project demonstrates world class innovation as an integrated project delivery structure for urban infrastructure, affordability combined with implementable financing and where appropriate community benefit subsidies, where efficiency and effectiveness drives affordability, the way that the community interact with the world and community-business engagement that matters (IBM Smarter Cities Australia).

Innovative thinking and transformative systems

TOWNSVILLE CBD
Sustainability Platform



TOWNSVILLE CITY COUNCIL

4. Customers

The customer segments for this project are the **businesses and community that reside and utilise the services provided within the CBD of Townsville**.

The operational costs for businesses and living costs of residents are on a rising trend and can potentially become unaffordable to continue to operate or live unless something changes in the way we do business and deliver services particularly in the CBD. Of these costs, a significant proportion is due to identifiable, actionable and preventable inefficiencies in energy resources. Identified through collective learning process and market research underpinned by community based education and involvement led by Townsville City Council and Ergon Energy, there is a need for a *framework for change* that will assist businesses and residents to think and act in different ways around energy use where losses can be turned into profits, savings can be achieved and the hidden costs of living and operating in the CBD of Townsville can be uncovered in real time and pathways made available so each individual and business can act for themselves, especially in the face of the economic climate that exists today with rising electricity costs and a price on carbon.



Emergent Business Practise Stakeholder Workshop - IBM Smarter Cities Challenge

5. Key Partners

- Townsville City Council – Lead proponent
- Ergon Energy – Townsville Energy Sense Community / Commonwealth Solar Cities
- IBM Corporation – Smarter City Research / Smarter Planet Initiatives
- CBD Taskforce
- Townsville Chamber of Commerce
- Townsville Enterprise
- City developers and commercial interests
- Environmental Products and Services Network
- James Cook University
- ICT Business Network
- Guided Innovation Alliance
- ScienceMob Inc
- TechNQ
- Activated Citizens
- Building Owners

Collaboration Key to Energy Innovation

An industry – research alliance is shortening the pathway to market for new innovations in the electricity sector.

Guided Innovation Alliance (GIA)

The GIA is an industry-applied research collaboration established to address barriers to uptake of innovations to the electricity sector. These barriers include:

- Less than effective collaboration between industry and research agencies in electricity sector innovation;
- A lack of guidance to innovators as to the needs of the end market;
- The need for impartial scientific validation of new technology innovations;
- Lack of understanding of applied value of innovations; and
- Difficulty in extrapolation of whole of society benefits of an innovation so that policy makers can make informed decisions.

The GIA was formalised in a Collaboration Agreement in October 2011. It has a pipeline of activities currently underway or under consideration addressing key priority issues for the industry. Areas of immediate interest include:

- Demand and Energy Conservation;
- Renewable Energy Integration;
- Voltage Optimisation;
- Storage - Thermal and Electrical Storage Innovations;
- Waste Heat Capture and Distributed Generation;
- New funding models; and
- Electric Vehicles.

Challenging Environment

This is a time of great change for the electricity industry. The demand for affordable, high quality, high reliability electricity to power our digital world is increasing. Rapid social and technology change presents risks along with opportunities. Recent experience suggests that despite best efforts, the rate of change can still overtake the capacity of the industry to respond -Solar PV deployment is a good example.

The global demand for electricity to support our digital lifestyles seems insatiable. Converging issues of customer affordability, low carbon electricity supply, safe access, regulatory changes, customer behaviour, technological change and environmental responsibility are combining to create a dynamically changing industry. Electricity distribution is rapidly moving from analogue to digital.

The disaggregated structure of the electricity industry does not readily lend itself to solutions which address equitable sharing across the various stakeholders in the value chain. In this structure new innovative models based on holistic systems thinking must be created to transition us to a sustainable energy future.

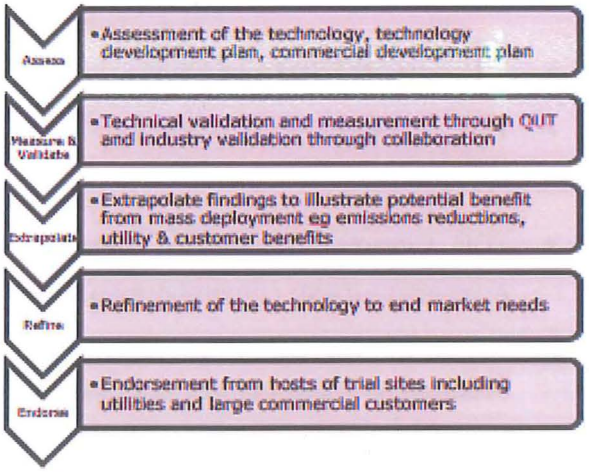
Key challenges include:

- Increasing customer expectations for affordability, service and choice;
- Mitigation of peakier loads to improve supply costs, capital spend and asset capital efficiency;
- Improving the level of demand side participation;
- Life extension and performance improvement of aging and stressed networks; and
- Reduced environmental impacts including increased renewables contribution.

Collaboration Gap

Despite best efforts the collaboration between research institutions and electricity distributors has been suboptimal. The GIA seeks to address this collaboration "gap" by identifying the needs of the industry and connecting with the research expertise within a commercial framework.

Value Proposition



Through this process the GIA can assist in preparing the entity for future fund raising, ensuring it can withstand due diligence and establish appropriate governance and business plans.

The Collaborators

Queensland University of Technology (QUT) is a leading Queensland university and is a national leader in collaborative industry research and teaching.

Ergon Energy is a distribution network service provider with a long history of innovation in the electricity industry

SmartGrid Partners is a solutions integrator established to provide strategic advisory and venture capability.

Brookfield Financial are a financial arm of the Brookfield Group, one of the largest infrastructure asset owners in the world.

6. Business Environment

Townsville City Council has a focus on the sustainability of the city with particular interest in the CBD through its innovative and collaborative sustainability programs that have been developing a transformative systems approach to utilising collective knowledge and individual actions to generate new systems that integrate the environmental, economic and social dimensions of commerce and lifestyle.

Council has a proven track record of working with the energy utility (Ergon Energy), developers, builders, environmental products and services businesses, ICT business network, research institutions, building owners and residents to deliver energy efficiency, demand and supply-side management initiatives throughout the whole of community.

Specifically this has included:

- The Commonwealth Townsville Queensland Solar Cities Project
- Townsville Network Demand Management Pilot which includes TCC Multisite, TCC Energy Performance Contract and CBD District Cooling Projects
- IBM Smarter Cities Challenge
- The development of a Smarter Water Research pilot in partnership with IBM research.
- TCC Citysolar Community Capacity Building Program which includes one of Australia's most comprehensive Community Based Social Marketing (CBSM) behaviour change programs – The Townsville Residential Energy Demand Program – where the key target behaviours are; Painting the roof with a white or heat reflective light coating (Cool Roofs Townsville Project), Replacing electric hot water systems with Solar/heat pumps and Planting shade trees especially on the western side of the building.
- The development of solar technology demonstrations and interpretative educational experiences for businesses, schools and the community.
- The facilitation of whole-of-community Collective Social Learning and Emergent Business Practise Workshops around energy efficiency and sustainability.

- The establishment of a knowledge network cluster approach to bridging learning and knowledge gaps involving a Sustainable Townsville network – Townsville: A Centre for Excellence in Tropical Design for Sustainability and Innovation.
- Established capacity building connections with a renewable energy corridor between Townsville and Mt Isa.
- Development and delivery of a number of Urban Sensor Network Pilots in partnership with JCU, ScienceMob Inc, Federation Place and Finlay Homes.

Townsville City Council has the capacity and resources both internally and through its strong partnerships and collaborative framework to deliver whole-of-community transformative projects for the city including leveraging the financial and non-financial resources available.

Townsville City Council has developed a number of collaborations and partnerships with different levels of government, the corporate sector, industry and the community and through this network of communications it has been identified that the businesses and residents of the city are adequately positioned to be involved in smart sustainable approaches to increasing commerce and liveability in the CBD.

The city-wide National Broadband Network (NBN) will provide a great opportunity to not only leverage off the high speed / high capacity communications network, but to also capitalise on the infrastructure development and relationship building.

The integration of the James Cook University Tropical Data Hub with the Australian Urban Research Infrastructure Network (AURIN) project will provide businesses in Townsville with the ability to access data and information that can benefit their operations.

Utilising all of our collective knowledge, visions, ideas and actions

7. Strategies

Each sub-project has been worked through by key stakeholders in a series of workshops facilitated by Townsville City Council and outcomes are outlined in in the form of a **Strategic SWOT Analysis** in the relevant sections of this report (See Sub–Project Details).

Functional

The Townsville CBD: Smart Infrastructure and Sustainable Energy Framework Project will build competitive advantage through achieving **Superior Innovation**. The integration of smart technology, infrastructure, renewable energy systems and data analytics can result in new products and services that can better satisfy customer needs, enhance the quality of existing structures and processes, increase efficiencies (including reducing costs) for business operations (Table 1).

Table 1: Functional Roles for the Project to Achieve Superior Innovation.

Value Creation Function	Primary Roles
Infrastructure (Leadership)	• TCC will lead and manage project • TCC will facilitate roles and responsibilities of project partners and build collaborative / co-operative framework.
Production	• TCC will build co-operation between partners on project design and maximise efficiencies with delivery • TCC will continue to work with partners to develop new process innovations
Marketing	• TCC will provide market information to partners • TCC will work with partners to develop new products
Materials Management	• Project partners to be responsible for their own management of materials
R & D	• Project partners will foster continuous development of new products and processes • Vertical and horizontal cross-functional collaboration through collective shared knowledge to maximise innovative thinking
Information Systems	• Project will utilise the information systems already in place and leverage off new systems to co-ordinate project management • Project will be supported by TCC Knowledge management MI-Townsville Project
Human Resources	• Project partners will utilise local expertise and invest in specialist involvement

Business Level and Competitive Positioning

As the services delivered by the *Townsville CBD: Smart Infrastructure and Sustainable Energy Framework* are targeted mostly to building owners and occupiers, a **Focussed Market Segmentation** approach will be taken. This will allow the project to allocate all resources to developing the product and delivering the service to this particular target segment.

During the initial stages of the project, financing may be sought from investment by project partners and costs incurred by customers utilising the services. At this stage, the project would be pursuing a **Differentiation** business model due to the unique service delivered that is different from anything currently available. The project will gain a competitive advantage as it will deliver services that will address the needs of the customers i.e. energy savings, network efficiencies, capital deferral and reduced operational and living costs; which allows it to charge a premium price to create value for investors.

As the project matures and return on investment is reached and/or efficiencies in delivery reach comparative advantage, the business model can shift to a more **Cost Leadership** positioning through lower prices and higher efficiencies. At this point the feasibility of further project development may be reached.

Going above and beyond
in search of better ways

8. Innovation Process

The *Townsville CBD: Smart Infrastructure and Sustainable Energy Framework* will capture and create value from its integrated project delivery structure for urban infrastructure with significant importance of demonstrating clear benefits (social, financial and environmental) to the community and stakeholders.

Building on a generic Innovation Entrepreneurial Model[vii], Townsville City Council through its Citysolar Community Capacity Building Program has developed an Emergent Business Practise Innovation Cycle which integrates Professor Valerie Brown's (Australian National University) Collective Social Learning as an approach to uncovering pathways to sustainable (social, economically and environmentally viable) project innovation and delivery.

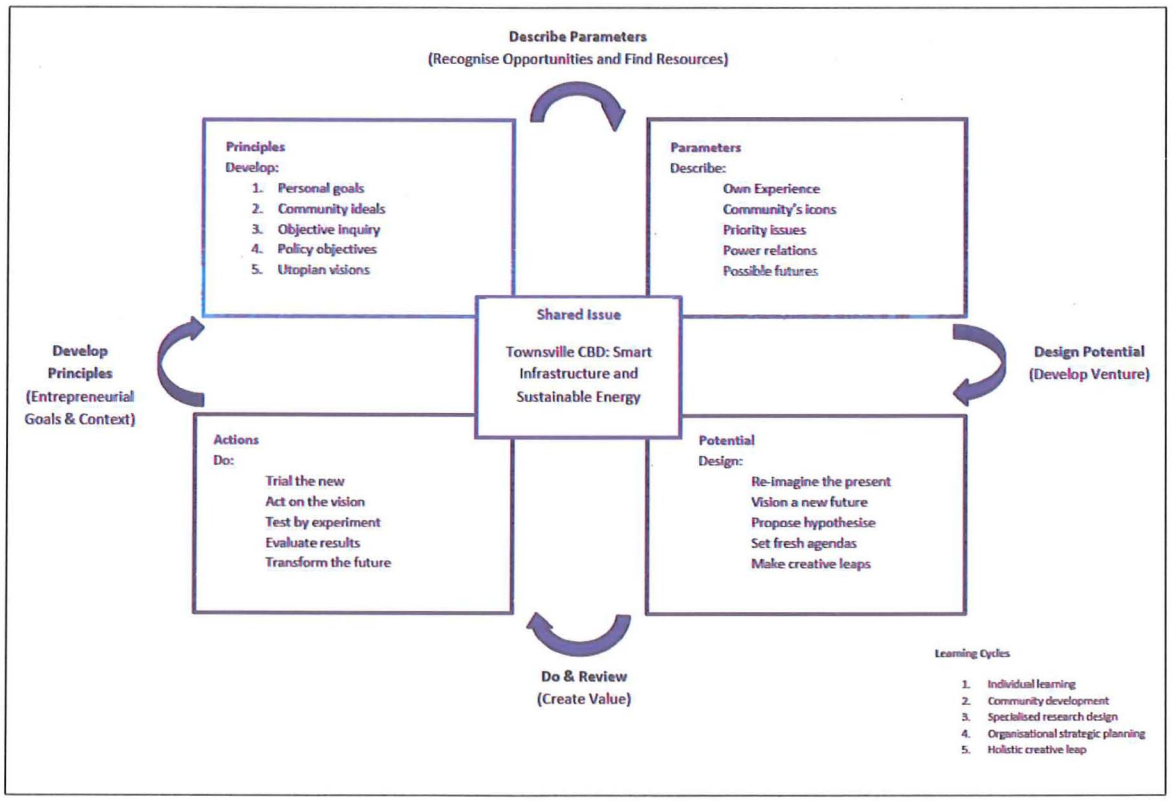


Figure 2: Emergent Business Practise Innovation Cycle (Adapted from Collective Social Learning (Professor Valerie Brown – Australian National University) and Innovation Process (Bessant & Tidd 2011).

9. Project Goals

Council's vision is for Townsville to be vibrant, progressive and a great lifestyle. Its mission is working with our community to provide quality services through commitment and leadership.

The Townsville CBD: Smart Infrastructure and Sustainable Energy Framework is a CBD-Business-Citizen wide integrated and collaborative model that brings together the collective knowledge and individual expertise that has delivered synergistic and successful projects for Townsville.

The Framework is supported by the simultaneous delivery and synergising of key sub-projects that are built on research and implementation trials delivered by the project partners through the city's sustainability programs such as the Commonwealth Solar Cities Project, Smarter Cities Initiatives and Ergon Energy's Network Demand Management Project and Energy Sense Communities.

Overall Goals:

1. Establish an interconnected CBD wide communications hub utilising the very fast broadband from the NBN fibre and wireless network (MiTownsville Business Case) which supports green buildings and energy management with advanced analytics (IBM Smarter City Research).
2. Townsville City Council to lead implementation of the first part of Stage One of the CBD District Cooling Master Plan (base on TCC owned assets, and adjacent and feasible buildings).
3. A strong foundation for developing sustainable energy and smart local infrastructure in the CBD via liveable, connected community that integrates innovative financing options.

Sub – Project Goals

Sub-Project	Main Goals
A. CBD District Cooling Project	▪ A decrease in the maximum demand for the CBD ▪ An increase in the NABERS Energy and Water Ratings for the building. ▪ A decrease in the carbon emissions associated with the building. ▪ An increase in the reliability of the chiller plant through an increase in the redundancy of the chiller plant (should one chiller fail). ▪ Reduced life-cycle costs for climate control ▪ A decrease in upfront capital required for plant installation and upgrades ▪ A decrease in the risk associated with Legionnaires disease. ▪ A decrease in the spatial requirements for plant within the building.
B. Renewable Energy Micro-grid and Storage	
C. Smart Buildings Pilot	
D. CBD Sustainability Platform	
E. CBD Urban Sustainability Sensor Network Pilot	
F. CBD Electric Vehicle Infrastructure Project	
G. Hybridised Low Carbon Energy Systems – Virtual Power Plant	
H. LED Streetlight Project	▪ Improve the energy efficiency of existing streetlights in the council footprint ▪ Break through current structural, financial and stakeholder barriers on street lighting for local governments with a new collaborative model ▪ Leverage the availability of external financing sources for a cost effective step change in accelerating the transition to energy efficiency in street lighting. Outcomes for Council • Reduction in emissions • Lower energy costs and maintenance costs by up to [60%] • Protection against future cost increases • Improved amenity • Potential to provide leadership in a whole of state LED streetlight swap out • Consistent with current energy sustainability programs • Leverage its Solar Cities credentials Outcomes for Ergon Energy • Demand reduction in areas where there is an evening peak • Reduction in CSO • Potential model for whole state Outcomes for Australian Government: • Emissions reductions • Highly leveraged funding - $5m could facilitate whole state swap out. • Breaks through current barriers of financial costs, approvals and stakeholder relations to streetlight swap outs and achieves many of the identified actions contained in the Draft Street Lighting Strategy July 2011.
I. Digital Learnscapes & City Sustainability Hub	
J. CBD Green Corridors Pilot	
K. Cool Roofs CBD Project	

10. Integrated Project Delivery Structure

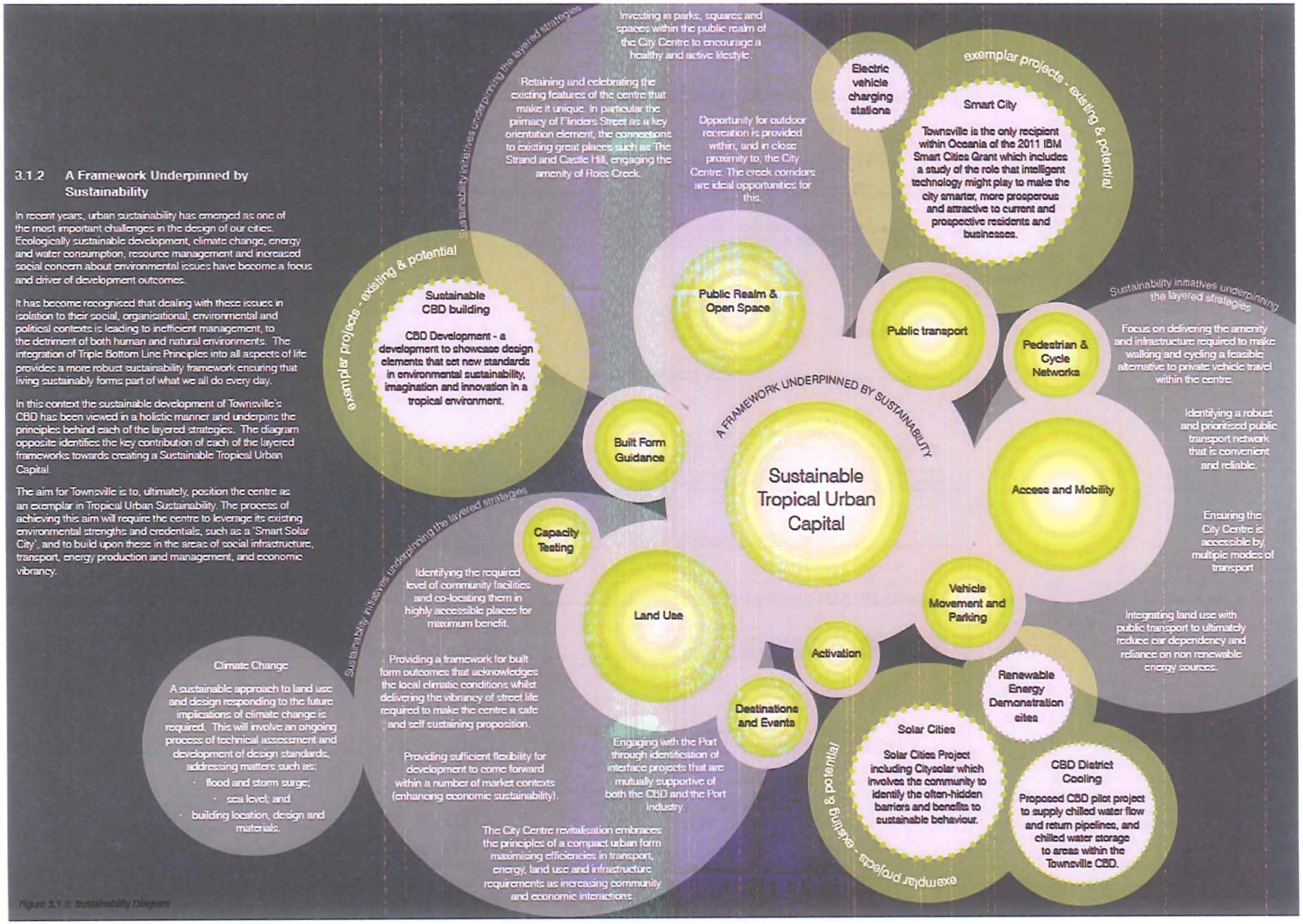


Figure 1: CBD Sustainability Framework and Project Delivery Structure

	Sub-Project	Activities	Implementation Cost	Project Status	Integration	Scalability	Replicability
A	CBD District Cooling Project	- Finalise project brief and tender documentation - Engage with project partners and stakeholders - Review tenders and award design and construct contract - Commissioning and operation	c. $15 million for Stage 1 c. $2.5 - $3 million for Townsville City Council buildings only	Pre-feasibility commenced, Detail planning commenced and subject to barrier (including financial constraints and is designed to be shovel ready within 12 months			
B	Renewable Energy Micro-grid and Storage	- Final roof inspections - Design system structure - Development contracts - PV and battery procurement - Implementation stage	c. $4 million	Trial projects as part of Townsville Solar City commenced and preliminary investigations and concept ideas develop			
C	Smart Buildings Pilot	- Contract development - Sensor deployment - Platform development	c. $500,000 - $1 million	Trial projects underway and consistent with advice from IBM Smarter City Challenge Report. Project workshops completed. Can be shovel ready within 12 months.			
D	CBD Sustainability Platform	- Contract development - Equipment installation - Platform development	c. $300,000	Concepts developed and can be shovel ready within 6 months.			
E	CBD Urban Sustainability Sensor Network Pilot	- Research finalisation - Sensor deployment - Platform development	c. $150,000	Trial projects underway linking buildings.			
F	CBD Electric Vehicle Infrastructure Project	- Research finalisation - Contract negotiation - Procurement stage - Implementation stage	$200,000	Trials underway – including Ergon Energy Townsville Energy Sense Community, EV trials. Consortium partnership with TechNQ and EV Qld for EV vehicle modification and integration with utility. Queensland's first public charging station installed on the Strand as part of Townsville Solar City Project (Citysolar).			
G	Hybridised Low Carbon Energy Systems – Virtual Power Plant	- Innovative PV and Storage Research - Partners and investment models Contract development and negotiation - Procurement stage - Implementation stage	$500,000	Concept Development			
H	LED Streetlight Project	- Lighting procurement - Contract development - Installation stage	$1.6 million	CEEP funding submission prepared and submitted Round 1 (unfunded). Is shovel ready subject to contracts and financing.			
I	City Sustainability Hub & Learnscapes	- Platform development, data integration and visualsation	$250,000	Physical learnscapes developed, digital platform concept developed, partnerships formed - seeking funding. Shovel ready subject to contract documents and financing			
J	CBD Green Corridors & Walkability Pilot	- Research finalisation - Implementation design - Implementation stage	c.$500,000	Concepts developed and previous base line projects completed.			
K	Cool Roofs CBD Project	- Roof inspections - Contract development - Coating application	c.$250,000 (Based on 12,000sq m of roof space in conjunction with PV microgrid)	Trials completed, research data developed and geospatial demographic profiling completed.			

11. Proposed Funding Sources

Funding vs Financing

Different options exist for paying for infrastructure (see above table) including grants, contributions. Additionally finance can be raised up front to deliver infrastructure which then can be paid.

Financing

Private finance for trial projects

Low interest loans

Tax increment financing

Review of Asset Ownership – sell off assets to create revenue/equity financing

Funding Sources

Community Bonds

Community Clean Energy Market – Carbon Townsville Community Cluster

Development Charges

Regional Development Australia Fund

Example Project for financing options:

Sub-Project H – LED Streetlighting

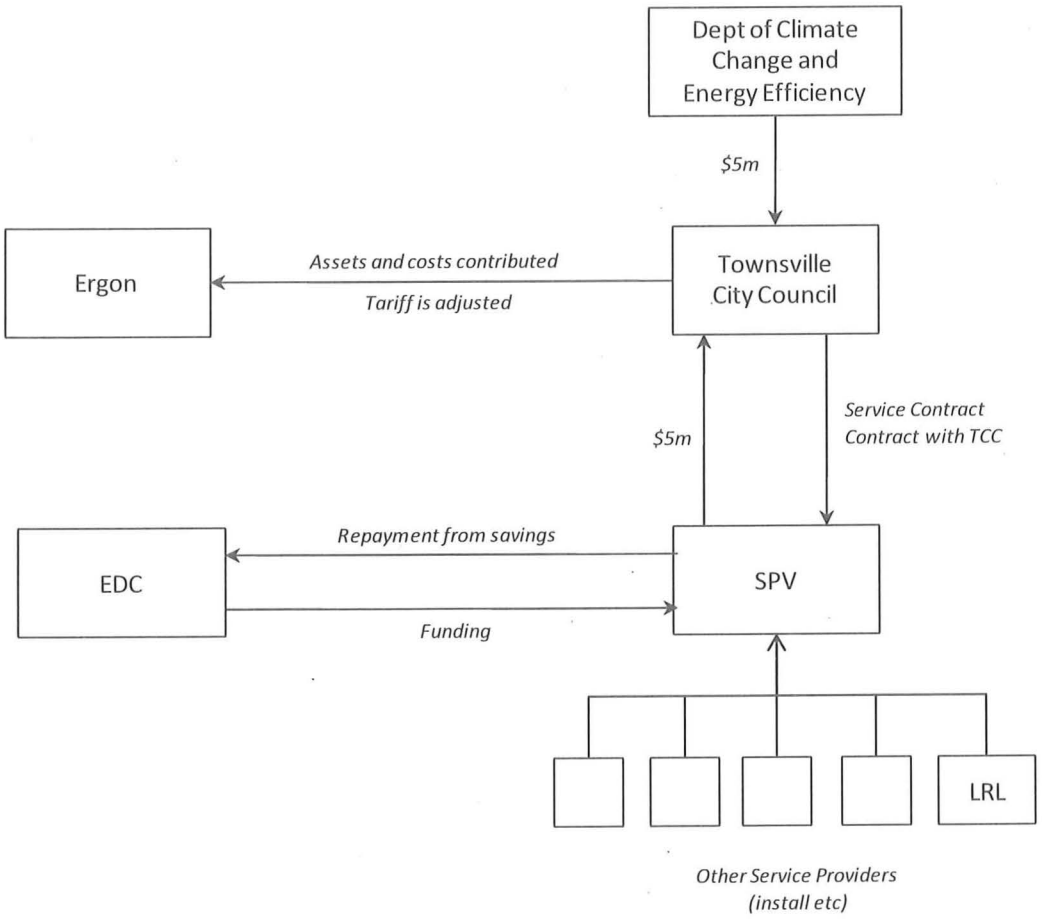
Brookfield Financial are in the process of exploring two alternatives for the structuring of the cash flows. As recognised in documents released by the Federal Government, one of the biggest impediments to efficient streetlight swap outs is getting cooperation from the relevant electricity distributor.

We have sought to overcome this by having Ergon Energy as part of the consortium. However, in order to ensure that implementation is as smooth as possible for both Townsville City Council and Ergon we have developed two basic structures

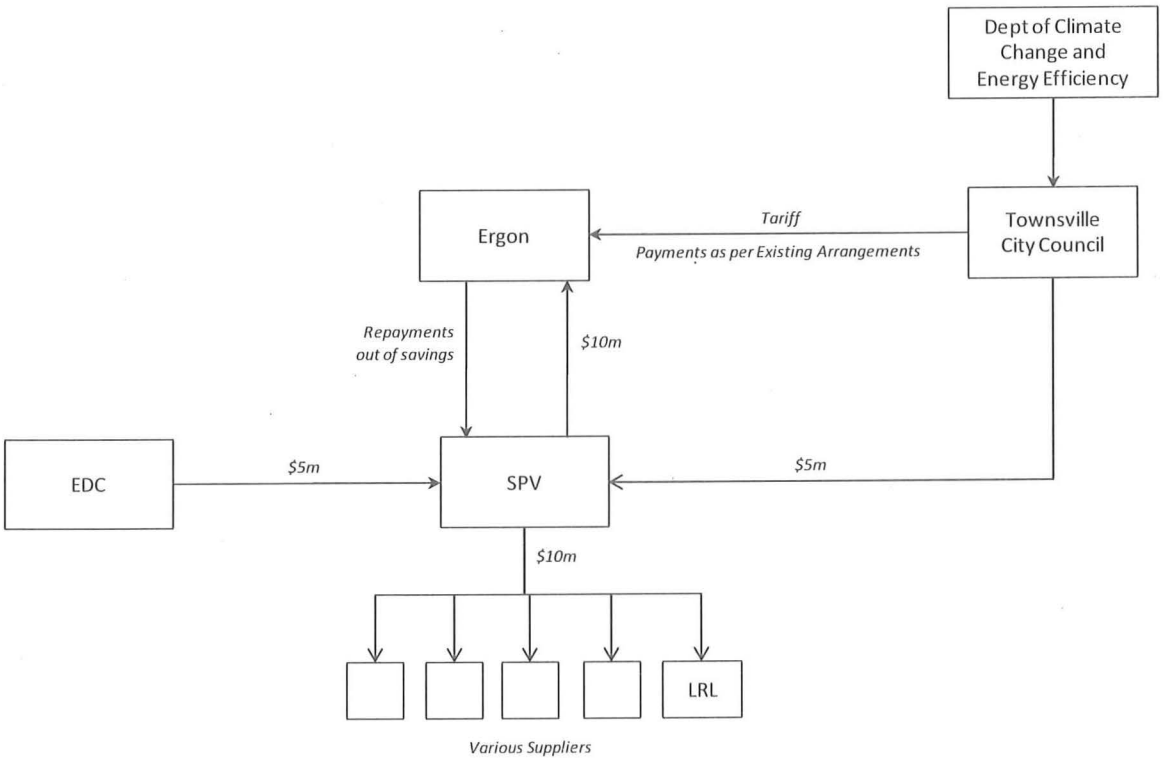
Current



Option 1



Option 2



Tariff payments remain the same until EDC funding is repaid.

Note that Option 1 is the preferred option however Option 2 achieves the same economic outcome for all parties. Option 2 is included as a fallback in case there are any technical impediments to Option 1.

Source: Guided Innovation Alliance (see attachment) and Townsville City Council LED street lighting proposal.

Sub-Project Funding Sources

	Sub-Project	Direct Contribution	Grants	Innovative Investment models	In-Kind Contributions (e.g. Research)
A	CBD District Cooling Project	**TCC Asset renewal (Capital works)**	Clean Energy Program (CEEP)	Low Carbon Australia – Low interest loan	Ergon Energy
B	Renewable Energy Micro-grid and Storage		Regional Development Grants	-Community Bonds -Community Clean Energy Market	Environmental Products and Services **Ergon Energy**
C	Smart Buildings Pilot		Clean Energy Program (CEEP)		IBM Research Lab
D	CBD Sustainability Platform				Citizens
E	CBD Urban Sustainability Sensor Network Pilot				JCU Research, ScienceMob
F	Public Transport and Electric Vehicles				Guided Innovation Alliance
G	Hybridised Low Carbon Energy Systems – Virtual Power Plant				
H	LED Streetlight Project		Clean Energy Program (CEEP)		Guided Innovation Alliance
I	Digital Learnscapes & City Sustainability Hub				Citizens
J	CBD Green Corridors Pilot		Community		Community / Citizens
K	Cool Roofs CBD Project				Guided Innovation Alliance
	Total Project Funds				

12. Governance

While no overall Governance structure has yet been determined for the whole proposed Townsville CBD: Smart Infrastructure and Smart Energy Framework - individual sub-project governance and investment frameworks have been established for specific projects:

- CBD District Cooling (Ergon Energy – Report to TCC dated May 2012)
- LED streetlights (GIA and TCC Project Submission for LED Street Lighting)

Investigations into potential governance and investment frameworks have been completed by Ergon Energy for PV Super highway concept (Sub-Project B – Renewable Energy Micro-grid and storage)

As a specific research alliance – the Guided Innovation Alliance (GIA) has established a governance structure between project partners (Ergon Energy, QUT, Brookfield Technologies and Smart Grid Partners) in order to develop shortened pathways to market for new sustainable energy innovations in the electricity sector (see attachment GIA – Collaboration Key to Energy Innovation).

13. Project Plan

To be developed using the Townsville City Council Project Management Framework for both overall Smart Infrastructure and Sustainable Energy Framework and individual Sub-Projects.

The TCC Project Management Framework is a proven risk reduction tool designed to effectively implement urban management projects implemented by council.

14. Risks

No	Risk	Risk Rating	Control and/or Mitigation Strategy	Risk Owner
1	Quality: Project team missunderstands the key project objectives which results in ineffective, inefficient and unproductive use of project resources	High	Develop detailed project implementation plan and monitor project actions consistent with the project objectives.	Project Director
2	Financial Issue: Scope of work exceeds project budget and program deliverables impacted due to insufficient funds.	High	Experienced energy auditors utilised to develop scope of work budgets with accuracy defined by relevant standards or best practice guideline.	Project Director
3	Governance: Maintenance and support for resources necessary to apply project management framework	High	Project Director and delivery team informed of project requirements. All meeting minutes distributed to leadership team and monthly reporting of project issues addressed with Project Director for resolution.	Project Director
4	Scope: Course of actions becomes constrained to known technologies with demonstrated performance and life cycle cost benefits and innovative measures do not necessarily achieve the best operational ROI / life cycle benefits (ie. innovative technologies).	High	Engagement with skilled and experienced professionals and contractors to ensure maintenance of cost / benefit outcomes.	Project Director
5	People: Insufficient resources to maintain obligations identified in funding agreement.	High	Review project resourcing requirements monthly. Allocate additional resources or raise delivery constraints with Project Team.	Project Director
6	Communication: Keeping project team and stakeholders informed of status of overall project.	High	Develop Project Plan stakeholder communication plan and review at regular project meetings.	Project Director



Foreground: CBD Flinders Mall Pavilion with 54kW Solar Array
Background: CBD Green Building

Appendix 1:

Sub - Project A: CBD District Cooling Project

Ergon Energy Corporation Limited (Ergon Energy) and Townsville City Council (TCC) have been key project partners in promoting and developing Townsville's future growth. The Townsville CBD District Cooling Project provides the opportunity to position Townsville with key urban sustainable infrastructure to make the CBD area more attractive to developers, tenants and landlords whilst enhancing Townsville's global reputation as an integrative and environmentally responsible sustainable city.

Council's continued committed involvement is developing from hosting the site of the proposed cooling facility, being a customer of the system and partnering to demonstrate the benefits to the community as a whole to leading the next stage of development of the project in progressing a design and construct tender process.

The alliance with Ergon Energy has realised a detailed feasibility which addresses all project planning, financial, technical, stakeholder, partnering and costing information. A copy of the report is attached (Attachment A) and a summary of the key points is as follows:

Project Objectives and Outcomes:

The district cooling system should meet a number of benchmarks in order to be an attractive proposition for a building owner. These requirements in turn will define the design of the plant. Customers will have a variety of reasons for signing up to take chilled water from the DCS. The goals of the DCS should provide some or all of the values to the customer.

- A decrease in the maximum demand for the CBD
- An increase in the NABERS Energy and Water Ratings for the building.
- A decrease in the carbon emissions associated with the building.
- An increase in the reliability of the chiller plant through an increase in the redundancy of the chiller plant (should one chiller fail).
- Reduced life-cycle costs for climate control
- A decrease in upfront capital required for plant installation and upgrades
- A decrease in the risk associated with Legionnaires disease.
- A decrease in the spatial requirements for plant within the building.

Stakeholder Engagement

Council recognises that stakeholder and customer engagement is a critical component in ensuring whole of community support for this essential urban infrastructure to deliver sustainability on a bigger scale to the CBD.

Stakeholder involvement is developed with collective social and emergent processes creating whole of community support by involving them in multiple linear (meetings and workshops) and non-linear (experiential learning and thought provocation) processes and activities to enrol them into the importance of protecting the living systems in our evolving city.

Technical Details

The general master plan of the system is to form a ring main around the city connecting multiple buildings and provisioning the system to enable chilled water to be supplied from both directions to maintain integrity of the piping network in the event of a failure.

Chiller plants shall be installed to potentially multiple plant room locations and sized to provide redundancy in the event of failure of any of the system components.

Chilled water storage tanks will be constructed of concrete or steel and at a height.

Table 2: Key metrics for Stage 1:

Measures	
Energy for chilling – Business as Usual (kWh)	4,520,650
Energy for Chilling – District Chilling (kWh)	2,454,067
Energy savings from District Chilling (kWh)	2,066,583
Customer Energy Savings (%)	46%
Peak Demand – Business as Usual (kW)	1,593
Peak Demand – District Chilling (kW)	486
Demand Reduction (%)	70%
Greenhouse Gas Reduction (t.p.a. – 2012)	2,069

All analysis shows that an acceptable market return can be achieved whilst delivering savings to customers and freeing up building area for other uses.

Project Cost:

c. $15 million for Stage 1

c. $3 million for Townsville City Council buildings only

Delivery Model:

A competitive selection process will be undertaken to find a development partner and construction contractor to own and operate the facility and assume construction, performance and financing risks for the project.

Channels:

- TCC Citysolar Program
- Ergon Energy Network Demand Management Project
- Digital Learnscapes

Feasibility:

The financial analysis by Ergon Energy indicates a saving of around 6% compared to business as usual costs and significant network demand reduction / augmentation benefits of around 2MVa.

All analysis shows that an acceptable market return can be achieved whilst delivering savings to customers and freeing up building area for other uses.

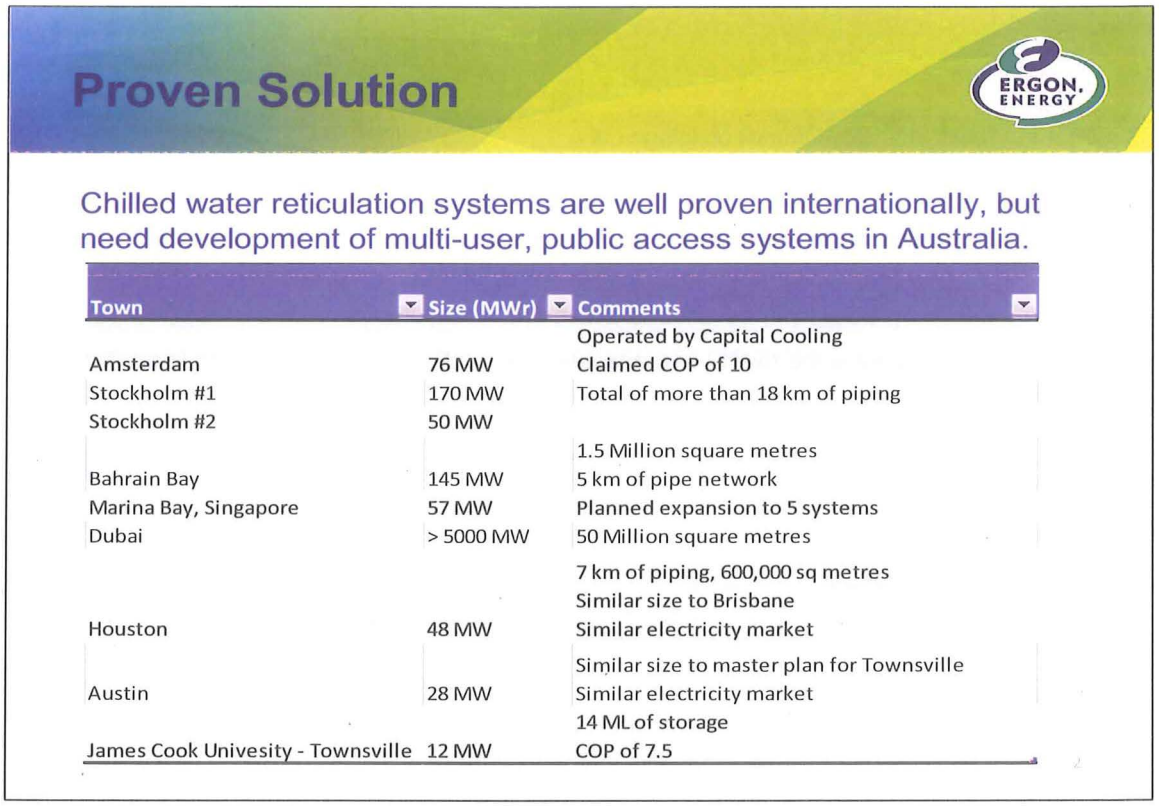
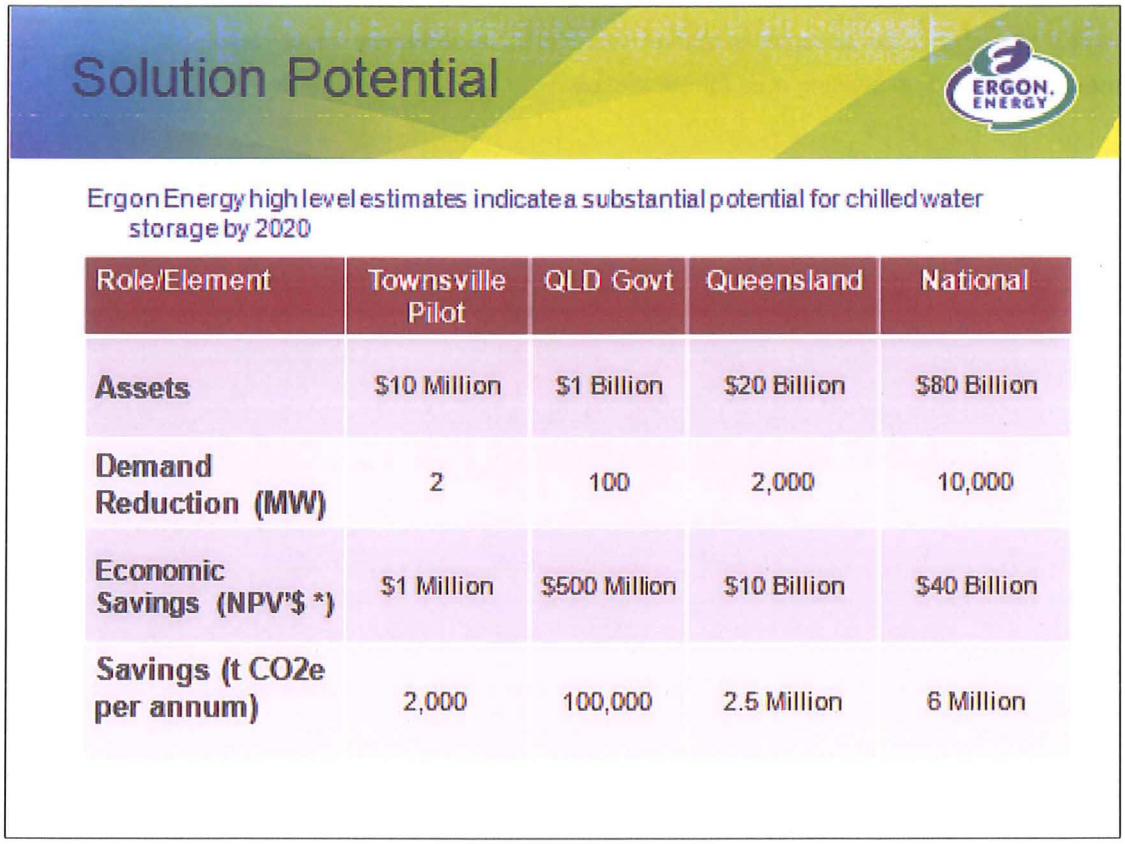


Figure 4: Existing Proven District Cooling Projects (Source: Ergon Energy May 2012)



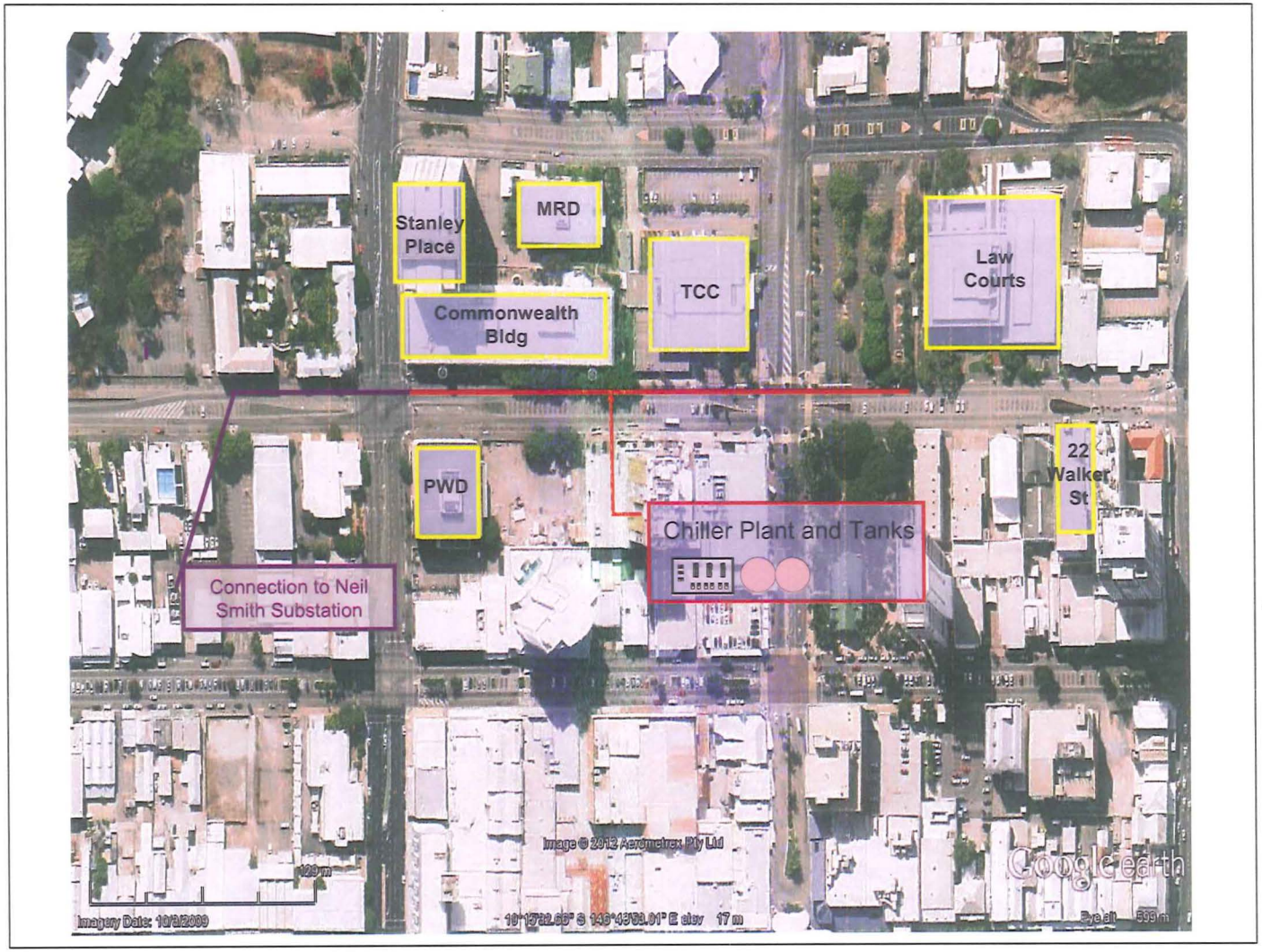


Figure 5a: Townsville CBD District Cooling Master Plan (Source: Ergon Energy)

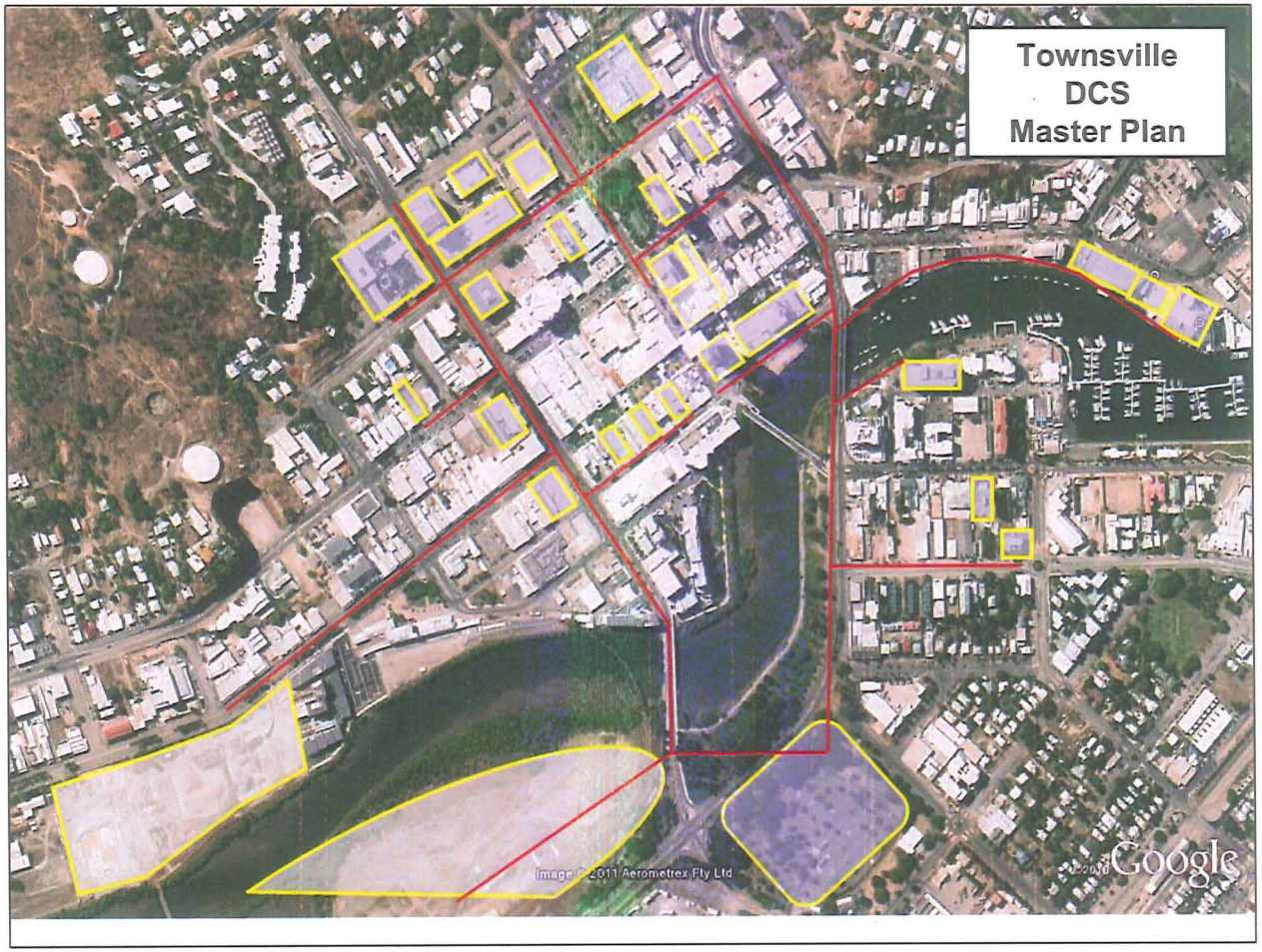


Figure 5b: Townsville CBD District Cooling Master Plan (Source: Ergon Energy)

Sub - Project B: Renewable Energy Micro-grid

Project Cost:

c. $4 million

Project Objectives and Outcomes:

Seven roofs have been identified within the CBD, suitable for solar PV panel installations over approximately 12,000 square meters in total that can be connected to a micro-grid. This would host 1.44 megawatts with a preliminary cost estimate of approximately $4 million.

This project compliments the CBD District Cooling Project, firstly by the maximisation of roof space from the removal of old and redundant A/C chiller plants and also the capacity for water chilling to act as storage capacity for excess photovoltaic (PV) energy generation.

The installation of PV arrays would be aligned with the delivery of the District Cooling Project where the energy generated will be consumed on site by the commercial buildings. Any excess PV energy generation (if probable would occur on weekends or public holidays when buildings are less utilised) would be optimised as storage, either chilling water through the district cooling, heating water through heat pumps and electric boosted solar hot water, charging electric vehicle infrastructure or stored in batteries distributed throughout the CBD which can be shifted and used to reduce peak load on residential buildings or restaurants and bars.

Key Stakeholders:

- Townsville City Council
- Building Owners
- State Government
- Ergon Energy – Distribution & Retail
- Local Community
- Guided Innovation Alliance
- Australian Energy Regulator
- Local Businesses

Table 3: List of buildings with available roofs

BUILDING NAME	ADDRESS	DESCRIPTION	ROOF AREA AVAILABLE APPROX (m2)	ASSUME ENERGY TARIFF PRICING
Stanley Place	235 Stanley Street	Australian Govt Commercial Offices of ATO and Child Support 14 Floors - 2 Levels carparking -12 levels commercial office space approx 18,000m2 GFA.	1500	Tariff 43
State Govt Building	187 Stanley Street	State Govt Building 5 Floors commercial office space for State Govt Departments approx 7500 m2 GFA	1500	Tariff 43
Townsville Commonwealth Centre	143 to 201 Walker Street	Australian Government Commercial Office Tenanted by Defence and Centerlink - 3 Floors approx 10,000 m2 GFA	3300	Tariff 43
Townsville City Council	103 Walker Street	Townsville City Council office and Chambers - 3 Floors of office space utilised by council departments and foyer for public service and access.	2800 (Total) 1200 (available)	Tariff 43
Main Roads Dept	136 Wills Street	Current Owner of building is THE STATE OF QUEENSLAND (REPRESENTED BY THE DEPARTMENT OF MAIN ROADS). Building is 3 floors utilised by the Department of Main Roads approx 4000 m2 GFA	1300	Tariff 43

Channels:

- TCC Citysolar Program
- Local Government Minister (David Crisafulli)
- Ergon Energy Townsville Energy Sense Community
- Townsville Solar Alliance
- Sustainable Townsville

Feasibility:

- Equalising savings benefits from other initiatives (eg LED streetlights) to contribute to solar farm costs.
- Gap funding needed

Strategic SWOT Analysis:

	External Opportunities (O) - Removes network issue - Synergistic with CBD cooling project - Synergistic with district cooling - Links PV with storage - Takes advantage of 'almost free' conduit from roof to substation -Helps CBD Cooling attract renewable funding -CBD District Cooling System can act as storage -Electric Vehicles can act as storage	**External Threats (T)** - The main problem with PV on network is in the residential area - The CBD network is probably currently good enough not to need highway - Project a pilot of a concept not a project to solve a current problem -Needs some extra funding for feasibility -Storage capacity needed
Internal Strengths (S) -Pre-feasibility studies underway -12,000sq m of roof space available -Ergon Energy Electric Vehicle (EV) Trial	**Strategies to Maximise Strengths and Maximise Weaknesses** -Develop a 100MW Solar PV Farm to supplement energy growth requirements of Townsville and to include a storage option to enhance the feasibility and improve security of supply as well as explore new community ownership model and / or wheeling power to TCC. -Integrate with Ergon Energy EV trial -Utilise roof space and service routes (freed up by district cooling) for renewable energy generation and utilisation by suitable storage style application, as precursor to widespread distributed generation in commercial district and other complex environments. - Infused analytics to optimise natural resources use	**Strategies to Maximise Strengths and Minimise Threats** -Integrate with Ergon Energy EV trial -Integrate with Cool Roof CBD Sub-Project -Utilise roof space and service routes (freed up by district cooling) for renewable energy generation and utilisation by suitable storage style application, as precursor to widespread distributed generation in commercial district and other complex environments. - Infused analytics to optimise natural resources use
Internal Weaknesses (W) - Stakeholders want too much (project can't be funded) -Needs Ergon Energy acceptance and support to trial	**Strategies to Minimise Weakness and Maximise Opportunities** -Integrate with Ergon Energy EV trial -Integrate with Ergon Energy Storage trials - Infused analytics to optimise natural resources use	**Strategies to Minimise Weaknesses and Minimise Threats** -Stakeholder and industry workshops -Develop Physical and Digital Learnscapes for District Cooling - Infused analytics to optimise natural resources use

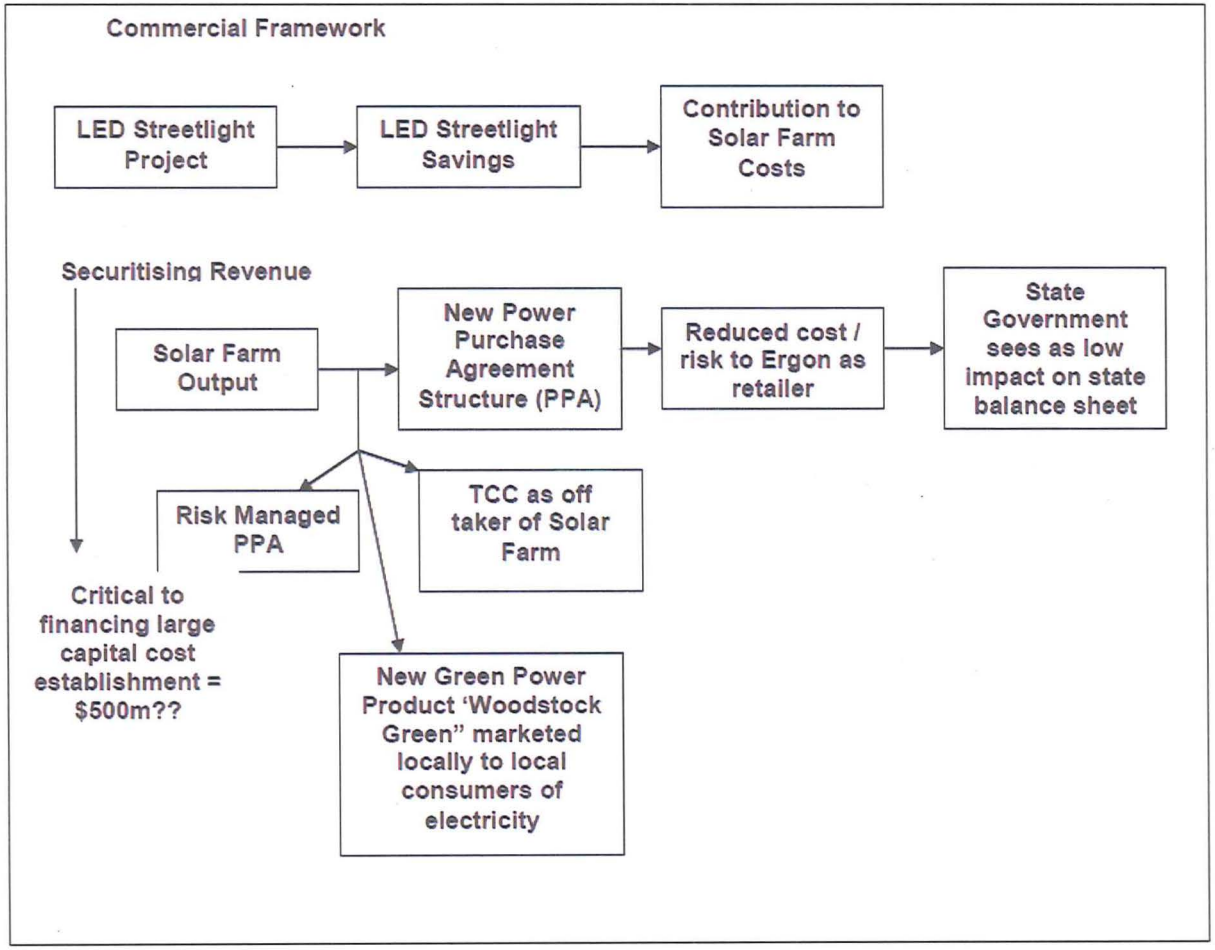


Figure 6: Townsville CBD Renewable Energy Micro-grid Commercial Framework (Source: CBD Taskforce and Integrated Sustainability Framework for CBD and Eco-City Action Plan Workshop – 19 April 2012 – Townsville)

Sub - Project C: Smart Buildings Pilot

Project Cost:

c. $500,000 - $1 million

Project Objectives and Outcomes

This pilot will be based on the smart buildings energy efficiency model produced through council's Australian Government funded Community Energy Efficiency Program – Energy Transformation Townsville which is a trial at an existing council facility in the CBD.

The Townsville Solar City Project is prototyping sensors and smart technology in partnership with Townsville City Council, JCU eResearch and ScienceMob Inc.

The Smart Buildings Pilot will involve instrumented, interconnected and intelligent[viii] buildings in the CBD that integrate:

- Sustainability metrics
- Building use – occupant density, interruption by non-work incidents such as maintenance faults, energy : productivity ratio, work delivered and generated, building usage patterns, lift vs stair use
- Building performance - HVAC efficiency, age of assets, solar output, extreme weather resilience, area of green space, usage patterns, capital vs operational expenditure
- Occupant experience – occupant satisfaction, happiness, well-being, health, comfort, temperature, vertical temperature stratification, air quality, air flow, lighting, access to natural light, circadian rhythms, visitor experience
- Communication and feedback – thematic communication, communication of energy performance to occupants, communication of future energy cost at current usage level, SMS / smartphone app surveys of building occupants
- Data sharing – information transfer between buildings and cities, demonstration of successful initiatives
- Individual responsibility – education on optimum operation of building design elements, personal energy meters, engage staff ' tenants in measuring individual energy use (with rewards), positive reinforcement, empowerment to make change, measuring sustainability behaviours, transportation audit

(Source: SBEnrc Stakeholder Workshop - Townsville [ix])

Stakeholders:

- Citizens (community)
- Building owners & tenants
- Council, State & federal government agencies
- JCU
- Ergon Energy
- Townsville Water
- Australian Urban Research Infrastructure Network (AURIN)
- IBM
- CSIRO
- Parks Association
- Grey nomad association
- Townsville Enterprise
- Chamber of commerce

Channels:

- Regional Development Australia
- CBD Taskforce
- Council
- Townsville Enterprise Ltd
- Chamber of Commerce
- Guided Innovation Alliance
- CBD District Cooling Project
- Schools
- Citizens / Community
- Internet
- Local park information sheets
- TCC Citysolar Program

Feasibility:

- Assume CBD (2nd release site)
- Feasibility study: 6 months $100k per building: comms connection, cost of data aggregation, develop response capability, establish baseline data, integration of energy network, commercial framework – network support payment, grant funding CEEP 2nd Round, financing options – Clean energy finance corporation, legals
- $500k - $1million
- Project Payback periods need to be easily demonstrated
- Incentive by those that gain (TCC for better city, Ergon for better peak load etc)

Strategic SWOT Analysis:

	External Opportunities (O) - New local green power product - Improved security of power supply - Open data available for innovation - Connections & integration of data - Can close gap between perception of energy and water - Chilling plants - Increasing infrastructure - Low cost - Build Townsville reputation	**External Threats (T)** -State government drive to improve balance sheets - Manipulation of data to make their building appear good. - Complacency - Too hard basket
Internal Strengths (S) - Council – Ergon relationship - Council Role (Potential) – approver, purchaser of power, ownership - Local generation - De- carbonising north-west mineral province - Documented consumption - Real and measurable - Participation and engagement - Innovation – 1st release - Low cost - Townsville reputation - Growth of aging population - Group has time - On main northern route - Developing city	**Strategies to Maximise Strengths and Maximise Weaknesses** - Reporting Status - Communication - HVAC Plant - Sensoring - Buildings talking to buildings – car parks communication full and instructing on empty car spaces. - Prove or disprove the underpinning infrastructure to interconnect buildings to respond to energy flows, occupancy patterns and uses, emergencies; environmental imperatives for optimal financial & social benefit.	**Strategies to Maximise Strengths and Minimise Threats** - Develop framework where there are economies of resources scale as buildings talk to each other. E.g. share car parks to spare in one buildings filled by another - Building communicates with street e.g. bus arrival, lights on when people are about i.e. city wide communication channel direct to buildings occupied.
Internal Weaknesses (W) -Ability to structure PPA (Power Purchase Agreement) This issue stopped solar flagships - Accuracy of sensor deployment if D.I.Y - Costs of getting "paying" someone to deploy sensors - Building owners preparedness - One segment - Ability of others to capture	**Strategies to Minimise Weakness and Maximise Opportunities** - Prove or disprove the underpinning infrastructure to interconnect buildings to respond to energy flows, occupancy patterns and uses, emergencies; environmental imperatives for optimal financial & social benefit. - Energy use layer / water use layer / eligibility. - Targets (Light, Relative Humidity, Temp)	**Strategies to Minimise Weaknesses and Minimise Threats** - Homes containing thousands of sensors incorporating data analytics that feeds back to consumers - Education program: Positioning of sensors / Do it yourself sensoring. - Energy use layer / water use layer / eligibility. - Targets (Light, Relative Humidity, Temp)

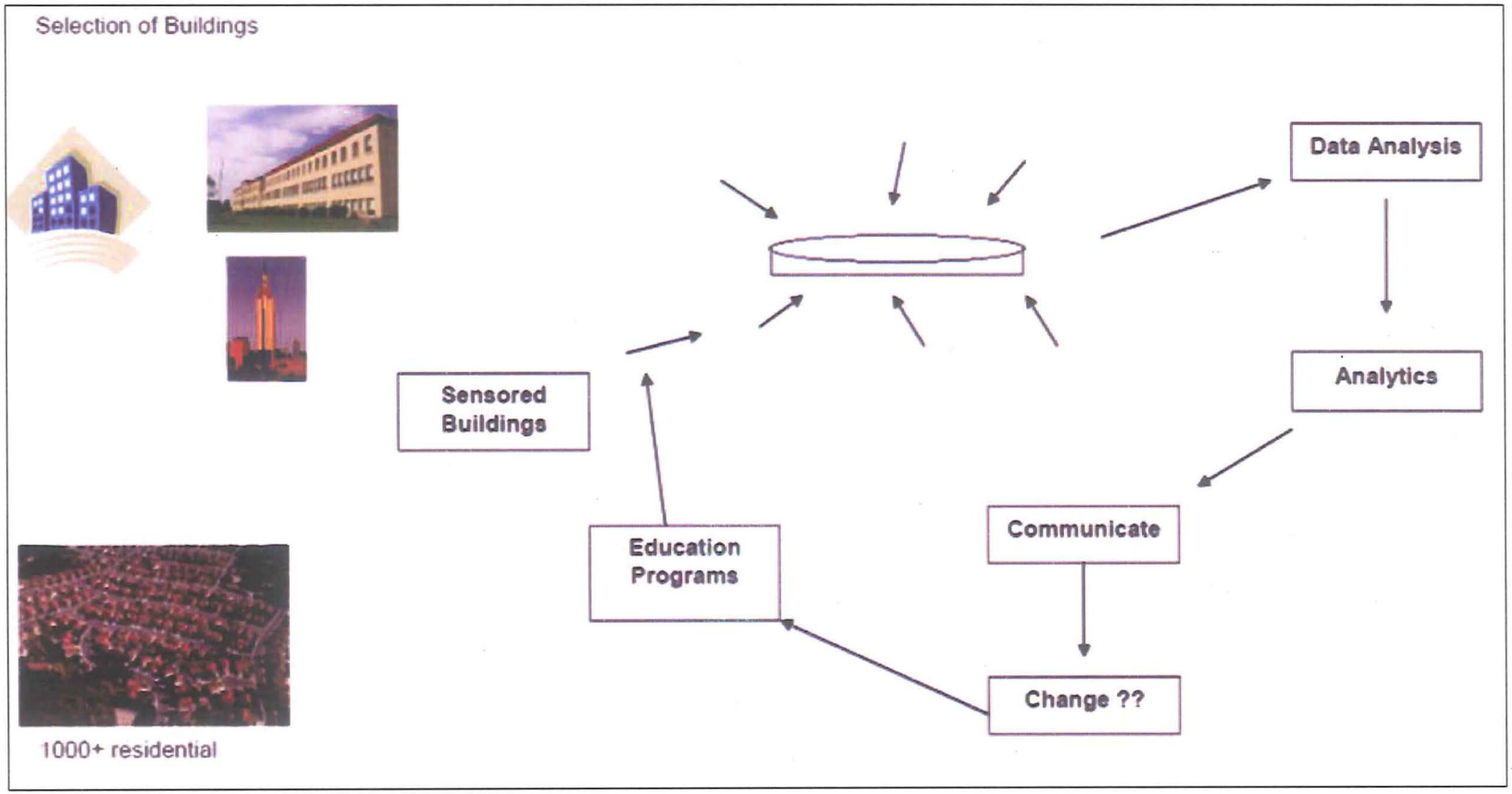


Figure 7a: Smart Buildings Platform A (Source: CBD Taskforce and Integrated Sustainability Framework for CBD and Eco-City Action Plan Workshop – 19 April 2012 – Townsville)

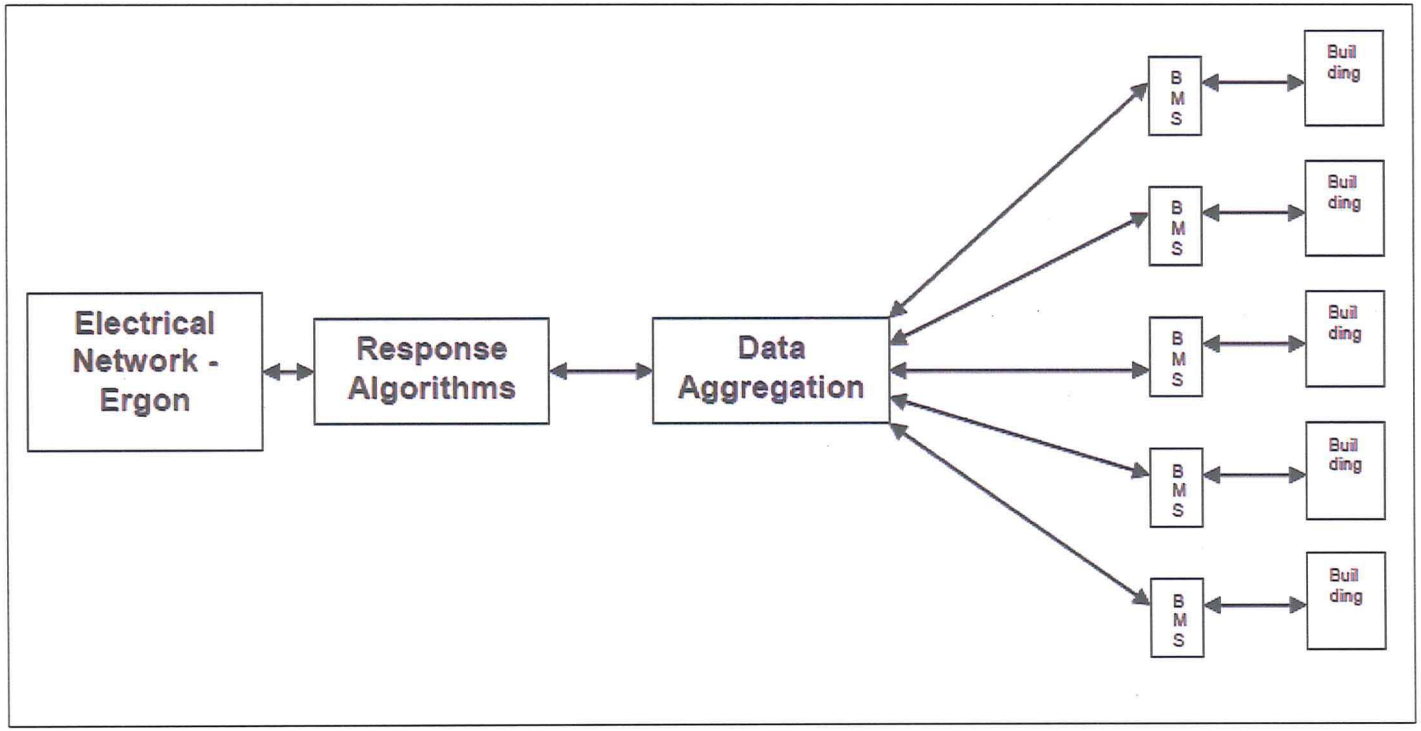


Figure 7b: Smart Buildings Platform B (Source: CBD Taskforce and Integrated Sustainability Framework for CBD and Eco-City Action Plan Workshop – 19 April 2012 – Townsville)

Sub - Project D: CBD Sustainability Platform

Project Cost:

c. $300,000 + ongoing annual license fees (localised research product delivery and innovation coupled with advanced analytics to create replicable and affordable sustainability platform (e.g. energy, water, greening) model).

Project Objectives and Outcomes:

The Sustainability Platform oversees the management systems of all city-wide infrastructure (including public and private BMS) identified in this plan and includes advanced analytics to integrate and clean data (e.g. IBM Intelligence Operations Center) to uncover otherwise hidden patterns and inform energy management sustainability. This platform is informed by sensor networks (see Sub-project E City-wide Sensor Networks), open data agreements and interconnected within cloud based data hub (via fibre or wireless locally based or remote data centers) to provide real-time information and prediction. This data can then be accessed and processed through advanced analytics to help inform and optimise building performance, energy efficiency and process innovation.

Key components to the CBD Sustainability Platform are the Australian Urban Research and Infrastructure Network (AURIN) Demonstrator Project and the TCC Mi-Townsville Project.

Open Data Framework

AURIN Demonstrator Project - Townsville Energy, Water and Land Management Open Data Hub.

One of the key outcomes of the IBM Smarter City Challenge was development of an open source data agenda (IBM Smarter Cities Challenge Report - Townsville) for water & energy management and efficiency in Townsville. This includes green building, sensing/metering and smarter building technology.

Since the challenge TCC has been working with stakeholders across Townsville to investigate opportunities and synergies in this area and developing a collaborative agenda to implement a pilot in Townsville. Council has been working with James Cook University, Ergon Energy and IBM Smarter Cities Team (Melbourne) around the vision and more

recently involved the Queensland Cyber Infrastructure Foundation (QCIF). A number of workshops have been held around sharing of data which is generated from multiple sources - e.g. GIS layers, cadastra, information indices) and protocol around the revealability of the data. This includes considerations of privacy and processes that effectively anomalise data without losing effectiveness.

The potential integration of data sets shared between stakeholders and organisations has been identified as having great potential in disaster management, water infrastructure planning, land-use planning such as walkability and including "what if" scenarios. Some of these data sets are keys to developing innovation and new knowledge and the impact of integration is very large and commensurate with the TCC Draft Digital Economy Strategy.

Recently an opportunity as arisen through the Australian Urban Research Infrastructure Network (AURIN) to participate in a project which reveals "big data" from various stakeholders for use by everyone involved for different purposes and generation of new knowledge (i.e. from the integration of the data and usage of advanced analytics).

An Energy and Water expert group appointed by AURIN has agreed that a Townsville Demonstrator should be supported based on the level of collaboration and partnership demonstrated in Townsville between stakeholders. Workshops have been held with stakeholders and a proposal developed.

Participation by the stakeholders would foster and accelerate appropriate sharing of data through development of real world examples relevant to Townsville City and sustainability.

AURIN is a partnership of University of Melbourne and Commonwealth Dept of Innovation, Industry, Science and Research. http://www.sustainable.unimelb.edu.au/content/australian-urban-research-infrastructure-network-aurin

Sources of co-investment and expectations around the project are currently being worked on by each stakeholder.

The next step is to develop the project plan and identify the areas for in-kind funding. TCC contribution is in the form of provision of datasets (under agreement and privacy considerations) and synergy of existing or funded programs in TCC. For example:

1. TCC could utilise a tropical walkability tool then we will need to identify and curate the data in a suitable place and then fund the Uni Melb team that built the tool to adapt it for the tropics.
2. Townsville Solar City (TCC Citysolar) project we have underway between JCU, Ergon Energy and a CBD commercial building - which has trial sensors now installed

streaming 30 sec on internal temperature range from ceiling to first floor (18-20 metres). We have the dream of a smarter building trial in Townsville.

3. TCC GIS White roof analysis.
4. Townsville Water metering trial and data utilisation.
5. Smarter technology/energy management buildings and homes in partnership with Townsville Solar City / Energy Sense Community (Ergon Energy).

Knowledge Management in TCC has been involved in the workshops and subsequent meetings and would manage the technical and privacy considerations to ensure Council data or data arising from residential information is protected.

The project offers huge potential to directly address a key recommendation of the IBM Smarter City Roadmap and activate key draft recommendations from the Townsville Digital Economy Strategy around smarter cities, smart technology, natural resources management (water, energy and nature) and smart energy efficient tropically relevant buildings etc.

<u>City-wide Integrated Data Management and Prediction:</u>

1. City-wide Integrated Intelligent Operations Centre

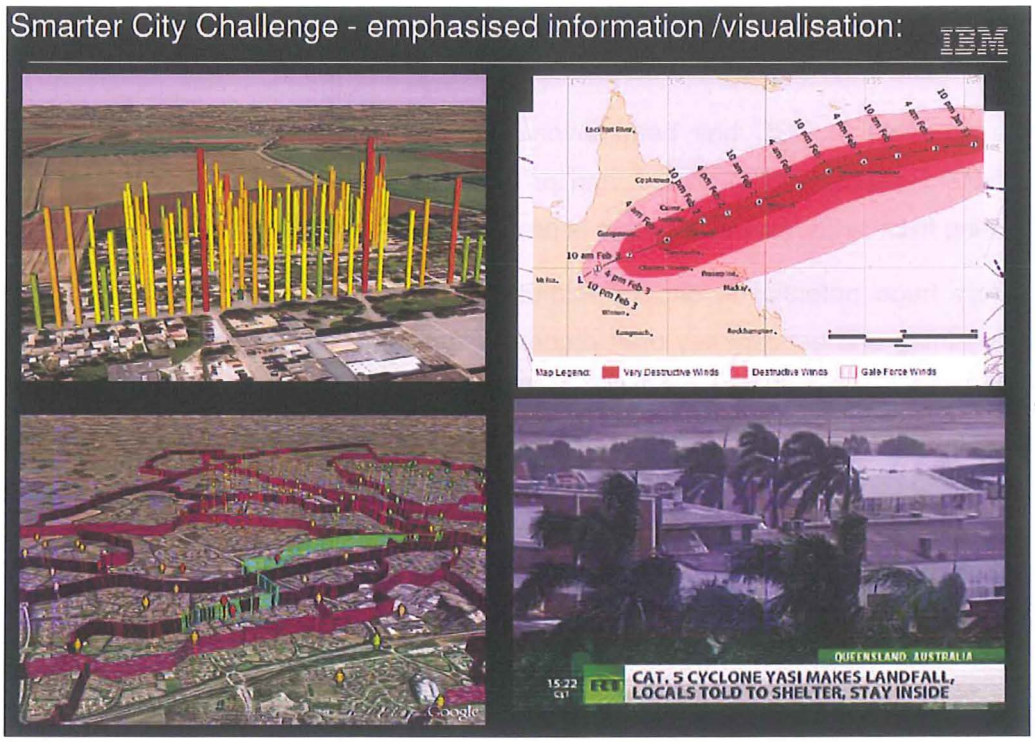
The *IBM Intelligent Operations Centre for Smarter Cities* helps organisations integrate information from disparate, instrumented systems and create an intelligent, interconnected environment that fosters collaboration, enhances efficiencies and sponsors effective decision making. IBM can help cities optimise individual departments—including buildings, energy, operations, public safety, transportation and water—while facilitating virtually seamless cross-departmental integration.

Vision for Townsville

IOC provided by IBM and partners will -

- Become the City's Nerve Centre for enabling seamless daily operation through historic and predictive insight.
- Providing resilience, security and accountability in the City's governance.
- Provide a command centre for forecasting and managing catastrophic events as they could and do unfold and often require all hands on deck to implement important and timely actions. IOC odes this with the coordinated 'chill' that the system offers people to remain in control and with level headed effectiveness.

- Incorporating the smart energy hub within the platform
- Integrating social media and social analytics - hardwiring emotional intelligence and added sensitivity into the city's response capabilities.



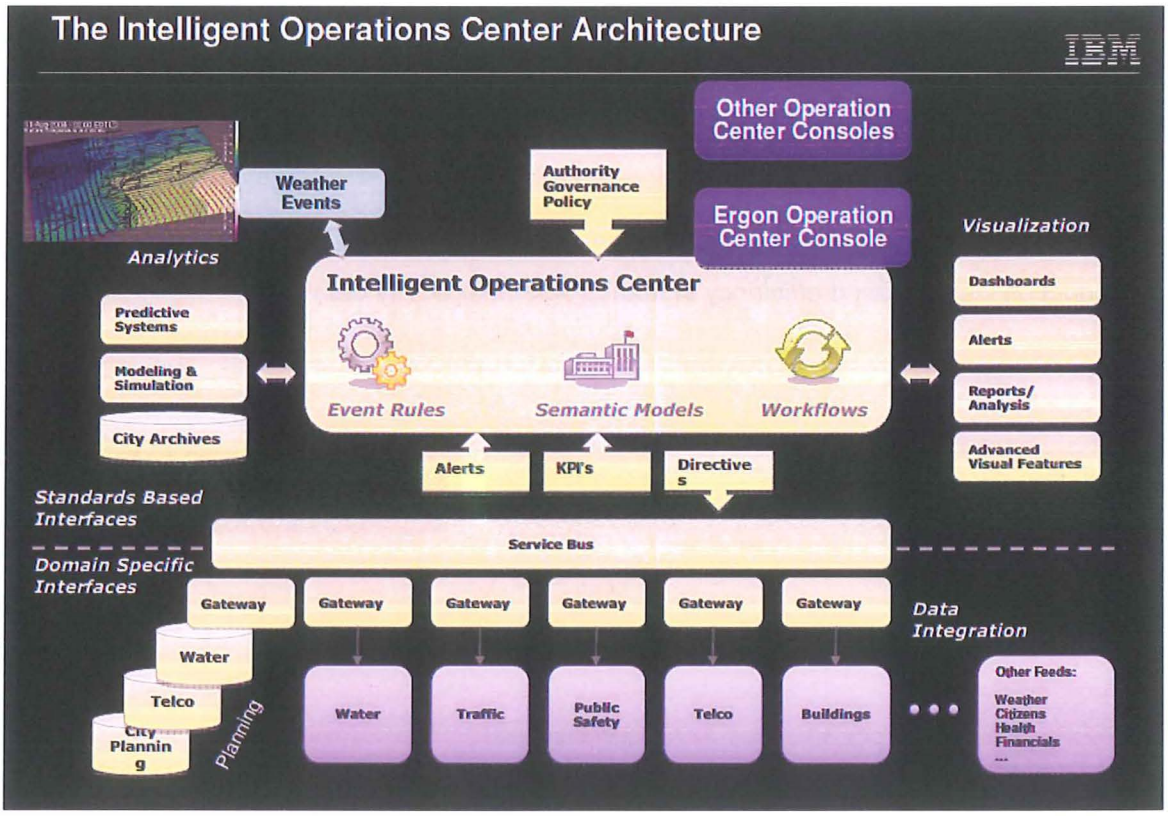
Experience

Rio de Janeiro in Brazil needed better ways to respond to landslides, floods and other natural disasters that might threaten its six million residents. Working with IBM, the city implemented a solution that enables personnel to analyse weather, energy, building, transportation and water data in real time. The solution draws on information collected from multiple sensors, such as traffic cameras and rain meters, and provides near-real-time situational awareness in a single view. Communications capabilities enable personnel to share information across agencies and synchronise rescue efforts. Now the city can marshal its resources within hours, instead of days, to warn the public and provide targeted rescue assistance to help save lives.

The *IBM Intelligent Operations Centre for Smarter Cities* offers integrated data visualisation, real-time collaboration and deep analytics that can help city agencies prepare for problems, coordinate and manage response efforts and enhance the ongoing efficiency of city

operations. Executive dashboard capabilities give decision makers a real-time, unified view of operations so they can see who and what resources are needed and available. Cities can rapidly share information across agency lines to accelerate problem response and improve project coordination. By providing visibility into key performance indicators (KPIs) and trends, the solution also can help fine-tune current resource usage and support forward-looking planning activities.

Diagram – The IOC Architecture (IBM Smarter Cities Research)



Stakeholders:

- Council (Integrated Sustainability Services and Knowledge Management)
- Ergon Energy
- AURIN
- JCU
- Building Owners
- IBM research

- ICT Business Network

Channels:

- AURIN Project
- CBD Taskforce
- Townsville Chamber of Commerce
- Digital Learnscapes
- City Sustainability Hub
- TCC Citysolar Program

Feasibility:

Cost reduction via increased efficiency in managing sustainability data

Strategic SWOT Analysis:

	External Opportunities (O) - NBN rollout - Local expertise (Schneider electric, AE Smith) - IBM Research - Reduce time and cost to manage sustainability data - Drive operational efficiency and cost savings across the CBD - Verify ROI and payback period on sustainability initiatives across the CBD	**External Threats (T)** - Individual BMS Systems
Internal Strengths (S) - IBM Smarter Cities Challenge - IBM partnerships - TCC Knowledge Management - Mi-Townsville Project - ICT Business Network - JCU eResearch partnership - ScienceMob partnership - Smart Water trial - In Digital Economy Strategy for Townsville - Network Demand Management Pilot	**Strategies to Maximise Strengths and Maximise Weaknesses** -Establish a centrally located, remotely accessible, web based platform that streamlines and automates the capture, management and reporting of all sustainability metrics from across the CBD via the installation of instrumented infrastructure in buildings - Build a sustainability platform that is both a comprehensive framework for collecting and managing the non-financial data that drives energy, carbon and sustainability profiles, as well as a platform for leveraging that data for intelligent business decision making.	**Strategies to Maximise Strengths and Minimise Threats** - Deliver up to date, financial grade business and compliance reporting - BMS integration
Internal Weaknesses (W) - Lack of experience	**Strategies to Minimise Weakness and Maximise Opportunities** - Develop research project and partnerships - Invest in bringing new talent to the city - Develop technology training projects	**Strategies to Minimise Weaknesses and Minimise Threats** - Develop learnscapes for buildings and BMS systems

Design Opportunities:

One of the key opportunities for Townsville is the optimisation of resources through the interconnection and balance of the energy demand, water usage and carbon output required by the buildings within the CBD. The integration and optimisation of the physical and digital infrastructures in individual buildings and groups of buildings will help to conserve water and energy, thereby reducing costs, environmental impacts and our increasing use of natural resources (IBM Research Australia 2012).

Sub-Project E: CBD Urban Sustainability Sensor Network Pilot

Project Cost:

$150,000 + annual maintenance ($5000 per annum)

Project Objectives and Outcomes:

Partnering with ScienceMob Inc and JCU eResearch, Townsville City Council has been piloting sensor networks at the Rowes Bay Sustainability Centre, Federation Place, Finlay Homes' Smart House to create Low Cost Environmental Sensors that can be deployed in the urban environment to monitor temperature, humidity and light which can be integrated with BMS systems and collected into a data hub where advanced analytics can identify and generate patterns and relationships in the data and be open-sourced in real time on the web.

A CBD Urban Sustainability Sensor Network will can be deployed in and outside buildings which will collect and integrate data to better optimise the performance of Townsville infrastructure and connect with the community and private enterprise to generate further economic and increased liveability opportunities.

Design

Deployment of cheap (internal and external) sensors across the CBD to monitor temp, light, atmospheric pressure, relative humidity, CO2. Use mesh or alternative newtorks to transmit data to a centralised database (dB). IN-house developed analytics will then allow correlation of behaviour/management change to environmental "comfort" related measures.

This data can then be made available as big data to the public for innovative approaches to enhance existing and planned sustainability goals. Our partners organisations may also integrate this data into their own dB's to enhance their existing management tools to enable increased granularity and contextual analysis of emerging trends in variable relationships and outcomes (**linking with all Sub-projects A-K**)

Sub–Project F: Electric Vehicle Infrastructure (Bike, Car, Motorcycle and Bus)

Project Cost:

c. $200,000 (Estimate $20,000 per charging station installed x 10 stations)

Project Objectives and Outcomes:

Electric Vehicle Supply Equipment (EVSE)

1. The past 18 months have marked the transition of the plug-in electric vehicle (PEV) into full commercialization. The electric vehicle supply equipment (EVSE) market is naturally a product of the PEV market, so the past year has seen a major uptick in EVSE deployments. In 2012, there will be almost 45,000 public charging stations installed globally. Much of this will be the result of publicly funded infrastructure initiatives. In comparison to government targets for PEVs, however, sales have been disappointing, and the relatively slow pace of PEV rollouts will act as a dampener on this market. With some exceptions, much of the private sector is waiting until PEVs are commonly seen on the roads in their areas before investing in charging infrastructure, therefore Local governments need to drive the deployment of EVSE.

2. **Series of charge point enabled carparks.** Within 5 years, 1 in 10 carparks will need to be Charge point enabled. As battery technology progresses and become more energy dense, there will be less need for charge point as vehicles have a range of 400km to 500 km. Therefore the burden of Charge point networks will not increase exponentially after the next 5 - 7 yrs.

3. **Charge point enabled bicycle/motorcycle racks.** As above in paragraph 2, there will an exponential growth in the E bike, E motorcycle market and this will reflect a need for racking/motorcycle charging points in the city. .

4. **Inter connectivity.** It should be noted that the J 1772 plug and socket system should be adopted to enable interoperability of all PEV systems.

5. **Public Education.** Public education and demonstrations will need to be implemented so as the public understands the way forward and their part in the process.

6. **Investment in up skilling of local trades people**. With the change in technology and associated infrastructure, there will be a need to train a competent workforce to maintain the EVSE and EV market.

Local Government requirements for integrated infrastructure for electric vehicles.

- Allocation of car park spaces
- Series of charge point enabled car parks and bicycle points.

Challenges

- Ensure compatibility of charging systems – push bike, car and motor bike and the financial payment system (pay for use).
- Competent work force to support the network (technical staff and trades);
- Public education – to articulate what the system is, or could be, how to use it and opportunities for obtaining new or retrofitted EV vehicles.
- Current technology changes – i.e. current have lithium phosphate as the basic storage device in car and in near future expected to change to lithium air (which incorporates greatly increased capacity). Therefore infrastructure challenge in predicting number of charging facilities required and their capacity (charge rate capacity).
- Local governments investing in infrastructure ahead of market – number of actual vehicles.
- No training system for workforce
- Need more demonstration
- Changing of technology – being able to keep up with changes in equipment

Innovative Opportunities

- Locally to create an integrated PV, storage and interpretative charging system (for bikes, cars and motorbikes)
- Grow local capacity in EV vehicle retrofit and trades

Sub–Project G: Hybridised Low Carbon Energy Systems – Virtual Power Plants

Project Cost:

c. $1 million

Project Objectives and Outcomes:

By developing Smart Energy Solutions for the CBD of Townsville we can create a distributed network of small-scale generation and storage sources (such as solar panels and fuel cells) to create a "virtual power plant" (Figure 9). Use the data aggregated from these generation and storage devices, in conjunction with residential and business smart meters, to manage peak consumption and balance the load on the electrical grid. This approach would assist in moderating the growing cost of energy for consumers and enable utility providers to redirect capital investment towards economic growth[x].

The community would be able to develop a network of these various energy sources that can be combined with load management and energy storage systems to improve the quality and reliability of the electricity supply[xi].

Active energy management, through an integrated operations centre, will enable the City to gain a clear overview of the true small-scale generation activities. This could assist in postponing or bridging the projected energy shortages by creating a "virtual power plant" that supports the reduction of peak demands on the existing electrical network[xii].

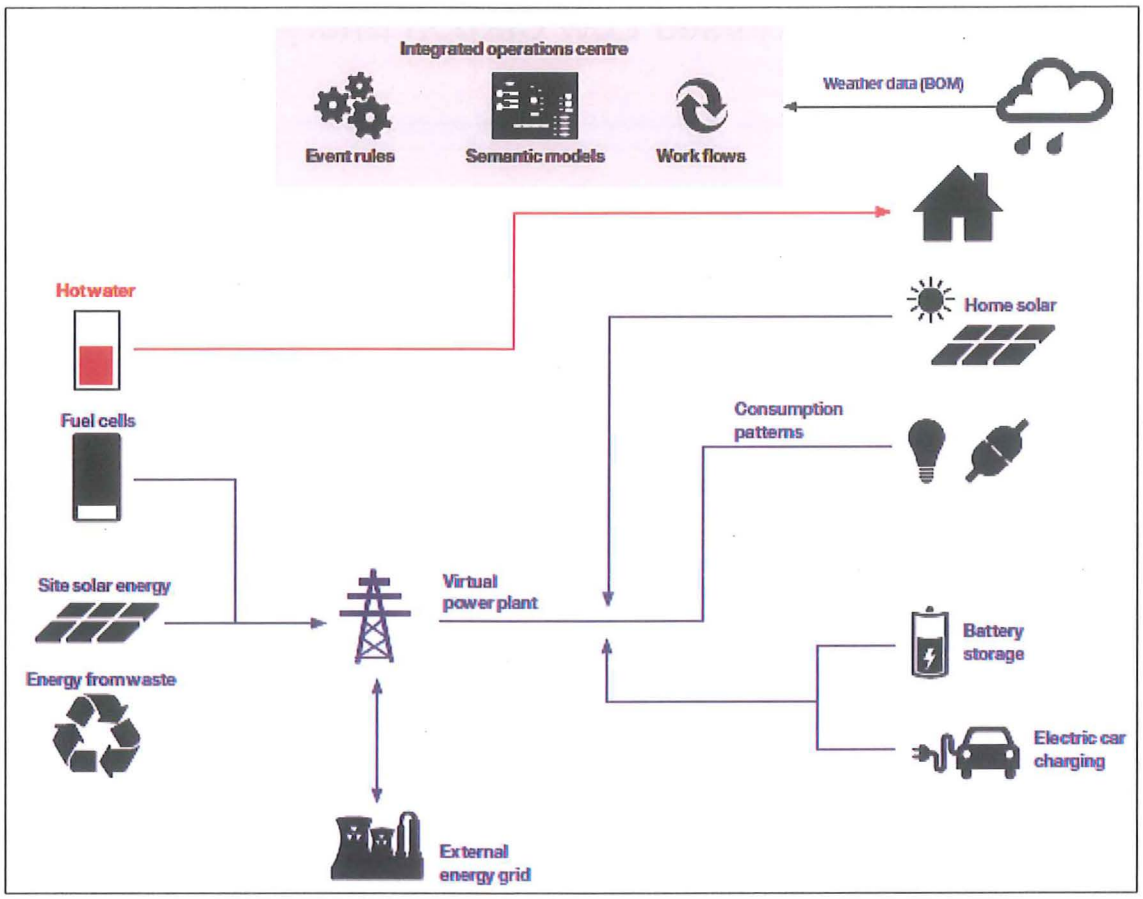


Figure 9: Virtual Power Plant (Source: IBM Research Australia 2012)

Recommendation[xiii]

The IBM team recommends piloting a "virtual power plant", where a network of small generators and energy-storage devices are installed by an individual or the City, and the generation data is aggregated into the integrated operations centre, providing a clear overview of the small-scale renewable capability of the City. The aggregation of the collective capacity and data across the entire grid forms a "virtual power plant" that can support portions of peak demand to collectively assist in balancing the grid during peak periods. The figure above illustrates how a virtual power plant contributes to the energy system.

A "virtual power plant" involves the development of a network of small-scale, connected energy devices, which can include standalone systems such as co-generation ceramic fuel cells, electric vehicles and solar photovoltaic systems.

The potential is significant. Other cities, such as Dubuque, Iowa (USA), have employed strategies to reduce peak load by as much as 15 percent.

In other examples, the district of Zurich, Switzerland, worked with the utility provider EKZ to use predictive analytics to validate the opportunity for an electric vehicle pilot project that

was expected to shift up to 50 percent of the charging time back into the grid to reduce peak usage.

A "virtual power plant" could consist of many renewable energy sources, including:

- Solar photovoltaic systems
- Ceramic fuel cells
- Electric vehicles
- Battery storage

Sub-Project H: LED Streetlight Project

Project Cost:

$1.6 million (Refer to below)

Table 4: CBD LED Street light Project Costs

Energy Audit	Preliminary assessment of suitable lights	$25,000.00
Technical assessment	Technical assessment of LED technology	$50,000.00
Procurement Costs	Preparation and administration of tender	$10,000.00
Materials	Various MV and HPS swap to high efficiency LED	$500,000.00
Equipment hire	Installation equipment hire	$175,000.00
Labour Costs	Labour for luminaire installation	$800,000.00
Monitoring, Verification and Reporting	Monitoring, data collection and analysis	$25,000.00
TOTAL		$1,585,000.00

Project Objectives and Outcomes:

In keeping with Council's commitment to lead the transition towards A Sustainable Townsville, it is proposing an iconic street light upgrade project in the CBD. The Project aims to act as a pilot for the transition of the street lighting service in Townsville to a high-efficiency, low cost and superior amenity service, changing the service which contributes to a significant amount of council's carbon emissions.

The pilot aims to:

- Improve the energy efficiency of existing streetlights in the Council footprint
- Break through current structural, financial and stakeholder barriers on street lighting for local governments with a new collaborative model.
- Leverage the availability of external financing sources for a cost effective step change in accelerating the transition to energy efficiency in street ighting.

Outcomes for Council:

- Reduction in emissions
- Lower energy costs and maintenance costs by up to [60%]
- Protection against future cost increases
- Improved amenity
- Potential to provide leadership in a whole of state LED streetlight swap out
- Consistent with current energy sustainability programs
- Leverage its Solar Cities credentials

Outcomes for Ergon Energy:

- Demand reduction in areas where there is an evening peak
- Reduction in CSO
- Potential model for whole state

Outcomes for Australian Government:

- Emissions reductions
- Highly leveraged funding - $5m could facilitate whole state swap out.
- Breaks through current barriers of financial costs, approvals and stakeholder relations to streetlight swap outs and achieves many of the identified actions contained in the Draft Street Lighting Strategy July 2011.

Strategy: Refer to Attachment B

The introduction of energy efficient streetlights from a local government perspective has in Queensland been a complex and difficult issue to progress. As previously stated street lighting is a large cost to Australian local governments estimated to be in excess of $250 million per annum.

At the highest level of consideration, this is due to the ownership structure and split incentives which exist between local government (the ultimate customer) and the regulated distribution network service provider (the owner and operator).

Recently work has been completed at the National level on identifying the current barriers ("Barriers to Energy Efficient Street Lighting" PWC July 2011) and developing a

comprehensive strategy to achieve national action -"Draft Street Lighting Strategy", Energy Efficient Equipment Program July 2011. A Public Lighting Sector Online Survey was also completed. This work has concluded that:

"Many governments have tried to improve the efficiency of street lighting with minimal results. This is because historically action has been limited to small scale funding of projects and short term reports identifying the problems within the public lighting sector.

This Strategy seeks to take a different approach and identifies a targeted group of priority actions that if taken together can significantly alter energy use and greenhouse emissions from the provision of street lighting.

In particular it identifies the following key areas of action as a concise list of activities that has the best chance of creating significant change:

1. Introduce regulatory measures to phase out the use of energy inefficient HID lighting;

2. Provide communications support to the sector;

3. Deliver replacement programs in each Energy Distribution Business Area;

4. Address financial barriers.

Further the Draft Strategy identifies that: *"...an opportunity exists to make a "step – change" improvement in street lighting energy efficiency through the accelerated phasing out of inefficient product classes across existing public lighting networks in Australia."*

This Project is consistent with these identified actions and contains a model that has the potential to significantly advance the rate at which energy efficient streetlights can be rolled out across Queensland. The Project addresses three identified barriers:

1. Financial Cost
2. Approvals
3. Stakeholder Relations

In addition the Project will address many of the strategies supported by both local government and electricity distribution businesses but specifically will target improving the information on performance of LED lighting, developing the business case for large scale changeovers and agreeing processes between electricity distributors and local governments to achieve bulk changes.

Objectives of the GIA Activity designed to contribute to support for LED street light technology:

- lab and field test a prospective adaptive LED Street Light technology;

- develop a validation process for use with LED Street Light technologies to support the development of a specification for use by large users and Municipalities;
- model the whole of state benefits of mass deployment to inform policy considerations at Queensland State Government level;
- to measure the energy performance of P and V Class LED luminaires compared with existing HID light (Mercury Vapour and High Pressure Sodium);
- to demonstrate that the enhanced LED light control system further increases energy savings, from 60 per cent with its current LED luminaire to 80 per cent with the SLI light control system

Stakeholders: Refer to Attachment B

Feasibility: Refer to Attachment B

Channels: Refer to Attachment B

Sub - Project I: City Sustainability Hub and Learnscapes

Project Cost:

$200,000 (web-based visualisation/ digital infrastructure) + $20,000 per annum

Project Objectives and Outcomes:

The City Sustainability Hub is a platform that aggregates digital services and products through interconnected networks that collect and integrate data and information from CBD infrastructure and community, visitor and business behaviour so that they can learn, organise and collaborate in ways that lead to change to individual and group behaviour[xiv] . This information will be further enhanced through the integration with the James Cook University Tropical Data Hub through the Townsville Australian Urban Research Infrastructure Network (AURIN) Project where researchers, innovators, businesses and government can design and deliver city and community benefitting projects based on information generated from Townsville infrastructure, which can further develop opportunities and enhance the sustainability of Townsville enterprise and infrastructure.

People and businesses can be always connected to the City Sustainability Hub through personal (smart phones and social media) and public (displays in social spaces and transportation) social media where it will be possible to increase CBD living through identifying efficient routes, comfortable walkability, coffee without the wait and specials on goods and services.

This will also keep sustainability in the day-to-day consciousness to continue to tap the community's creativity, to leverage data, information and feedback loops that create a personal and community sense of well-being[xv].

Benefits potentially include:

- A real-time environmental performance map of Townsville
- Increased impact on sustainable long-term planning
- Government organisations, Ergon, JCU, local businesses and others to share information to create a comprehensive view of the city ecosystem
- Feedback and input can be quickly gathered and acted upon

- Creation of a governance model such as the Townsville Index
- Contribution to external sources such as City Forward and global best practices
- Generates actionable insight from information, and provides feedback loops
- Smarter decisions on how to use resources

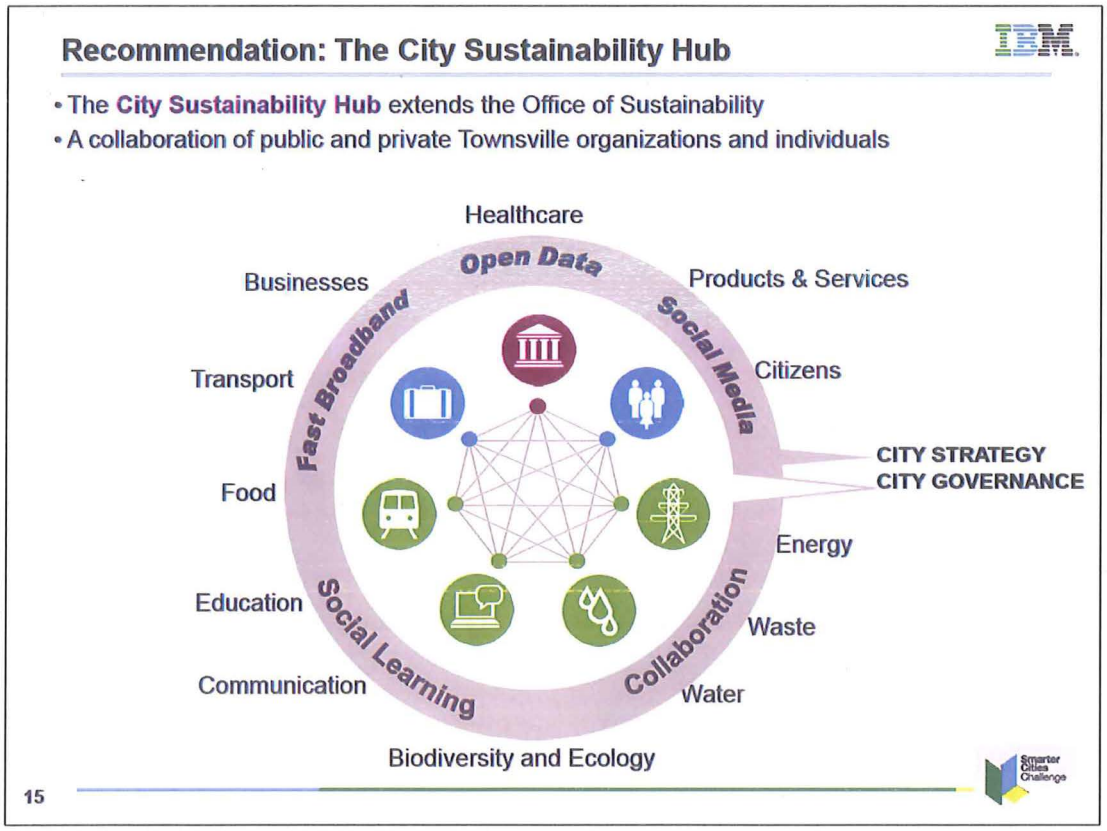
(Source: IBM Smarter Cities Challenge Townsville Stakeholder Presentation – IBM)

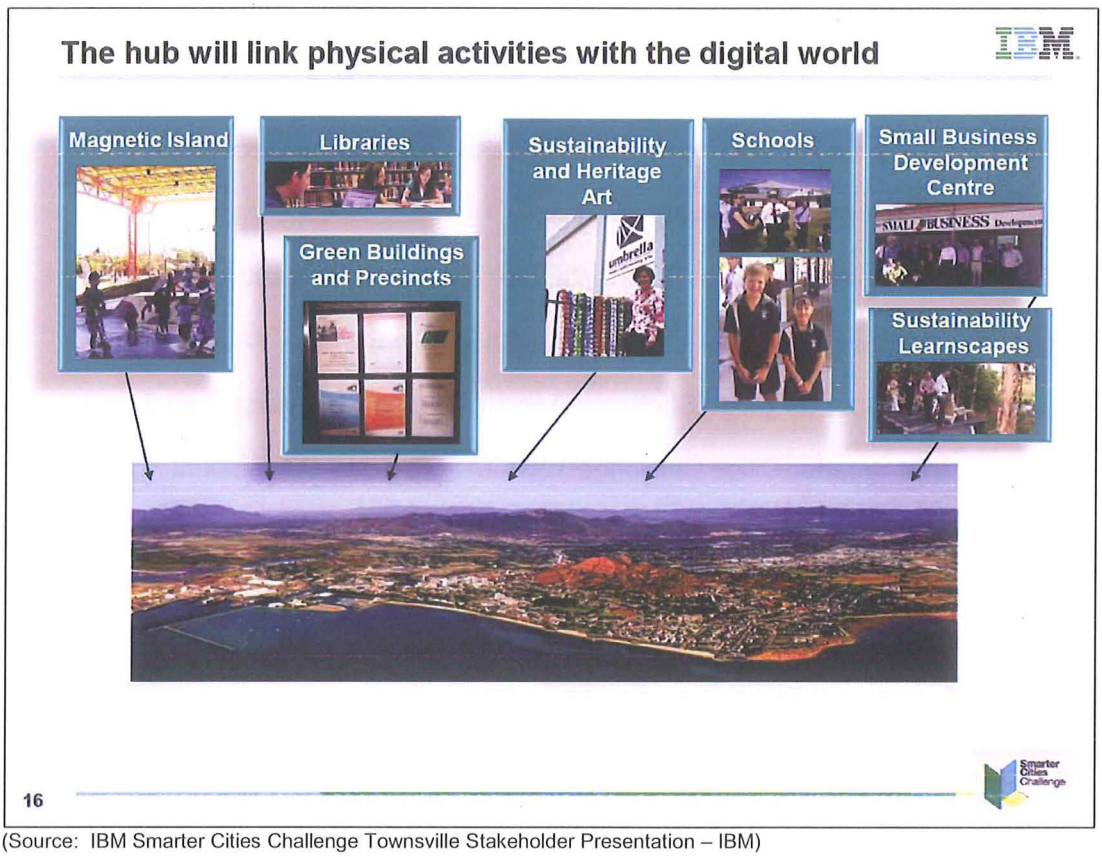
Stakeholders: As per IBM Smarter Cities Challenge Townsville Report – Attachment 3

Feasibility: As per IBM Smarter Cities Challenge Townsville Report – Attachment 3

Channels: As per IBM Smarter Cities Challenge Townsville Report – Attachment 3

Design:





(Source: IBM Smarter Cities Challenge Townsville Stakeholder Presentation – IBM)



The City Sustainability Hub can ....

Imagine a smart utility **planning and management** system....



- Green buildings and homes
- Optimize resources

Townsville



Smart asset management by government, business and utilities through shared information, to defer capital spend and to optimize resource management, and to provide insight to green building and home resource decisions

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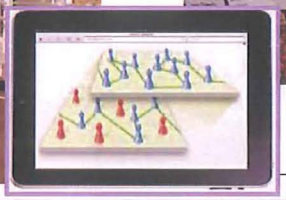
(Source: IBM Smarter Cities Challenge Townsville Stakeholder Presentation – IBM)

The City Sustainability Hub can ....

Imagine a collaborative **food exchange** ....







- Opportunities for farmers
- Reduction in transport cost and emissions

Townsville



Information sharing can produce opportunities for regional warehousing and distribution facilities to create wholesale and farmers market opportunities, decreasing costs and carbon emissions, and increasing resilience.

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The City Sustainability Hub can ....

Imagine small business and JCU cooperating to build **eHealthcare and sustainability**....



- Building new healthcare and sustainability solutions
- Serving rural citizens

Townsville

eHealthcare via broadband to all of the community, creating opportunities for business and higher education to build valuable solutions for Townsville

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(Source: IBM Smarter Cities Challenge Townsville Stakeholder Presentation – IBM)

The City Sustainability Hub can ....

Imagine a young family's **interactive** library visit....



- SMS draws families from the market
- Live readings, online downloads
- Mix of physical and virtual
- Tie-in to Turtle Hospital

Townsville

Library services can reach customers via messaging, utilize faster broadband for downloads and video, and link to other business and government services

21

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(Source: IBM Smarter Cities Challenge Townsville Stakeholder Presentation – IBM)

Physical and Digital Learnscapes

Project Objectives and Outcomes:

Council has developed a city-wide network of inter-communicating "Learnscapes" (Figure 8) where the community can communicate and interpret energy through experiential learning in the form of Eco-Efficiency Tours and interpretive demonstrations.

The purpose of the Learnscapes are to connect people with the environment in which they live and work to provoke them to think about what sustainability means to them at any point in time.

At present these Learnscapes exist as 'physical' buildings and sustainable infrastructure such as electric vehicle charging stations and solar technology demonstrations however an opportunity exists leveraging from Townsville's Smarter City initiatives in partnership with IBM and ICT business and research networks to develop the stories of the buildings into interactive digital media which can be accessed from anywhere in the city to further embed sustainability into the ethos of everyday living.

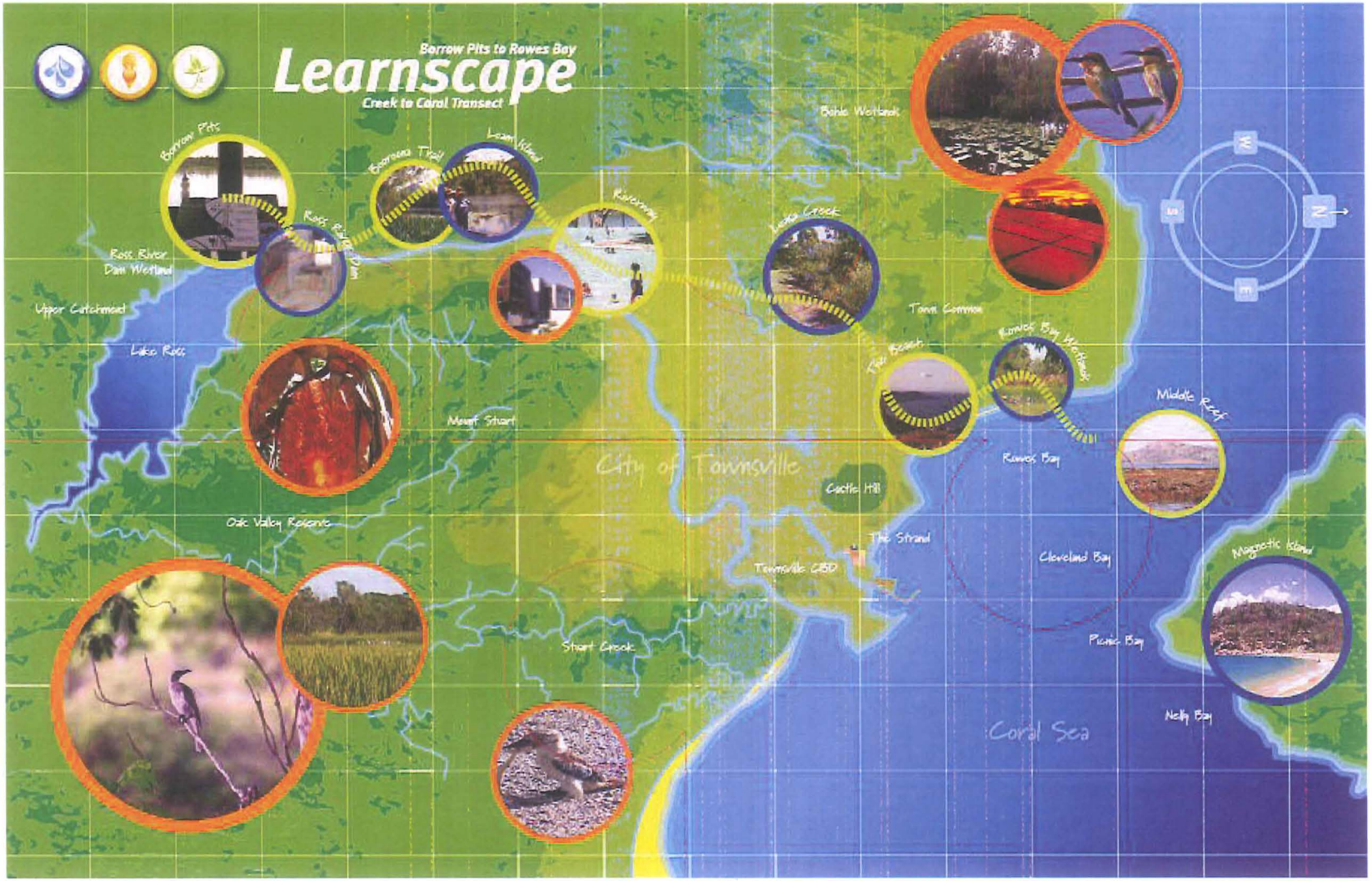


Figure 8: Townsville as a Learnscape

Sub - Project J: CBD Green Corridors and Walkability Pilot

Project Cost:

c.$500,000

Project Objectives and Outcomes:

Green corridors in the CBD will transform current areas of pavement (including roadways, car parks, sidewalks and paved areas) into low energy absorbing and pervious materials and green spaces to allow greater biodiversity, shade planting, soil enhancement, to create cooler and more liveable and enjoyable urban areas, with options to encourage the reduced use of vehicles in urban areas considered[xvi].

By incorporating a greater degree of natural environment through permeable pavements, high albedo pavements, bio-retention areas, urban street trees, conversion of disused road infrastructure to parkland, green streets and alleys and promoting alternative transport to reduce road infrastructure we will not only reduce the heat island effect but also increase the walkability and liveability of the CBD of Townsville.

This pilot will include a sensor network that can collect temperature, humidity and light data to produce a heat map of the CBD that can be accessed online and through smart technology applications. Integrating this data with information generated by retail and hospitality businesses, transportation and amenities can provide information identifying the walkability of the CBD. The lessons learned in developing these green corridors can inform replication and scalability to other streets, suburbs and city-wide level.

Strategy: Further detail to be provided

Stakeholders: Further detail to be provided

Feasibility: Further detail to be provided

Channels: Further detail to be provided

Design: Further detail to be provided

Sub - Project K: Cool Roofs CBD Project

Project Cost:

c.$250,000 (Based on 12,000sq m of roof space in conjunction with PV microgrid)

Project Objectives and Outcomes:

The Cool Roofs Townsville program which targeted residential houses investigated the effect of painting roofs with a white-reflective coating on temperature reduction found that in many cases the roof cavity temperature decreased by between 10-20 degrees Celsius and internal living room temperatures decreasing by 1-5 degrees[xvii].

Townsville City Council has also painted its two administration buildings with white reflective coatings and found significant temperature reductions which have ultimately resulted in operational energy savings.

Federation Place which is a multi-tenant 4 storey heritage listed commercial building has recently painted its roof white and is also host to a sensor network project. Federation Place has found dramatic reduction in both roof cavity temperatures and energy savings at its upper most floors. Similar results have been found at the Townsville Fuji Xerox building in the CBD.

A Cool Roofs CBD Project will compliment well with the Renewable Energy Micro-grid project as a 'cooler' roof will maximise the efficiency of the operation of the PV array. The temperature reductions from a Cool Roof on the commercial buildings will play an important role as part of the whole system of energy reduction across the CBD of Townsville.

Strategy:

Cool Roof Validation Project

Scope of the Activity

- Elements of a scope will include the following activities:

Phase 1:

Desktop Review and Report

Phase 2

Site Selection for Trial Scale – Residential and Commercial Energy Customers

Baseline (energy and demand)

Predictive Modelling

Installation

Measurement and Verification

Scope in detail is contained in the Attachment 1

Anticipated Outcomes

Phase 1 – Desktop Review

- Desktop review of literature and available data.
- Identification of coating types and manufacturers,
- assessment of likely energy and demand impacts

Phase 2 – Field validation and impact modelling capability

- Modelling results
- A report from QUT which includes:

Results of the validation testing

Conclusions as to the performance of the roof coatings against the agreed test parameters

Recommendations with respect to Phase 2 testing including:

Nature and scale of field trial to achieve valid results

Commercial and financial development plan outline

Stakeholders: Further detail to be provided

Feasibility: Further detail to be provided

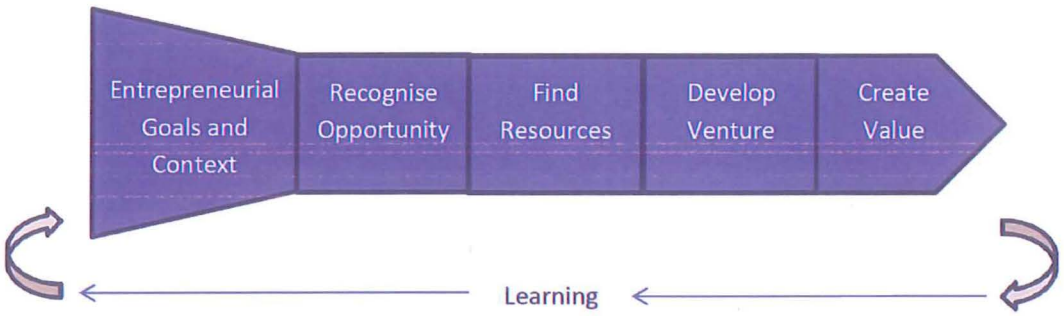
Channels: Further detail to be provided

Design: Further detail to be provided

Appendix 2

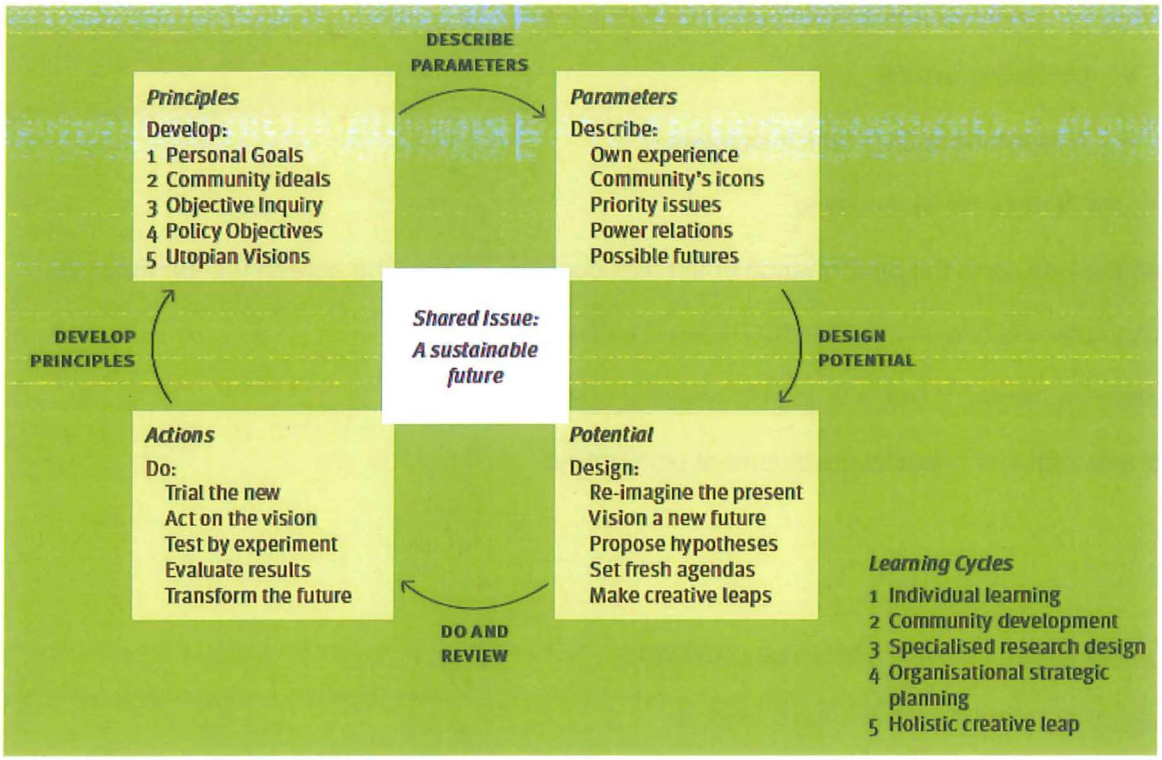
The building blocks of the Emergent Business Practise Innovation Cycle – Innovation Entrepreneurship and Collective Social Learning.

An Innovation Entrepreneurship Model (Bessant & Tidd, 2011) can be seen below:



Source: Bessant & Tidd 2011

Collective Social Learning Cycle (Professor Valerie Brown – Australian National University)



Source: TCC Citysolar Annual Report 2012

[i] IBM Smarter Cities Challenge Townsville Report - July 2011
[ii] IBM Smarter Cities Australia http://www.ibm.com/smarterplanet/au/en/smarter_cities/ideas/index.html?re=sph
[iii] Townsville CBD Master Plan http://public.townsville.qld.gov.au/townsville/economic/Pages/CBDmasterplan.aspx
[iv] Townsville Digital Economy Strategy Report – October 2012
[v] Townsville Queensland Solar Cities Project http://www.townsvillesolarcity.com.au/
[vi] IBM Smarter Cities Challenge Townsville http://smartercitieschallenge.org/city_townsville_australia.html
[vii] Bessant, J., & Tidd, J. (2011). *Innovation and Entrepreneurship* (2 ed.). U.K.: John Wiley & Sons, Ltd.
[viii] IBM Smarter Cities Challenge Townsville Report July 2011
[ix] SBEnrc Stakeholder Workshop (Townsville), Hosted by Townsville City Council and facilitated by Curtin University and QUT, 29 July 2011 from Sustainable Built Environment Research Centre – Project 1.1. Design and Performance Assessment of Commercial Green Buildings – Research Program 1: Greening the Built Environment
[x] IBM Research Australia 2012
[xi] IBM Research Australia 2012
[xii] IBM Research Australia 2012
[xiii] IBM Research Australia 2012

[xiv] IBM Smarter Cities Challenge Townsville Report July 2011
[xv] IBM Smarter Cities Challenge Townsville Report July 2011
[xvi] Reeve, A. Hargroves, K. Desha, C. Bucknum, M. 2010. *Harnessing the Potential of Biophylic Urbanism in Australian Cities: A Sustainable Built Environment National Research Centre Literature Review*, Curtin University and Queensland University of Technology.
[xvii] Townsville City Council. 2012. *Review of Pilot Program and Development of Recommendation Report*. Townsville City Council and Griffith University (The Natural Edge Project) as part of the Australian Government Solar Cities Program.