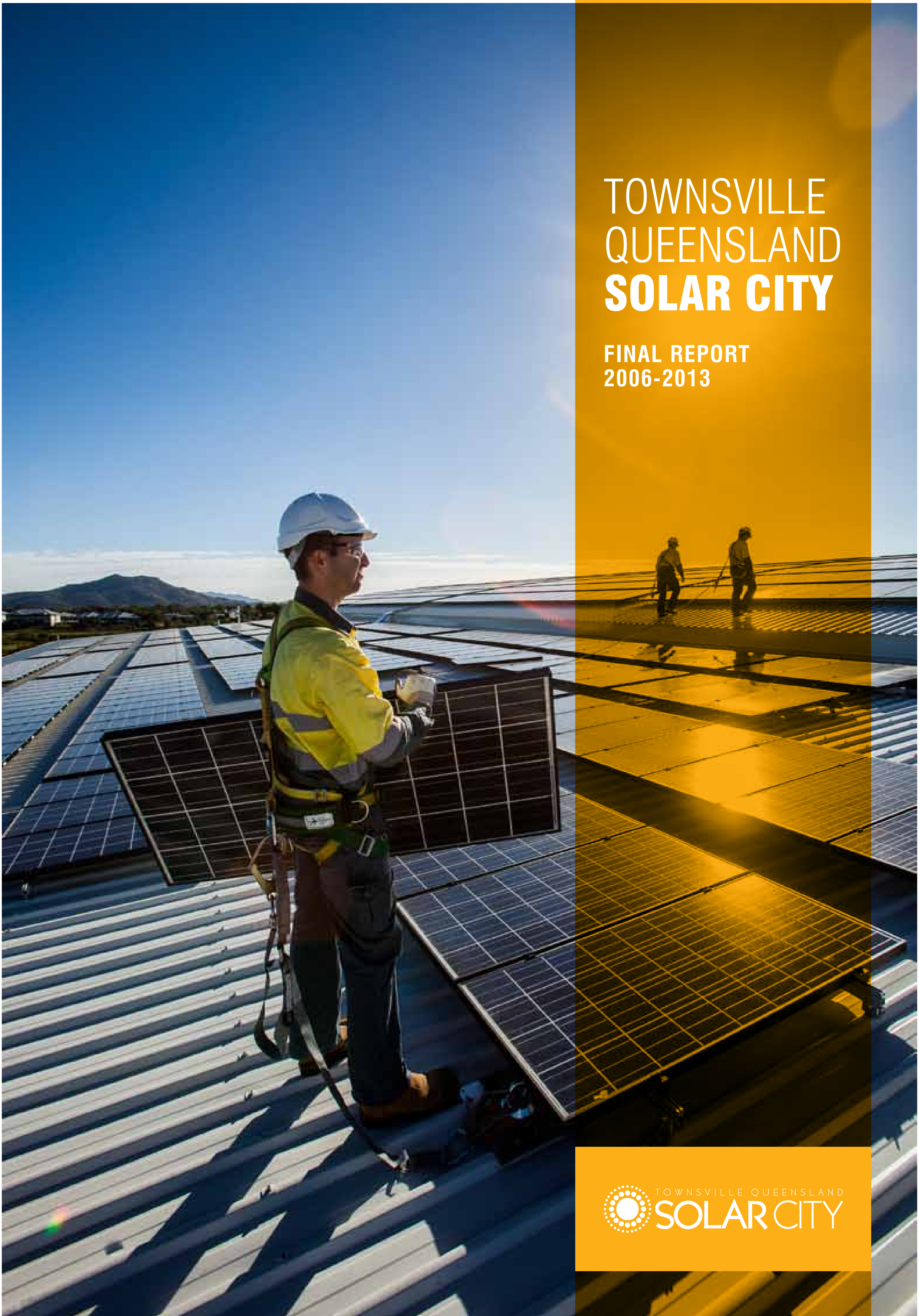

TOWNSVILLE QUEENSLAND **SOLAR CITY**

FINAL REPORT 2006-2013

TOWNSVILLE QUEENSLAND SOLAR CITY

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"Peak demand reduction has deferred the installation of the third undersea electricity supply cable to Magnetic Island."

01. EXECUTIVE SUMMARY

01

Changing a city's energy efficiency and sustainability attitudes and behaviours

The Australian Government's Solar Cities Program was designed to trial new, sustainable models for electricity supply through the use of distributed solar technologies, energy efficiency, load management, smart meters and cost-reflective pricing combined in large-scale grid-connected urban sites.

The transformation to the Townsville Queensland Solar City (TQSC) has been undertaken by a consortium comprised of developers Cafalo Pty Ltd, Honeycombes Property Group, and Delfin Lend Lease; building owner Chester Holdings; the Townsville City Council with their community capacity building program; and Ergon Energy with their focus on the Magnetic Island Solar Suburb.

There is no doubt that the Solar City project has had a marked positive impact on the residents of Townsville and Magnetic Island. The community has embraced the concept, and uptake and participation has – almost without exception - been excellent.

Key results for the Townsville Queensland Solar City project –

While highlights are naturally the project successes, there are also excellent learnings which are already being applied in other parts of the consortium partners' businesses. These are discussed in detail in this final project report.

OBJECTIVE	TARGET	ACHIEVEMENT	
Reduce maximum demand	27% against business as usual	46%	✓
Reduce electricity consumption	25% against business as usual	46%	✓
Defer undersea cable	By 6 years	Now at least 8 years	✓
Reduce greenhouse gas emissions	50,000 tonnes	53,000 tonnes to June 2012	✓
Increase take up of renewable energy	Install 1 MW of hosted photovoltaic systems	1.084MW installed in 212 systems	✓
Reduce costs to consumers	$1,000,000	$1,784,000 to June 2012	✓
Build capability in the community for sustainable living	Develop campaigns for the community, schools, and businesses using the Citysolar program	Eco-electricity tours, Cool Roofs, Centre of Excellence, Smart Lifestyle Expo	✓
Demonstrate energy efficient housing	Develop continuous improvement in residential and medium density housing	Three efficient apartment complexes completed, energy efficient construction now BAU	✓
Energy efficient office accommodation	Investigate best practice for energy efficient office accommodation	Wide research, workshops, report produced	✓
Energy efficient refurbishment of heritage office building	Reduce the energy demand in a 128 year old office building	25% reduction in demand from the grid	✓

"In 2013, I do not see that the Solar City work is completed – I would like to see the project move to as the next phase – which is to build on the installed Solar City architecture and community engagement. I'd like to create the pathway to understanding how we can structure network tariffs so that Ergon Energy and our customers can both extract value."
– Ian McLeod, CE, Ergon Energy

01

Electricity consumption and maximum demand

Growing demand for power has traditionally been met with expensive infrastructure upgrades. The Solar City project showed that by encouraging behaviour change and energy efficiency, customers could enjoy the same lifestyle while reducing costs and having a smaller impact on society's resources – doing more for less.

By encouraging residents and businesses to change their behaviour and their attitude to electricity use, but not change their lifestyle, electricity consumption and maximum demand are well down compared with the trend that was emerging prior to the project. The energy needs of customers have been met without infrastructure upgrades.

Compared to the Solar City Business Case (medium growth scenario), annual peak demand measured in the 2012-13 summer is 46% below the predicted annual peak demand for the island without the solar city project. This is 27% below the target set for the project. Magnetic Island has reduced peak demand by 11% more than the town of Ayr, 100km south of Townsville, which was used for control.

Maximum demand dropped 4% in the last year of the project and is now 16% less than the peak in 2008.

Peak Demand reduction in turn has deferred the augmentation of cables feeding Magnetic Island. At this stage the commissioning of a third cable is being deferred from 2014 to 2016, again more than target. A full review in 2013 is expected to further defer the infrastructure upgrades.

Electricity consumption

Energy consumption in 2011-12 was 1.6% less than in the previous year. This is a 46% reduction in energy consumption when comparing business as usual with the impact of the Solar City project, and 29% below the target set for the project. Savings to customers from less consumption is now $1.784 million.

As a result of the reduced consumption, the associated saving in greenhouse gas emissions is 53,605 tonnes (at June 2012) or 7% above the project target of 50,000 tonnes with 12 months remaining in the Ergon Energy Solar Suburb project.

Behaviour change, demand management and energy efficiency

It's not about the technology, it's about getting people to use the technology.

The decline in electricity consumption coincides with the commencement of the energy assessments. The assessments conducted are very detailed and highly personalised which has been one of the hallmarks of the project's success. By using highly trained and accredited assessors and allowing them to spend time (a couple of hours) in the homes of residents, the project has established loyal support across the community.

The energy assessment is the culmination of the Energy Behaviour Change Model developed by the project which starts with research, proceeds to developing a community culture and then peaks with a personal interview with the customer which incorporates a range of proven and tailored interventions aimed at changing behaviour. This all combines to get commitment from the customer to undertake changes to achieve greater energy efficiency.

The Energy Behaviour Change Model is based on the proven principles of community engagement, community based social marketing and thematic communication. Using the model, residents and businesses on Magnetic Island are asked to join the project and take part in an energy assessment, with the aim of working together to reduce peak demand and electricity consumption. The model can be replicated in any community with confidence of measurable behaviour change results.

Assessors use the meeting to test appliance loads and discuss a range of energy efficiency behaviours and options as well as undertaking some simple changes in the home (such as replacing light bulbs). This has been a great way to inform customers about the issues associated with maximum demand and has resulted in significant behaviour change by residents when it comes to electricity consumption.

The most important outcome of the energy assessment is getting the customer to commit to making a change in their behaviour, using their electricity more wisely, or upgrading old inefficient appliances.

The introduction of the Smart Lifestyle Voucher System as an incentive has helped to rid the Island of inefficient electricity guzzlers, in particular second (and generally more than old) fridges. It has also prompted residents to act now to retro-fit their homes with energy efficiency in mind. A group of the commercial properties were used to trial various technologies and gauge their effectiveness in a tropical operational setting.

During the project just over 80% of residential and 99% of commercial customers had energy assessments.

Immediately after an energy assessment, residential customers reduced their electricity consumption by an average of 5%. Twelve months later they had further reduced their consumption till it was 9% less than before the energy assessment, and after two years, they were using 12% less.

Concentrated photovoltaic (PV) trial

Ergon Energy under the project has now installed 1068 kW of solar photovoltaic panels in 211 systems. Over four Gigawatt hours of solar electricity has now been generated by Solar City panels since the project started.

During 2012 the project completed the Annandale Solar Power Station at the Townsville RSL Stadium, comprising 348 kW of PV in an urban network. The power station was officially opened in August 2012 by then Parliamentary Secretary for Climate Change and Energy Efficiency Mark Dreyfus.

The PV trial uses a business model where all electricity is fed back into the grid and the ownership and maintenance of the PVs remains with the utility company, in this case Ergon Energy. Hosting is done by premises for the greater good of the community with a collective benefit rather than their own direct and individual benefit.

Hosts comprise a combination of residences, commercial buildings and public facilities (such as the transport terminal, clubs and the school). These structures have the added benefit of a larger (than a residence) roof area so more PV panels can be fitted. Suitable locations where the owner is willing to host panels were identified through the energy assessment process, and then the systems were installed.

The business model has been working well but was impacted upon by subsidies available to residents to install solar power and/or hot water. This resulted in a rise in residential homes installing their own solar power (under a different business model) where they individually received the benefit of the power generated and in some cases are paid for any excess that is fed into the grid. It also means that most of these houses were unlikely to have suitable additional roof space to host PV panels for the project thereby reducing the pool of potential hosts.

With 720 kW installed on the two feeders at Magnetic Island, the PV systems are now at times supplying up to 25% of the Island load. As the 100 kW Solar Park is connected to the feeder TOMA10, the load for this feeder supplied by renewable energy is a higher percentage. On 8th September 2011, the solar generation supplied 39% of the feeder load for one half hour. Analysis of the effect of the PV systems on the electricity network has shown expected (but within manageable limits) voltage rises and little effect from harmonics. Experimentation with power

"With 720 kW installed on the two feeders at Magnetic Island, the PV systems are now at times supplying up to 25% of the Island load."

factor correction by the latest generation inverters shows promise for positive effects on the network.

The Townsville City Council has installed 180kW in 12 systems on their buildings around Townsville. Chester Holdings has installed 17kW on Federation Place to help with reducing their dependence on the grid by 25%.

Smart meter trial

This trial has been hampered by a number of technical and regulatory issues. Smart meter technology has not been widely used in a residential environment such as Magnetic Island. On inspection, the project found out of date distribution boards which meant more work needed in upgrades than anticipated, and this together with the layout of the network on the island and the houses themselves has reduced the volume and integrity of data collected.

Whilst it was slow to start, the project eventually recorded some good measurements and sufficient data was collected for project purposes. Due to the slow deterioration of the communications aspect of the smart meters, the meter data was collected manually from each meter for the last year of the project. Data volume and integrity has improved greatly, but at a higher cost.

Other trials

The Peak Demand Reduction trial was completed in March 2012 with great results, though the sample size was small. The trial gave rebates to households that reduced their electricity consumption by an agreed percentage during the peak demand hours of 6pm and 9pm; and further rebates were available to households that sustain the reduction for three months. Results have been excellent with 27% reduction of peak loads and 23% reduction overall.

An Alternate Off Peak Tariff trial has commenced to build on the success of the trials of load limiting devices - Demand Response Enabling Devices (DREDs) which were trialled earlier in the project. The devices allow a central controller to turn off the appliance at certain times of the day. The Alternate Off Peak tariff tests customer take up and administrative issues while allowing Ergon to manage maximum demand in situations where security of supply is reaching a difficult state. This trial is being carried out in parts of Townsville separately to the Solar City project, as few suitable sites were identified on Magnetic Island, mostly due to changes householders had already made under the project.

Energy efficient pool pumps with variable speed drives were installed and have shown savings of between 65% and 80%.

Housing design trials

Building houses and offices to suit the climate, and lessen the energy footprint

Chester Holdings – greening federation place

Chester Holdings joined the Townsville Queensland Solar City consortium in July 2011 following the owner's positive interaction with the project at their holiday home on Magnetic Island. Tony and Sharyn Denyer proposed a partnership with the project to retrofit their 1885 Federation-style heritage listed building, Federation Place in Sturt Street, Townsville. Chester Holdings have now installed a chilled water air-conditioning system, refurbished the common area to increase air flow, painted the roof white, installed temperature sensors throughout the building and are sharing this data with open access on the internet. The story of the building, the latest upgrades and the Solar City are being told in an interactive display in the building foyer. The partnership has reduced the imported energy requirements of the building by 25% without impacting on tenant amenity or comfort.

HPG - Riverway Itara and Central medium density residential development

Honeycombes Property Group completed the Environmental Sustainable Design measures in the first stage of the Itara Medium Density Residential Development and then transferred these features to the inner city Central Development of Holborn Apartments and the Kensington Apartments. These measures include

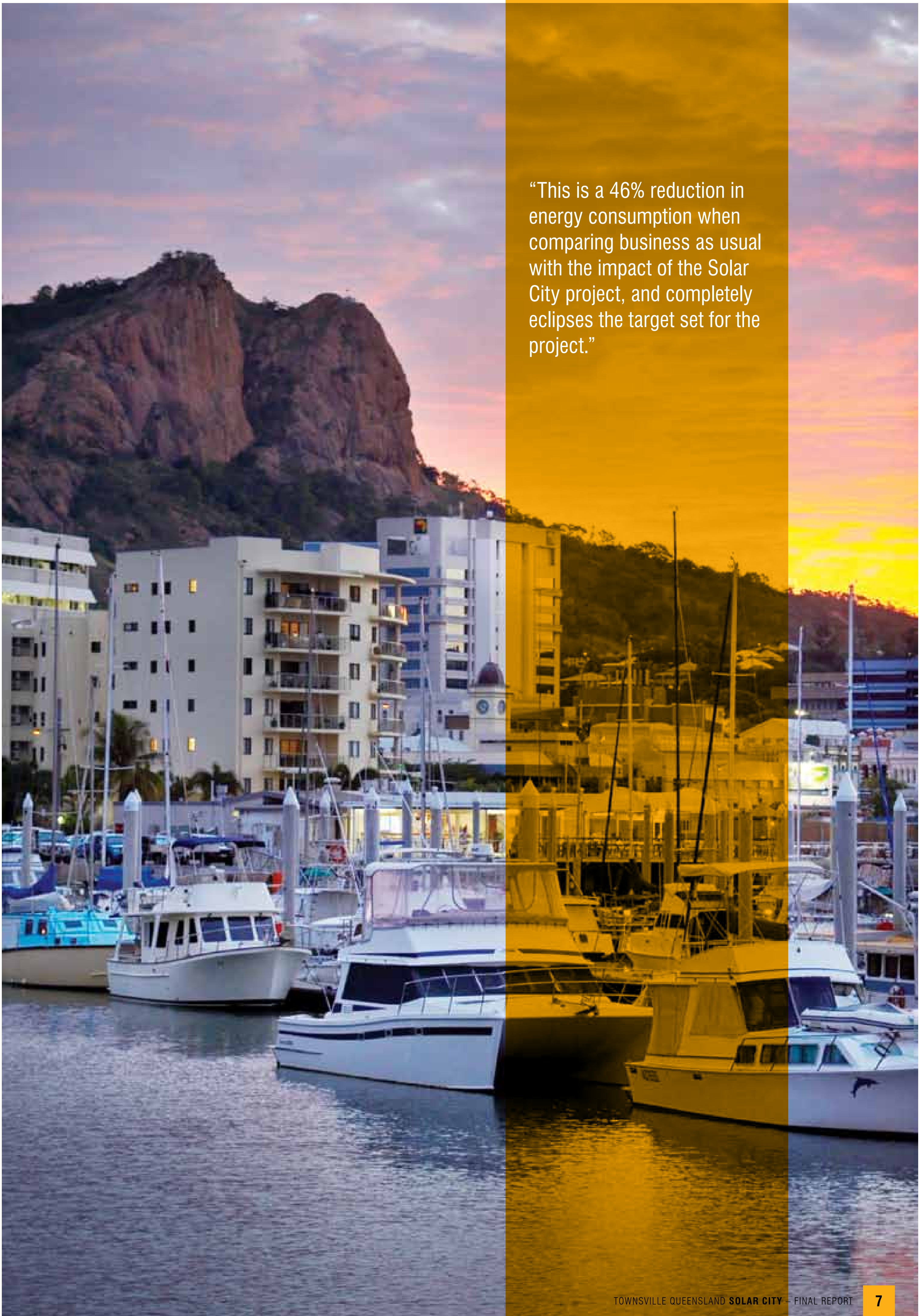
- Hot Water Plant Assessment and Trial
- Energy Efficient Lighting Trial and Solar PV
- Design and Cooling Trial
- Smart Meter installation

These design measures have become standard practice within the company.

Lend Lease (Delfin) - Rocky Springs residential development

This project has not progressed as anticipated as a result of unexpected issues arising out of the permit approval process across all three levels of government.

The Solar Pergola using built-in PV on a shelter on top of Townsville's iconic Castle Hill, built with the assistance of the Townsville City Council, now provides a lasting legacy from Delfin Lend Lease's involvement.



"This is a 46% reduction in energy consumption when comparing business as usual with the impact of the Solar City project, and completely eclipses the target set for the project."

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Cafalo Pty Ltd - Green[t] high rise CBD office

The investigation stage of the sustainable design aspects of this project has been completed and the report presented. The outcomes of Cafalo's research were included in proposals for a 6 star building for the State Government and Ergon Energy.

Community engagement

Empowering the community to make the right choices about their efficiency

Townsville City Council's Citysolar capacity building project and Ergon Energy's community engagement underpinned all the work conducted by the Townsville Queensland Solar City consortium.

Townsville City Council

Citysolar: Community Capacity Building is ever-evolving and is moving from local scale sustainability to a transformative community by utilising

- collective knowledge and vision and sharing this within the community
- new systems creation that maximises old process and enhance them
- the integration of environment, economics and social systems

In particular, Citysolar has carried out the first complete and rigorous example of Community Based Social Marketing for social behaviour change in the world. This culminated in the Cool Roofs campaign to increase the number of reflective white roofs on houses in Townsville.

The Eco-electricity tours involve schools and other groups in the story of electricity and water use in Townsville, educating and encouraging a more sustainable community. Citysolar has been active in education and awareness and in 'solar connections' in national and international forums. The Centre for Excellence in Tropical Design has been an excellent example of a cluster organisation for mutual advantage.

The Smart Lifestyle Expos run annually provided a showcase for sustainable goods and services, giving a boost to these providers.

The Townsville City Council has built on the Solar City project, winning the IBM Smarter Cities Challenge and developing a world-wide reputation as a champion sustainable city in the tropics.

A collective social learning program was commenced in 2013 to ensure the continuation of the Townsville Queensland Solar City into the future as the Townsville Solar City Smart City.

Ergon Energy's Solar Suburb on Magnetic Island

A small island making a big difference

All the work undertaken on Magnetic Island has been made possible by the comprehensive community engagement program and the application of the principles of the energy behavioural change model. This work draws on social science research and specifically psychological research to develop a variety of tools for promoting behavioural change. It has been further enhanced by using thematic communication to prompt for desirable behaviours.

The community engagement program included standard engagement and communication tools such as surveys, events, sponsorship, newsletters, support of local groups and committees, media and a range of promotional material. As well, a key component of the program has been a strong presence on the Island through the Smart Lifestyle Centre. The Centre has been the focal point for the project providing a visible project office and information centre where residents and visitors can go to learn more about energy efficiency.

The success of this approach is shown by the 82% participation rate in the energy assessments and the widespread interest in the project.

Installed in 2011, the Magnetic Island Solar Skate Park is now an exciting blend of publicly designed multi-use recreational facilities, a permanent public art exhibition illustrating important Magnetic Island values, a showcase of innovative renewable energy technologies incorporating thematic signage to support the sustainability message and a proud legacy demonstration place for the Townsville Queensland Solar City project.

The project conducted a survey of residents and business attitudes in late 2010, and compared this to the similar survey conducted just prior to the start of the project in late 2007. The results were excellent. Some outcomes were:

- People said they were now well informed about reducing electricity use
- The energy assessment had the most impact on changing the way they used electricity. They saw the assessors as professional who gave reliable information
- The survey showed that customers expected their bills to be lower, and were disappointed when they saved kilowatt hours but not dollars.
- Some of the themes emphasised by the project communications were reflected in the survey responses. Respondents felt that:
  - they were part of a community that is doing something to reduce electricity
  - they could be more energy efficient without changing their lifestyle

The Townsville Queensland Solar City Project won the 2012 National Golden Target Award for the Environmental Category from the Public Relations Institute of Australia, was a National Finalist for the Education Award of the 2012 Banksia Awards (for both the Ergon Energy and Townsville City Council programs), and a National Finalist in the 2012 Business Community Engagement Award from the Clean Energy Council. In 2011, the project was the national winner of the Marketing Institute of Australia's Green Marketing Award for Excellence, and in 2008 won the national Keep Australia Beautiful Sustainable Cities Community Action award.

Transforming Townsville and beyond – the way forward

The Townsville Queensland Solar City project has had a marked positive impact on the residents of Townsville, Magnetic Island and beyond. The project has been embraced locally and raised interest from national and international stakeholders, with the learnings already being implemented by the consortium partners.

The project has produced successful results in both quantitative and qualitative terms. The consortium is building on the gains made to date and taking the lessons from the project into the wider community of Queensland and Australia. As well, we continue to share these lessons within Ergon Energy. Locally the emphasis will be on continuing the energy efficient culture beyond the current Townsville Queensland Solar City project into the ongoing Townsville Smart City Solar City.

"The project has been embraced locally and raised interest from national and international stakeholders..."

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1.1 – A word from our leaders

Ergon Energy is continually seeking ways to improve service delivery to our customers by understanding their needs and planning effectively for the future.

As the energy provider to more than 97per cent of Queensland geographically, we recognise customers across the state want reliable, affordable and sustainable energy. So we are cognisant of the need to plan ahead to meet the challenges of climate change and increasing energy costs associated with rising peak demand.

The Australian Government's Solar Cities Program provided the platform for Ergon Energy to develop Magnetic Island as a Solar Suburb, and, with our consortium partners, contribute to a broader sustainable energy program throughout Townsville.

Today, we have achieved great things on Magnetic Island including reductions in peak demand, energy consumption and greenhouse gas emissions. So substantial are these savings, we have delayed the need for another undersea electricity cable, which in turn reduces capital costs and price pressure.

Importantly, we are transferring the lessons from Magnetic Island to the rest of Queensland. Already we are applying our knowledge of mass take-up of solar PV systems to other parts of the network. Behavioural change strategies to reduce energy consumption and peak demand are being rolled out in broader community engagement initiatives. I am very proud of the results we have delivered with our consortium partners and the Magnetic Island community. The Solar City project is a strong demonstration of what can be achieved when a community works together with an electricity utility to create a new energy future.

In 2013, I do not see that the Solar City work as completed – I would like to see the project move to what I see as the next phase – which is to build on the installed Solar City architecture and community engagement. I'd like to create the pathway to understanding how Ergon Energy can structure network tariffs so that both Ergon Energy and our customers can extract value.

Ian McLeod
Chief Executive, Ergon Energy

In recognition of the need to transform the way we use, generate and conserve energy, the Australian Government's Solar Cities program has trialled a range of innovative products and services under real-world conditions in seven 'Solar Cities' across Australia.

Townsville was one of seven cities chosen for their diverse cultural, climatic and lifestyle characteristics. The other participating locations include Adelaide, Alice Springs, Blacktown, Central Victoria, Moreland, and Perth.

Now, the Solar Cities Program has come to an end after seven years. In partnership with the Australian Government, the program provided these communities with the opportunity to trial a range of energy efficiency measures, including new technologies, aimed at encouraging consumers to change their attitudes towards energy use.

There have been a number of exciting outcomes including the benefits of properly delivered home energy assessments, the value of community based social marketing integrated with sound community engagement practice, the necessity to encourage the use of combinations of technologies such as in-home displays together with solar photovoltaics and the benefits of solar powered community facilities.

Looking to the future, it is hoped that many of the lessons from the program can be incorporated into new policy opportunities. In effect, this has already commenced, with activities associated with programs under the Low Carbon Communities banner utilising administrative practices developed by Solar Cities.

Townsville Queensland Solar City has been exemplary in its contribution to the program. Their trials, the results and the public support garnered are a wonderful example of the value in engaging governments, businesses and community groups to deliver energy efficiency activities that benefit everyone.

Malcolm Thorp
Director, Solar Cities Program

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It's with great pleasure that I take this opportunity to acknowledge the incredible work that the Townsville community and Ergon Energy has achieved as a whole through the Townsville Solar City project. This has been achieved through our collaborations, partnerships and by simply taking action.

As Australia's largest tropical city, we have a duty to invest in our community to learn from one another and collaborate to build a resilient and adaptable city where we can respond to rising energy prices, and future energy demand while finding new ways of providing the infrastructure required to support our community.

The Townsville Queensland Solar City project has been one of the city's most significant opportunities to drive sustainability and change by catalysing green investments and the development of local expertise in energy efficiency and demand management. It has been an exciting journey from the day the community came together and stood on The Strand beach in 2006 to symbolise the beginning of the project.

In the last four years our CBD has gone from barely demonstrating one new idea in sustainability, to the recognition that good design existed in Townsville 30 years ago in our city centre – we even had "green walls". We only needed a renaissance in thinking. Looking around the city today and experiencing the change is remarkable. Innovative and smart technologies abound from solar panels to sensor networks.

Townsville is now recognised as a world leader in implementing collaborative sustainability projects in an emerging business model. Building on the successes of the Solar City project, we have now developed a Smart City Solar City road map to the future, integrating smart technology, data, advanced analytics, social media and networks and innovative behaviour change methods along with practical energy demand management.

I particularly want to congratulate Ergon Energy, the Australian Government and the local community who have been the catalyst for driving an innovative idea into reality through collective knowledge and action that has benefited Townsville as a whole.

Cr Jenny Hill
Mayor, City of Townsville

As I reflect on the Townsville Queensland Solar City project there are many things that stand out for me. I am very pleased with the results – the successes of the project on Magnetic Island and in the rest of Townsville have been exceptional, and the many things that the organisations involved in the project have learnt along the way have been invaluable.

The importance of having the right people working on the project cannot be underestimated. The Solar City project has attracted a group of keen, enthusiastic and knowledgeable people to each and every facet of the project, and these people have driven the success we have seen.

Our consortium model of local government, private developers and government owned utility has worked extremely well. Each member of the consortium worked on their own part of the project and generously supported the other members with all the activities happening on the project.

I know I speak for the whole consortium in saying that it has been a pleasure dealing with the Australian Government's Solar Cities Program team. They have been professional, responsive to our needs, and always available.

As well, the State Government provided funding for the work on Magnetic Island through the then Office of Clean Energy, and the staff of this Office have been most helpful and attentive to the project.

All through the project I have been acutely aware that the success of the project depended entirely on community goodwill. Everyone on our team, no matter what the nominal role was, has been an ambassador for the entire project, responsive to the community's needs, professional and knowledgeable, and always available. The many community engagement awards that we have won are testament to the fantastic way the team worked with each other and with the community.

To me, one of the rocks underpinning the project has been the management of Ergon Energy with their wholehearted support of the Solar City, and their commitment to taking the things we have learnt to other parts of Queensland.

Ian Cruickshank
Manager, Townsville Queensland Solar City

01

1.2 – Project timeline

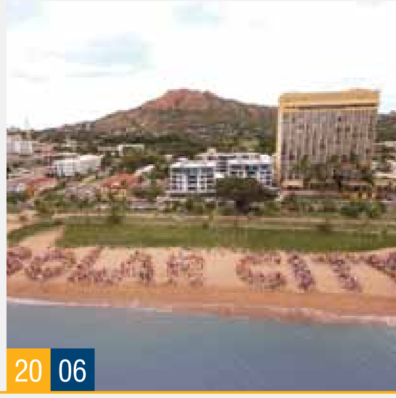
2004

Australian Government announces $75 million Solar Cities program (later expanded to $94m)

2005

Ergon Energy leads a Townsville-based consortium to bid for one of only five (later seven) opportunities to create a Solar City – November.

The Australian Greenhouse Office receives 23 expressions of interest to participate in the program and invites 11 cities to submit a business case to host a Solar City trial.



2006

The Townsville Queensland Solar City bid is announced as successful – 26 September.

3000 people form the words ‘Solar City’ on The Strand in a show of support for the bid on –19 March 2006 (the day before Cyclone Larry)

2010

Townsville City Council holds first community capacity building workshop with ‘Thematic Communications’ expert Professor Sam Ham – April.

Trade Expo at the Smart Lifestyle Centre, with celebrity carpenter Scott Cam attracts a strong crowd – 11 May.

Cafalo Report published and circulated – December.

2011

Honeycombes Holborn development complete – March.

Energy efficient product voucher offers close with a total of $280K claimed in rebates.

More than 75 per cent of Magnetic Islanders participated in the project – with a total of 1351 audits so far.

Greenhouse gas emissions reduced by over 33 520 tonnes, well on track to 50 000 tonne target – June.

Magnetic Island’s 100kW Solar Skate Park opens – 23 July

A total of 725 kW of solar PV installed in 211 systems across the island – December.

Peak demand and energy consumption are 40 per cent below that predicted without the Solar City project – December.

2007

Ergon Energy installs the first solar panels with a 9kW system at the Queensland Transport Magnetic Island Ferry Terminal – November.

2008

The sustainable energy transformation of world heritage listed Magnetic Island begins – February.

Free energy assessments commence on Magnetic Island. In the first month over 500 people sign up – February.

First ever Smart Home and Lifestyle Expo in Townsville – July.

The Smart Lifestyle Centre for community engagement opens on Magnetic Island – September.

2009

Honeycombes Itara development complete – March.

The first voucher for energy efficient products is written at the Smart Lifestyle Centre – 29 March.

2012

Community event to mark the end of operational phase and start of measuring and monitoring – 21 April.

The 348 kW Annandale Stadium Solar Power Station is commissioned – May.

Honeycombes Kensington development complete – September.

Federation Place sustainable upgrade complete September.

2013

The Federation Place project concludes, with the 128 year old building using 25% less electricity from the grid over the summer period than the previous year. – March

The Solar City Smart Lifestyle Centre was handed back to the council for community use and equipped with signage to communicate the project legacy. – May

The Solar City project created a springboard for a number of new and ongoing programs. New proposals to move the project to the next exciting phase are being discussed. – June

LEGEND

Thin – Magnetic Island milestones

Yellow Bold – Consortium partner milestones

Bold – Australian Government milestones

01

1.3 – Townsville Queensland Solar City

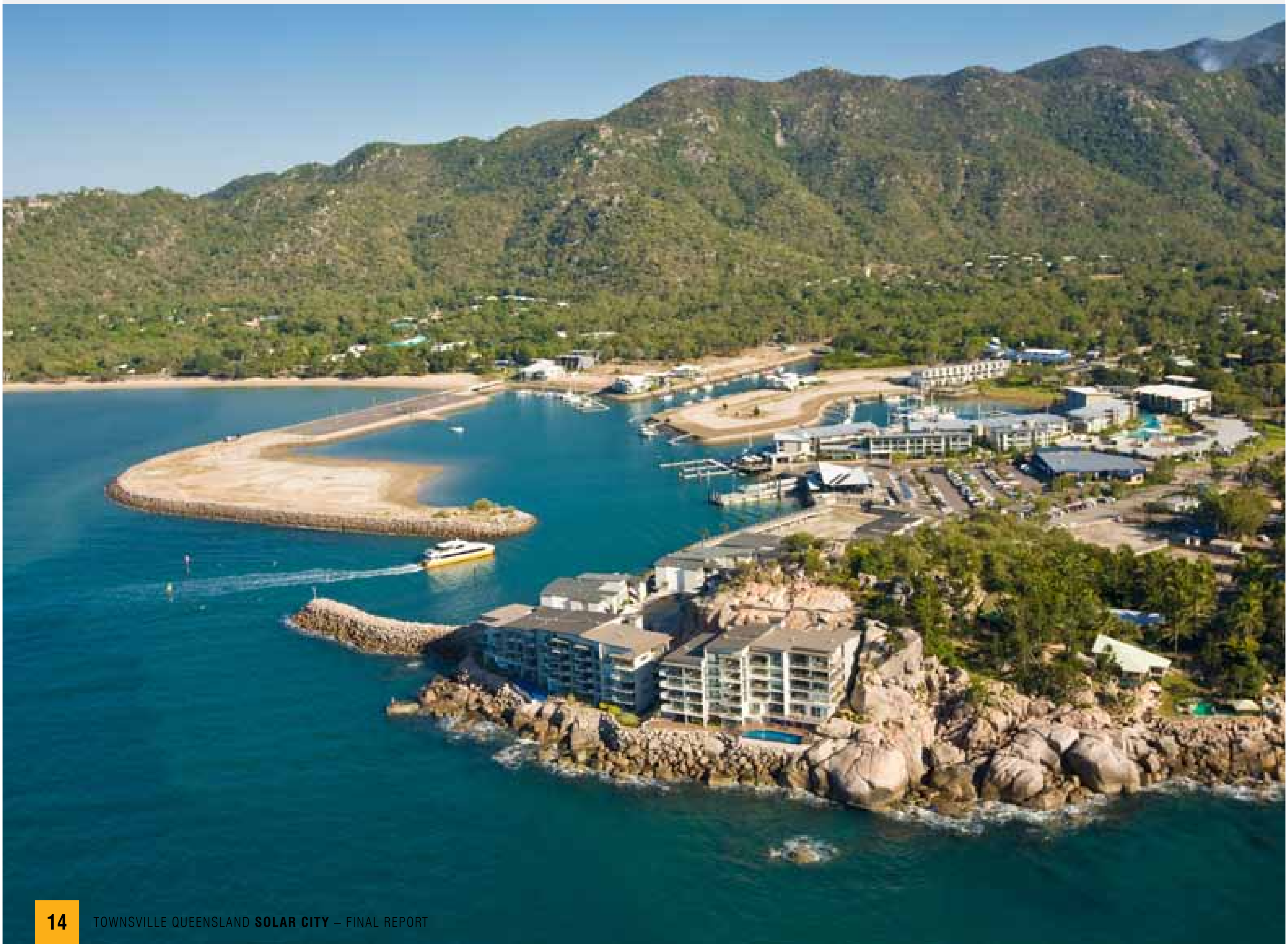
Townsville Queensland Solar City
Ergon Energy leads the overall project consortium

Magnetic Island Solar Suburb	**Rocky Springs**	**Itara Riverway**	**Green[t]**
Ergon Energy	Delfin Lend Lease	Honeycombes Property Group	Cafalo Pty Ltd

↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑

Citysolar
Townsville City Council's community capacity building program

Figure 1.1 – initial TQSC structural representation



02

02. TOWNSVILLE BECOMES A SOLAR CITY

People are the engine room of the Solar City

In 2005, Greg Bruce from the Townsville City Council brought world renowned sustainability advocate Hunter Lovins to Townsville and filled the Entertainment Centre with people, one of whom, Gordon Binks, worked for Ergon Energy. Gordon encouraged Ergon Energy to form a partnership with the Council and together they worked on the bid to make Townsville a Solar City.

Executive General Manager Corporate Sustainability and Innovation Jim Chisholm added the vision of building the equivalent of a Kogan Creek Power Station on roofs in Townsville, and Gordon, Graeme Foulger, Dean Comber and Peter Goggins pitched in to convince the rest of the Ergon executive team of the value of demand management as a tool for deferring infrastructure. They also worked with Peter Cronin, Brook Walters and Ty Taylor from the Queensland government to help with funding.

Meanwhile Greg Bruce was busy getting the support of state and national members of parliament, as well as the then Mayor, Tony Mooney, Deputy Mayor Jenny Hill, Councillors Ann Bunnell and Les Walker, and enrolling consortium partners in Townsville – Peter Honeycombe from the Honeycombes Property Group, Delfin through Rob Ball and Cafalo through their director Bill Spee. In 2011, Tony and Sharyn Denyer brought the greening of their historic Federation Place building into the consortium.

A highlight of the bid period was the Solar City Community Day on 19th March 2006, where over 3000 people gathered on the Strand in Townsville to spell out the words “Solar City” on the beach, and send a message to the Australian Government that the wider Townsville community supported the bid. This gathering was more remarkable as it was the day before Cyclone Larry hit North Queensland, and many people were busy preparing their homes and businesses to survive the cyclone. Some people came to the Community Day direct from the Disaster Control Centre, and returned immediately after.

The agreement between Ergon Energy as consortium lead and the Australian Government was signed in April 2007, and thanks to some hard work and dedication by Peter Goggin, the consequent agreements between Ergon Energy and the other consortium partners were all finalised by the end of 2007. The project could begin!

The Townsville Solar City project begins

The Townsville Queensland Solar City project is part of the Australian Government’s $93.8M Solar Cities Program to rethink the way we produce, consume and conserve electricity.

The stated objectives of the national program are to:

- demonstrate the economic and environmental impacts of cost-reflective pricing, the concentrated uptake of solar, demand management and smart metering technologies;
- identify and implement options for addressing barriers to distributed solar generation, energy efficiency and electricity demand management for grid connected urban areas.

There are seven Solar Cities around Australia, each doing the same things in completely different ways and at various different stages. The others are Adelaide, Alice Springs, Blacktown, Central Victoria, Moreland and Perth.

For the Townsville Solar City project, the Australian Government provided $15 million, the State Government $5 million, and the consortium members contributed $11 million towards the $32 million project. The Townsville Queensland Solar City project commenced in April 2007 and was completed in June 2013.

During the project a quarterly Operations Report was submitted outlining the activities undertaken by each consortium partner, the cost of these activities and a listing of the qualitative lessons learned. This report draws on these as well as specifically addressing the outcomes of the activities.

The Townsville Queensland Solar City consortium members are –

- Ergon Energy, lead consortium member for the Townsville Queensland Solar City project. Ergon Energy’s focus has been the Magnetic Island Solar Suburb where it carried out a comprehensive and very successful program of community engagement, demand management, smart meters, solar generation, tariff trials, and technology trials
- Townsville City Council through their ongoing Citysolar program of community capacity building have enhanced community engagement across the city,

conducting a Community Based Social Marketing (CBSM) trial, promoting solar technology, and creating a tropical design cluster

- Honeycombes Investment Group who contributed to sustainable design, smart metering, solar hot water and community engagement through their Itara and Central medium density housing developments
- Delfin Lend Lease who planned to contribute to sustainable design, energy efficiency, solar generation, smart metering and community engagement through their Rocky Springs master planned community development
- Cafalo Pty Ltd who contributed to sustainable design, energy efficiency solar technology and community engagement through their Greent high rise CBD office building investigations and reporting, and
- Chester Holdings, who joined the consortium in 2011, and retrofitted a Federation era building with a chilled water air-conditioning system, white roof painting, solar photovoltaic installation and sensor monitoring system available for open access on the internet.

Each of the consortium partners' contribution is highlighted in the key areas of this report.

Townsville City Council has the people who bring the Solar City to Life

Greg Bruce, the Executive Manager Integrated Sustainability Services within the Townsville City Council, was instrumental in bringing the Solar City to Townsville. He has been the driving light not only behind achieving the project aims, but in broadening the vision of Townsville as the leading sustainable tropical city in the world.

Greg, with great support from Councillor now Deputy Mayor Vern Veitch, formed the Citysolar team to implement the Council's commitment to the Solar City project with many willing members including DJ McKenzie, Guy Lane, Adrian Turnbull, Damien Sweeney, Jon Shaw, Mark Robinson and Dylan Furnell.

As well as their own projects – CBSM and the Cool Roofs campaign, Learnscapes and education programs across the city, renewable energy installations, and developing cluster of sustainable products and services businesses – Citysolar has supported the other consortium partners with events, displays and their developing capability in Collective Social Learning and Thematic Communication.

Townsville City Council's Community Capacity Building Initiatives

INITIATIVE	IMPLEMENTATION	OUTCOME
Community Based Social Marketing	Design of CBSM community program	Extensive research and development of CBSM for energy efficiency resulting in the Cool Roof campaign
Education and Awareness	Provide and support community, business, industry and school (including universities) based activities to increase and develop knowledge networks of solar technology, energy management and sustainable practise.	Eco-electricity tours for schools and community groups, education materials produced for teachers, workshops to encourage action by the community, interpretive signage at Council buildings and specially developed sustainable learnscapes.
Promotion	Community based Citysolar activities connecting people with key elements of the Solar City Program	Smart Lifestyle Expo held annually for sustainable and eco-efficient product and services
Centre of excellence in tropical design	Develop, host and facilitate CETD network action forums and workshops	Network developed, workshops on energy efficiency actions undertaken, website established, wiki database developed
Solar Technology	Installation of solar technology and learnscapes to assist with education	Installation of 140kW of various types of PV systems, including one battery storage system
Incentives	Trial partnerships with local businesses to provide incentives for customers to take up efficiency measures	Cool Roof program successfully uses incentives from painting contractors to reduce customer costs.
Economic Policy and Instruments	Establish links with local and state governments to foster energy efficient economic policy and instruments	Influential meetings and presentations to local government associations, and state and federal government policy bodies. International influence through International Solar Cities conference and IBM Smarter Cities and subsequent work.
Monitoring and Evaluation	Develop and publish evaluation requirements for Citysolar activities	Extensive publications of CBSM work including evaluation of the program. Publication of all Citysolar activity outcomes.

Citysolar encouraged the consortium and members of the Centre of Excellence for Tropical Design to attend the 4th International Solar Cities Conference in Dezhou, China in September 2010, which was the follow up to the conference held in Adelaide in 2008. Dezhou is home to the visionary China Solar Valley established by the Himin Solar Energy Group. The 26 person Townsville delegation was the largest from outside China at the conference.

"Importantly we have more green buildings with NABERs ratings in our CBD than ever before as a direct result of the impact of the Townsville Solar City project and our champions in Ergon Energy – we are progressing towards Townsville as a Smart City Solar City and the legacy of the project will continue long into the future."
– Greg Bruce, ISS, Townsville City Council

Honeycombes Property Group led in energy efficient apartments.

Peter Honeycombe was one of the early supporters of the Townsville Queensland Solar City project. He originally intended to use all five proposed stages of his Itara Apartments at Riverway to showcase sustainable design and energy efficiency in medium density apartments in the tropics.

Justin Howie was given the job of delivering the first stage of Itara and representing Peter on the Solar City project.

Unfortunately, the property market in Townsville was hard hit by the Global Financial Crisis, and Honeycombes postponed the remaining stages of Itara. In 2011, with Lachlan Bell now representing the company, HPG proposed to include their Central development to demonstrate sustainable building practices for the remaining stages of this. Holborn and Kensington apartments were incorporated into the Townsville Queensland Solar City project in July 2011.

A highlight of the HPG involvement with the Solar City Project was the Community Social Learning Day organised by the Citysolar staff for Honeycombes, their builders and designers to look at ideas to ensure the Central development is at the leading edge of sustainable and energy efficient tropical residential/commercial precinct. Many consortium members took part, and the innovative ideas generated surprised and enthused many there.

"Our involvement in Solar City was also a valuable tool that enabled us to investigate and implement various sustainability measures that may not otherwise have become what is now a staple in our development methodology."
– Lachlan Bell, Honeycombes Property Group

Honeycombes Property Group Sustainable Building Design Initiatives

INITIATIVE	IMPLEMENTATION	OUTCOME
Hot Water Plant	Trial of centralised hot water	Central hot water systems installed in Itara (gas), Holborn (gas) and Kensington (heat pump). Both systems proved economic from the long term view.
Energy Efficient Lighting	Assess and implement energy efficient lighting in the medium density housing environment.	Energy efficient lighting installed in Itara, Holborn and Kensington. Fluorescent lighting has been excellent, but CFLs down light designs to date have not satisfied insulation requirements.
Smart Metering Installation	Install smart meters and monitor apartment electricity usage	73 smart meters were installed in Holborn and the data added to the Solar Cities database
Design and cooling trial	Review of sustainable cooling measures, and implement commercially viable building works to improve sustainability features within each project	The design of Itara, Holborn and Kensington ensured that apartments have comfortone glass, DRED ready air conditioning, cross flow ventilation, large outdoor living areas, optimal available orientation and shading on sun affected areas.
Community Engagement	Rollout of marketing for materials for future stages of relevant projects, and review of materials produced to market benefits to prospective purchasers of sustainable design.	Marketing material produced for Itara, Holborn and Kensington. The benefits of sustainable design are recognised by potential buyers, but they are unwilling to pay a premium for it in the present market.

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The principles demonstrated in the Solar City sites have now been incorporated in the latest medium density housing developments by Honeycombes, including the Paddington apartments in Central, and the Jacana apartments at Riverway.

Cafalo makes CBD office buildings more sustainable

Bill Spee has been an enthusiastic supporter of the Solar City since the beginning. Cafalo owns the CBD land parcel left vacant by the fire and demolition of Buchanan's Hotel in Sturt St, Townsville. When Bill joined the Solar City project he decided that any CBD office block on his site would be built to the highest sustainability principles, and be a benchmark for efficient office buildings in the tropics. Together with the Citysolar team from the council, Bill held a series of workshops to determine what would be best to achieve his aims. Due to the downturn in the CBD property market in 2008 and subsequent reduction in demand for office space, the proposed "green^{t}" building has not proceeded.

However, Cafalo has contributed to the Solar City project with their report on the principles and practices required for high efficiency office buildings in the tropics. In compiling this report, Bill would like to thank Mick Pearce, Hunter Lovins and Sam Ham for their inspiration, and Charlie and Cheryl from the Natural Edge Project, Craig McClintock, Bruce Barrett and Paul Hotson for their assistance.

"At the start of 2006, I think it would be fair to say that 'green' design and development did not figure highly in Townsville. Today it is a totally different story, and we believe that Townsville's Solar City consortium had a very big impact in raising awareness in the local construction industry of the need to 'build sustainably'."
– Bill Spee, Director, Cafalo

Cafalo Pty Ltd Sustainable Building Design Initiatives

INITIATIVE	IMPLEMENTATION	OUTCOME
ESD Design Trial	Investigate the potential elements of and best practice for a building of this nature in a tropical climate.	Workshops held and report produced
Energy Efficiency Trial	Identify energy efficiency options including lighting, air conditioning and energy management systems.	Workshop and consultant input to the final report
Solar Technology Trial	Identify solar technology options including PV, hot water and solar thermal.	Workshop and consultant input to the final report.

Lend Lease (Delfin) and their master-planned residential development

The Serene Valley – Rocky Springs residential development was proposed by Delfin (now lend Lease) as a major master-planned community on the southern edge of Townsville, close to the university, hospital, Lavarack Barracks and with easy access to the CBD.

Lend Lease joined the Solar City project to demonstrate how residential subdivisions could be made more energy efficient and sustainable, with building design suited to the tropics, energy efficient appliances, and distributed generation. Original consortium representative Rob Ball handed over the reins of the project to Simon Walker soon after the Solar City project began. Despite the efforts of Simon and his team including Martin Wiltshire, Pam Griffiths and Matthew Montgomerie, the approval processes of the Federal, State and local government have combined to delay the commencement of development until after the Solar City project finishes.

Simon recognised the slow progress and tried to bring together several ideas from other parts of Lend Lease. He proposed a 1.2MW solar array that would feed the Townsville Prison Complex, however on review the State Government decided not to proceed with this.

In 2012, the Townsville City Council installed on behalf of Lend Lease the 'Solar Pergola', an exercise shelter and "Learnscape" on the top of Castle Hill. The shelter has built-in photovoltaic generating panels provided by Lend Lease that drive a water misting system to provide cooling for those who get their exercise walking, running or riding to the top of the iconic landmark.

"We do believe that when the Rocky Springs project proceeds it will offer a unique opportunity to demonstrate the benefits of solar energy, energy efficiency and other innovative energy solutions at a large scale... we believe this will reduce our ecological footprint and assist us to deliver better communities for our customers."
– Simon Walker, Regional Development Manager Communities, Lend Lease

Lend Lease Sustainable Building Design Initiatives

INITIATIVE	IMPLEMENTATION	OUTCOME
Learnscape	Install a structure with interpretation to encourage sustainable energy efficiency	Solar Pergola with built-in PV and interpretive signage installed on Castle Hill

Federation Place becomes much more than a heritage listed building – it steps from 1885 to the 21st century and beyond

The last consortium member, Federation Place, owned by Chester Holdings, joined in 2011. Directors of Chester Holdings, Tony and Sharyn Denyer also have a house on Magnetic Island, where they participated in the transformation of Magnetic Island into a Solar Suburb by having an energy assessment. The couple took up project recommendations to paint their roof white and host an Ergon Energy owned and maintained PV system for no direct financial benefit to themselves.

Impressed by the aims of the project, they then decided to apply sustainable energy principles to Federation Place, their 140 year old heritage listed office building in Townsville's CBD. Together with engineering consultants GHD, one of the tenants of Federation Place, the Denyers submitted a proposal which was accepted by the other consortium partners and the Department of Climate Change and Energy Efficiency in July 2011.

Meanwhile, with the support and history of the Solar City project, on behalf of the Townsville City Council Greg Bruce won the IBM Smarter Cities Challenge, and the whole of Townsville started talking about data and open access to data. Swept up in this were Ian Atkinson and Scott Mills from James Cook and Adelaide Universities who put the energy usage of Federation Place out there on the web for the world to see. Using Federation Place as a test bed, Scott and Ian have now installed an 18 meter temperature 'tree' in the rainforest to further our knowledge of the natural environment.

"The process of greening Federation Place is ongoing. At every opportunity in the future sustainable measures will be introduced as we better understand the dynamics of the building and the benefits of sustainable living. So the project really hasn't finished." **– Tony and Sharyn Denyer, Directors, Chester Holdings**

Chester Holdings - sustainable improvements to a 140 year old heritage listed office building

INITIATIVE	IMPLEMENTATION	OUTCOME
Energy Efficiency Trial	Implement practice and options for this type of building to address reduction in building heat load, air conditioning and ventilation of common area.	Building management system, chilled water air conditioning system, efficient air handling, white roof and walls, and extensive monitoring installed.
Solar Technology	Identify best practice solar technology option for Federation Place.	17kW Solar PV array installed.
Community Engagement	Develop communications strategy to engage with building users and visitors	Interpretive centre installed with interactive building management information and a history of the building

Overall, Federation Place used 25% less electricity from the grid over the 2012-13 summer than they did over summer the previous year.

Ergon Energy's team worked with the community to transform Magnetic Island into a Solar Suburb

To get the project off to a running start after the agreement was signed in April 2007, Ergon Energy appointed an interim team to get the various streams underway – purchase of solar panels, setting up of data management systems, preparation for Community Based Social Marketing research, etc.

The permanent team came on board over the next few months – Ian Cruickshank - Project Manager, Julie Heath – Community Engagement Manager and Marissa Giacomantonio – Finance Manager in August 2007, and later, Dean Condon – Technical Manager.

Recruitment of the energy assessment team was a longer process than expected. The skills needed for this role became clearer as more experience was gained on the project. Magnetic Island resident and Ergon Energy

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electrician Brian Kerr was the first Energy Advisor, and worked with a number of assistants who were engaged for short periods as the project's managers tested the various blends of skills needed. Brian completed the first Energy Assessment in February 2008, and by later that year Aaron Young had been appointed as the permanent second Energy Advisor.

A second team of Advisors was needed to meet the project timelines, and it became obvious that a skilled commercial advisor was also needed. The project recruited Graeme Pollock to head up the Demand Management team and guide the commercial assessment team, and appointed Bree Nott and Nicola Rodgers to make up the four Advisors. Danielle O'Connor (nee Ryan) came on board twice with the project, the second time to install the IHDs in a co-ordinated program in 2011 / 12.

Community Engagement was a major part of the project, and Julie recruited communications specialists to assist her. Stephanie Hunt had a big impact during her time, with Pam Abrey, Ruth Durant, Melanie Landrigan and the irrepressible Lori Weightman all contributing as well.

After some attempts at leveraging joint projects with Energex, the Solar City project appointed Wayne Preston to drive the Cost Reflective Pricing stream of the project.

Dean Condon recruited the PV installation team in late 2007. By early 2008 Paul Gjecko, Adrian Goldsworthy and Michael Eyles were trained and qualified PV designers and installers, and were also later fully qualified to install the smart meters. The team also included Stacey Smith, Toby Larcombe and Sam Walters, as well as a number of Ergon Energy's electrical apprentices who rotated through gaining solar installation experience. It finished up with Matt Wuersching as team leader, with Chris Fellows, Grant Skuse, Dean Price and Paul Gjecko who provided continuity to the installation team for the whole project. The installation team were also ably assisted by Ergon Energy's Magnetic Island based Electrical Fitter Mechanic, Joost (Jo) Van Andel.

Administration for the project was admirably handled by Kylie Dodd who at the time was also a resident of Magnetic Island. She was the 'face of the project' and receptionist at the Smart Lifestyle Centre, and assisted with bookings for energy assessments and PV installations and was often the first person from Solar City that residents and visitors met. Records management for the PV systems was handled by another resident Natalie Tonking. Later in the project Denise Soars took over the major administration roles with Kerrie Miskell and Rachael Angus (who also carried out energy assessments and provided advice to Centre visitors) located in the Smart Lifestyle Centre handling community concerns, general information and engagement.

Jon Waqainabete became the Finance Manager in mid 2009, taking on the task of implementing the Annual Results Report, and keeping the budget on track. David Robinson was recruited part time to help with the analysis of the data to showcase the success of the Solar City.

Ergon Energy's Meter Data team in Maryborough had the job of interrogating the smart meters from afar, and despite many technical and system problems, they did a superb job in collecting and distributing 48 data points on up to 1600 meters for five years – over 100 million numbers. The team included Belinda Martin, Belinda Devlin, Gerry Van der Lee, Kylie Fletcher and Wayne Murray.

In 2012 and 2013 as the operational phase of the project reduced, many of the team moved on to other projects and interests.

> "The Solar City project has been vital to Ergon Energy in its journey from a simple electricity distributor towards a business focussed on what is best for its customers. Because of the success of the Solar City project, many new sustainability and demand management initiatives have been allowed to be rolled out across Queensland. This success has been built on the support of our consortium partners, our project staff, and particularly the community."
> **– Ian Cruickshank, Manager Townsville Queensland Solar City, Ergon Energy**

The Townsville Queensland Solar City project has achieved its aims, demonstrating sustainable energy practices and building capacity within the Townsville community for a sustainable tropical city. Along the way the consortium members have adapted their plans to suit the changing economic, political and environmental pressures, and still delivered on their original promises, often with much enhanced outcomes.

Townsville and the Solar City project are recognised at home and around the world, with awards and by word of mouth among policy makers and industry peers.

The Townsville Solar City will continue to develop once the original project comes to a close, with the Council developing the Smart City Solar City theme and building on their IBM Smarter City program; with Honeycombes continuing to improve their efficient design for medium density housing in the tropics; with Federation Place placing their performance on the web for all to see; with Lend Lease making sustainability a centrepiece of the Rocky Springs development; with Cafalo always looking at ways to make their properties more sustainable; and with Ergon Energy taking demand management by the electricity distributor to all parts of their network.

As Greg Bruce would say, the best outcomes are non-linear, and the outcomes and future of the Townsville Solar City are good examples of great things growing from non- linear thinking.

Ergon Energy transforms Magnetic Island into a Solar Suburb

INITIATIVE	INSTALLATION	OUTCOME
Demand management trial	Develop and implement a program of demand management to reduce peak demand and energy consumption	Energy Behaviour Change Model developed and implemented. 82% of businesses and residents participated in the project. Energy use and peaks now reduced to 2005 levels
Concentrated PV trial	Trial a new business model of PV ownership	Over 1MW of PV is owned by Ergon and installed on 212 private premises, where the owner hosts for no direct financial benefit.
Smart Metering Installation	Trial of remote read interval meters	1679 smart meters installed using power line carrier communications and data concentrators
Cost reflective pricing trial	Trial of response by participants to incentives to reduce peak demand	Peak demand reduction trial very successful. Large take up of incentives to switch to off peak tariff.
Community Engagement	Qualitative market research, establishing community culture of energy efficiency, enrol participants and maintaining enthusiastic support for the project	Pre project survey assisted with the messages that resonated with the community, allowing development of a culture of energy efficiency, and enrolment of 80% of islanders in the program. Continuing engagement has maintained high interest as shown by the continuing reduction in electricity use.

> "...the best outcomes are non-linear, and the outcomes and future of the Townsville Solar City are good examples of great things growing from non- linear thinking."

"Bungalow Bay and Solar City teamed up to reduce our carbon footprint, for the good of the island – and these fellows"

03. RESULTS

Magnetic Islanders shift and reduce their electricity use

Since the beginning of the Townsville Queensland Solar City project, the people of Magnetic Island have reduced their electricity consumption and the demand drawn at peak times, so that both are now back to 2005 levels. Greenhouse gas generation has been reduced, the third undersea cable has been deferred and residents and businesses have put a brake on their electricity bills.

3.1 – Magnetic Island background

Magnetic Island is approximately eight kilometres (km) off the coast of Queensland and is considered a suburb of Townsville. It is an easy commute via 20 minute fast ferry for workers and students to Townsville, a desirable retirement location and a popular holiday destination. The permanent population is about 2500, although this increases significantly in holiday seasons. Most businesses service the permanent or tourist populations, and there is very little light industry and no heavy industry. The Island is supplied with electricity via two submarine cables each approximately 12km in length extending from the mainland to Nelly Bay, as shown on Figure 3.1. Once on the island, the 11kV distribution network radiates from Nelly Bay as two separate and predominantly overhead feeders, one from Nelly Bay to Horseshoe Bay and the other towards Picnic Bay. In March 2009 there were approximately 1850 customers on the island. As at June 2012, 2042 customers were connected to the grid.

A review in 2003 identified emerging limitations in the electricity distribution network supplying Magnetic Island. The load on the 11kV submarine cables supplying the island had progressively increased such that augmentation would be required if reliable supply was to be maintained. The cable capacity is determined by the electricity that can be transported in any half hour period. As the electricity demand (referred to as demand in this report) from the island rises and falls during the day and with the seasons, the half hour with the maximum demand determines when the cable should be augmented. Before the project commenced, this "peak demand" had been rising faster than the total electricity use on Magnetic Island, as it has all over Queensland in the last decade. Increased use of air conditioners, electronic entertainment and changes to building design and lifestyles all contributed to the rising peak demand, threatening the reliable capacity of 5.4MVA.

Figure 3.1 – Magnetic Island

When the Townsville Queensland Solar City Project was being developed, growth in peak demand had historically been rising at 4.5% per annum (over the previous 7 years) and though this was expected to slow in line with economic conditions, the long term forecast was expected to remain steady at 4% per annum. The peak load occurs each year on one evening during the Christmas/New Year summer holiday period.

Ergon Energy's part of the overall project, the Magnetic Island Solar Suburb, sought to demonstrate ways to:

- reduce total electricity consumption and greenhouse gas to help meet Australia's commitment to Climate Change abatement,
- Reduce peak demand so that costly network infrastructure could be deferred.

3.2 – Energy conservation

An aim of the project was to reduce greenhouse gas to help meet Australia's commitment to Climate Change abatement. Key to reducing greenhouse gas emissions is the reduction in electricity consumption. The measure for electricity consumption is the number of kilowatt hours (kWh) recorded on the two feeder cables to Magnetic Island.

The target for the Magnetic Island Solar Suburb was to reduce electricity consumption by 25%, compared to the Business as Usual scenario in the Detailed Business

Case (DBC). Electricity consumption for the 12 month period to June 2012 was 46% below the annual consumption predicted for the island without the Solar City project and 29% below the target in the Solar City Business Case.

Annual grid-supplied electricity consumption on the island to June 2012 declined by 304,000 kWh or 1.6% compared to annual consumption to June 2011.

3.2.1 – Energy consumption index

The graph on Figure 3.2 shows the electricity consumption for Magnetic Island compared to all of Townsville. As the scale of each is very different, the measures have been reduced to an index showing the percentage increase in consumption for each location and the relative changes between them.

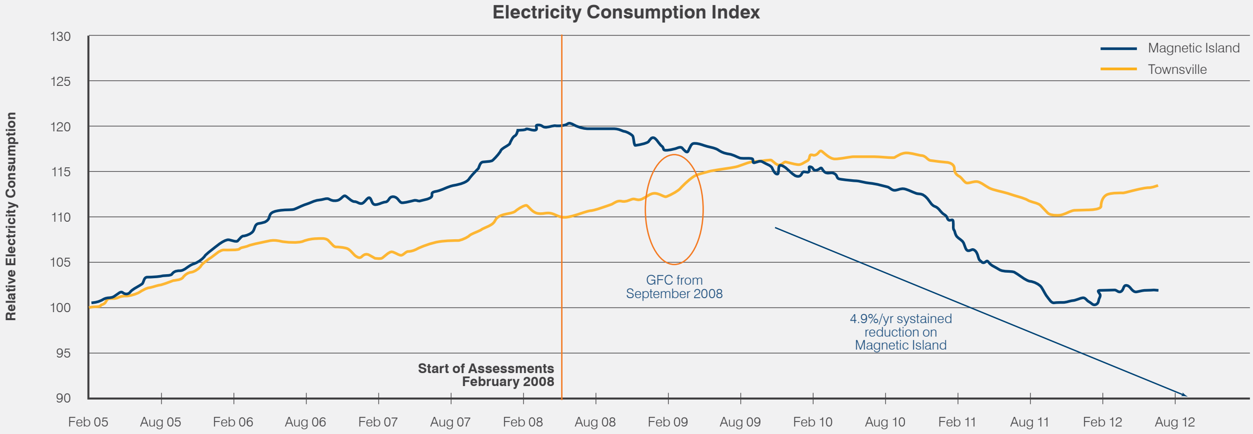

Figure 3.2 - Electricity Consumption Index

The data is highly seasonal, so to allow easy comparison between years, the datasets of daily consumption have been averaged over a twelve month period. The chart shows a sustained reduction in average daily consumption on the island since early 2008, shortly after the Solar City project commenced, which has only flattened off in 2012. In comparison average daily consumption in Townsville increased through most of the analysed period, and the reduction over 12 months from the last quarter of 2010 has reversed in 2012 to return to a growth trend once again.

The target for the Magnetic Island Solar Suburb is to reduce electricity consumption by 25%, compared to the Business as Usual scenario in the Detailed Business Case (DBC).

Figure 3.3 shows the electricity consumption over 12 month intervals. Electricity Consumption for the 12 month period to June 2012 was 29% below the target in the Solar City Business Case (medium growth scenario), and is 46% below the annual consumption predicted for the island without the Solar City project.

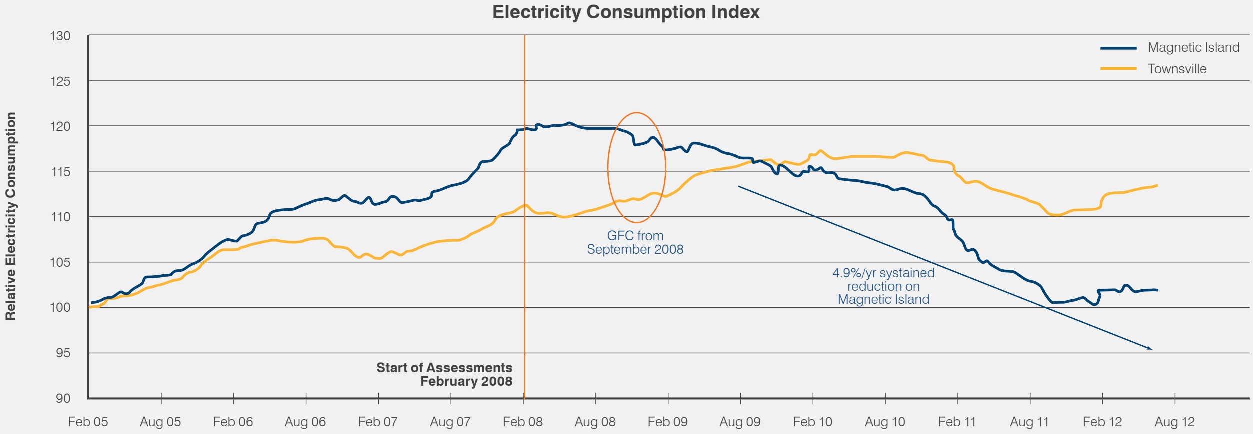

Figure 3.3 – Annual electricity consumption compared to Business Case

3.2.2 – Annual and quarterly electricity consumption

Annual grid-supplied electricity consumption on the island to June 2012 declined by 304,000 kWh or 1.6% compared to annual consumption to June 2011 as shown in Figure 3.4. The fall in electricity consumption from the peak which was in the year that the project started, is 15%. Consumption has dropped to below 2005 levels.

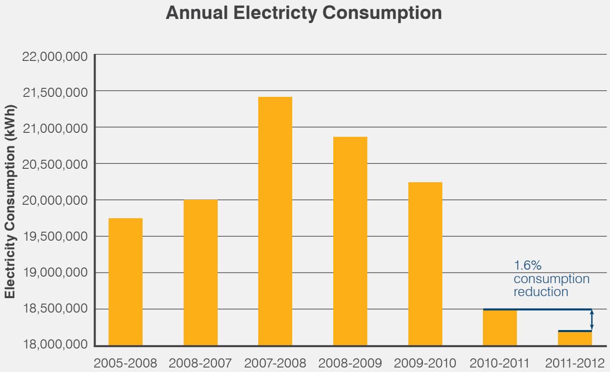

Figure 3.4 – Annual electricity consumption

The majority of customers at Magnetic Island are billed on a quarterly basis. Figure 3.5 shows the total quarterly electricity consumption since 2006. In every quarter since the project commenced until the end of 2011, consumption has been constant or declined, compared to the equivalent quarter a year earlier. In the first 2 quarters of 2012, consumption increased slightly compared to the same quarter a year earlier.

The more significant year-on-year rise in Q1 is due to the loss of supply to the island in Q1 2011 in the aftermath of Cyclone Yasi. An average of the Q1 results for 2011 and 2012 still reflects the trend of falling consumption.

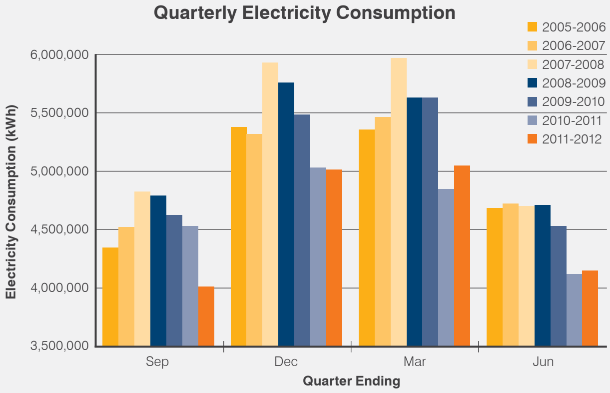

Figure 3.5 - Quarterly electricity consumption

3.2.3 – Daily electricity consumption

The graphs below show the effect of the Christmas and Easter holidays on the average daily electricity consumption for each month. On Magnetic Island, both periods see a significant increase in population as holiday makers fill up the resorts, holiday houses and stay with permanent residents. This increase in population creates a peak in electricity use, with the Christmas/New Year period being the larger mostly due to the hot and humid weather.

The average daily electricity consumption in December 2008 was the highest recorded at 75,299 kWh, when only 15% of energy assessments had been carried out, shown in Figure 3.6. The average daily electricity consumption for December 2009 was 69,575 kWh, and in December 2010 it dropped to 62,362 kWh, with 52% and 76% of energy assessments respectively completed by these dates.

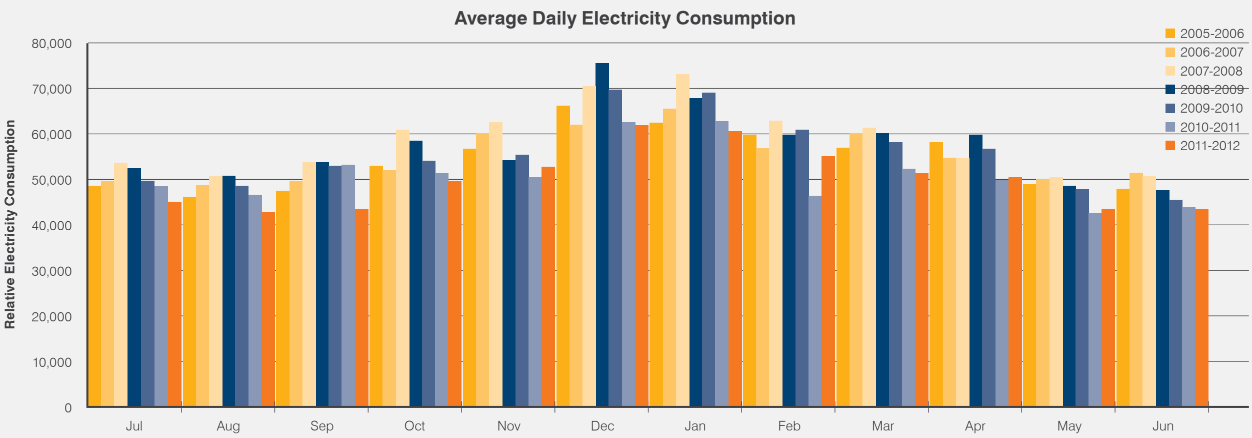

Figure 3.6 - average daily electricity consumption by Month

The variation shown below in Figure 3.7 in March and April is due to Easter falling in different months in successive years. Less electricity was consumed in Easter 2010 than in Easter 2009, and 2009 was less than 2008 (although the early Easter in 2008 may have impacted on consumption).

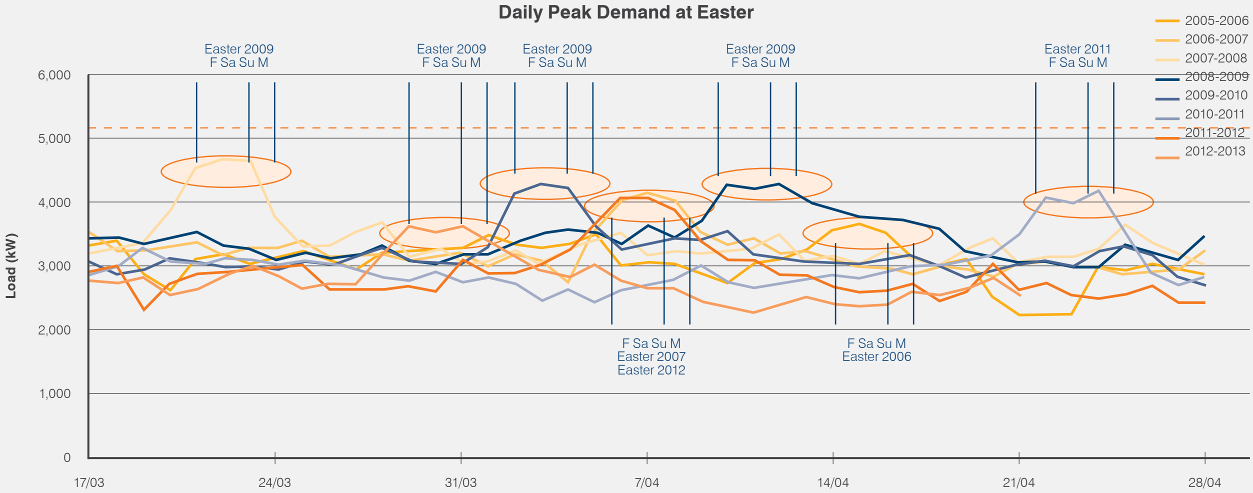

Figure 3.7 - Easter daily peak demand

Reducing year-on-year consumption in all months but November 2011 and February, April and May 2012 is consistent with the previous downward trends. That some months are starting to show an increase in year-on-year consumption is consistent with the prediction in the business case that economic growth on the island would see a resumption in consumption growth after the pause resulting from the projects' interventions.

The most significant rise in consumption in February 2012, compared to a year earlier, is due to the supply interruption in February 2011 caused by Cyclone Yasi. Without that interruption, the February 2012 consumption is likely to have been a continuation of the consumption reductions seen in previous years.

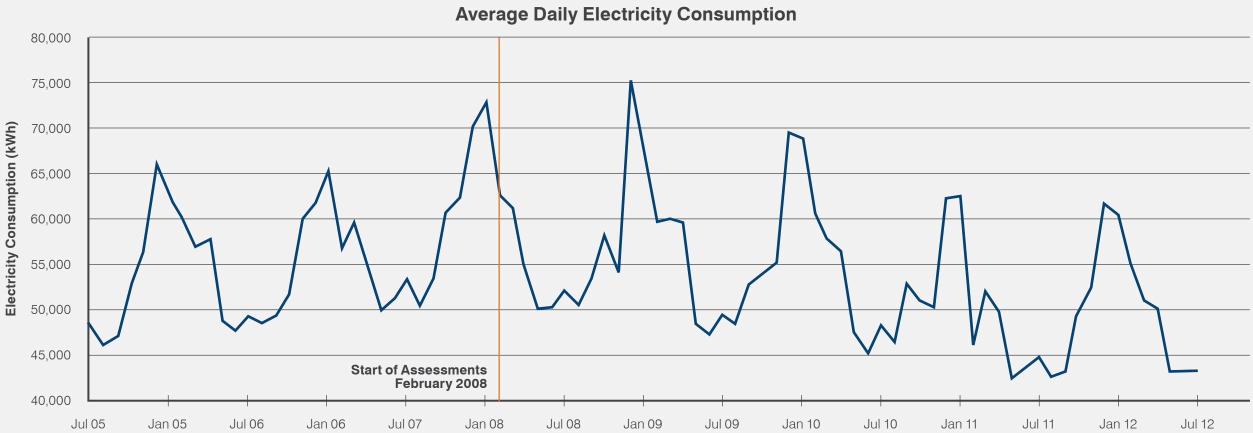

Figure 3.8 - Average daily electricity consumption

The daily electricity consumption above shows a declining trend from April 2009, the period with the highest energy assessments.

3.2.4 – Trend in daily electricity consumption

Using a 12 month rolling average, the seasonal variations are smoothed out, revealing underlying trends in the data.

Figure 3.8 clearly shows a consistently decreasing trend in electricity consumption for the island, at an average rate of 4.9% per year since soon after the project commenced operations until January 2012. The accelerating decline in consumption in 2011, aided by cyclone Yasi in February that year, has flattened off in 2012. The upward tick in February 2012 shows consumption returning to normal levels that month compared to the previous February.

In December 2010 seasonalised average daily consumption on the island returned to the level last seen before the Solar City project commenced, and since then has dropped significantly below that value. At just under 50,000kWh, the seasonalised daily average consumption is more than 4,000kWh below the steady level seen before the island's 2007 growth phase. The project has arrested and reversed the long-term growth, and stabilised electricity consumption at a lower level.

Table 3.1 is a summary of the average daily electricity consumption compared to 2010. The spring and summer periods show the greater percentage reduction of 5%. The mild weather in the last period contributed to this reduction.

SEASONS	CURRENT PERIOD	PREVIOUS PERIOD	CHANGE (KWH)	CHANGE (%)
Spring	48,663	51,469	(2,806)	-5%
Summer	59,130	62,045	(2,914)	-5%
Autumn	48,165	48,056	109	0%
Winter	43,160	43,601	(441)	-1%
Total	**199,118**	**205,170**	**(6,052)**	**-3%**

Table 3.1 - Summary of average daily electricity consumption in seasons

More information on seasonal consumption and profiles can be found in our 2012 Annual Report on our website www.townsvillesolarcity.com.au

3.2.5 – Magnetic Island and comparable regions

The electricity consumption at occupied residential properties on Magnetic Island, in Townsville, and in Ayr and in the Herbert and Lower Burdekin region, which includes the first three, was compared from March 2007. To ensure a valid comparison, total quarterly consumption in each region was normalised to the daily average per occupied residential property.

The chart comparing Average Daily Electricity Consumption per residence in Figure 3.9 shows that the pattern of consumption through each year is similar in each region, with a minimum in each quarter ending each September and a peak in the quarter ending each March (note that this is the relates to the summer quarter due to the timing of the electricity reads and billing period). It is important to note the significant increase that occurs in consumption over the hot summer months due to the widespread use of air-conditioning.

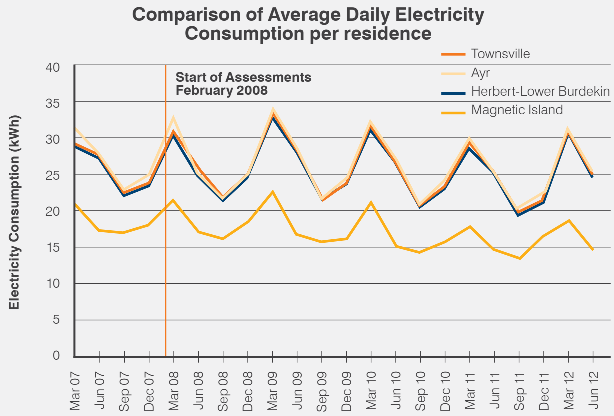

Figure 3.9 – Comparative average daily electricity consumption per residence

Magnetic Island has consistently had an Average Daily Electricity Consumption per residence between six and 10kWh/day less than the other adjacent regions i.e. Townsville, Ayr and Herbert-Lower Burdekin. Though overall consumption in all these regions has been declining over the analysed period, since the start of energy assessments, the gap between Magnetic Island's consumption and that of the other regions has widened slightly, with the island achieving a lower consumption than the other regions of between 7 and 12kWh/day in subsequent quarters. In comparison, the other regions showed almost equivalent consumption levels to each other through each quarter.

Seasonally adjusting the Average Daily Electricity Consumption per residence as a trend (on Figure 3.10), starting in March 2008 shows that all properties experienced an increase in consumption in the year to September 2009, followed by a reduction in subsequent quarters. On Magnetic Island the increasing trend was less significant, and the reducing trend more significant than in the other regions.

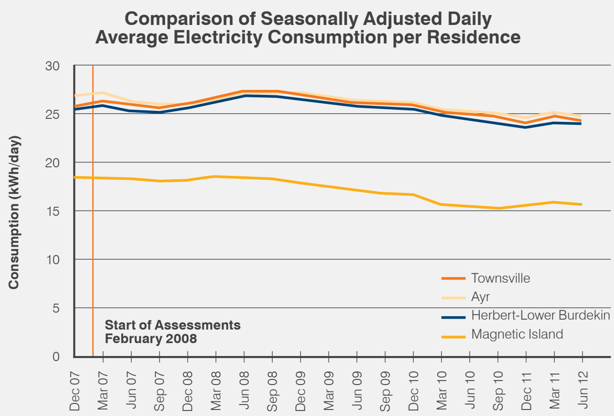

Figure 3.10 – Seasonally adjusted average daily electricity consumption per residence

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The trends in the seasonally adjusted average daily electricity consumption per residence in Townsville and Herbert and Lower Burdekin regions in Figure 3.10 are virtually indistinguishable from each other, whilst the Ayr trend shows consumption has not declined as much as the other regions since September 2009. On Magnetic Island, the consumption trend has reduced about 6.31% more than in Ayr since March 2008 (and a little more compared to Townsville), as shown in Figure 3.11.

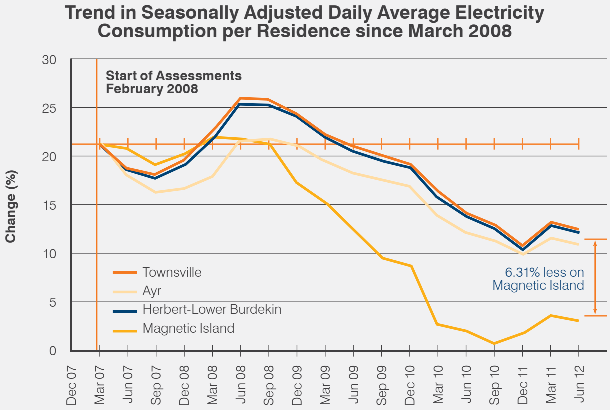

Figure 3.11 – Trend in seasonally adjusted average daily electricity consumption per residence

A similar picture emerges when analysing the total feeder consumption in the Townsville and Magnetic Island regions, and extracting the seasonally adjusted trends in each relative to an index value of 100 on a starting date in July 2006.

Figure 3.12 shows the trend of continuous reduction in consumption on Magnetic Island, commencing soon after the energy assessments started, and accelerating in the last quarter of 2010. In contrast, consumption in Townsville has been on an almost uninterrupted increasing trend from January 2007, to mid 2010. In late 2010 the trend in Townsville turned and consumption started to decline, though at a lower rate than on Magnetic Island. The electricity consumption in Ayr shows similar trend to Townsville, and markedly different from Magnetic Island.

The Global Financial Crisis (GFC) that started in September 2008 had virtually no perceptible impact on the growth in consumption in Townsville, apart from a few small dips over the several months following, but there were several more pronounced declines over similar short periods on Magnetic Island (which were mostly followed by a rebound of similar magnitude).

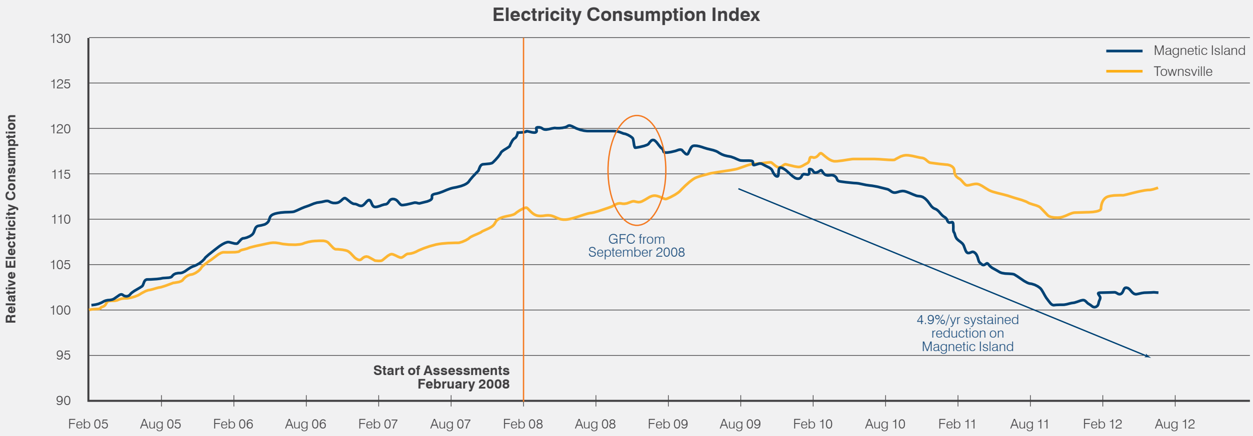

Figure 3.12 –Total feeder electricity consumption index

The differences between Figure 3.12 (based on feeder measure consumption) and the previous ones (based on residential consumption per premises), show that while Townsville residential consumption per premises has been declining in recent years, the overall supply to Townsville has only started to decline from January 2011. On the island both residential consumption per premises and overall consumption have been declining since the start of the operational phase of the Solar City project.

3.3 – Greenhouse gas reduction

The business case for the project targeted a cumulative reduction of 50,400 tonnes of CO2e by June 2013. These savings will result from the demand management aspects such as changing light bulbs, increasing shading, changing appliance settings and usage, electric hot water substitution, electricity generation from photovoltaic systems and from the reduced losses on transmitting electricity from power stations (HV losses). The loss due to transmission of electricity in the Detailed Business Case (DBC) for Magnetic Island is 10%. Any reduced consumption or local generation saves the coal fired generation needed for the transmission losses, and hence is included in the greenhouse gas savings.

An analysis was made by comparing the annual reduction in electricity consumption as per the DBC without Solar City to the actual consumption since inception of the project. The results of the analysis showed a cumulative reduction of 47.3 GWh for electricity consumption reduction and avoided HV losses to the end of June 2012. This is an equivalent of 53,600 tonnes CO2e savings compared to the predicted figures in the business case, exceeding the project target one year ahead of schedule.

The key differences between the DBC prediction and the actual reduction in emissions calculated from the consumption reductions are:

- the actual emission reductions are greater - about 40% more than predicted
- the makeup of the emission reductions is different from that predicted, with
    - solar PV a much smaller contributor than predicted, due to the PV rollout being slower than anticipated
    - avoided HV reductions
    - consumption reductions for other reasons (Demand Side Management measures, behaviour change, increasing awareness etc) greater than predicted

GHG quantification is subject to inherent uncertainty because of incomplete scientific knowledge used to determine emissions factors and the values needed to combine emissions of different gases.

TQSC has complied with the Code of Ethics for Professional Accountants issued by the International Ethics Standards Board for Accountants, which includes independence and other requirements founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality and professional behaviour.

3.4 – Demand management

"Demand management and renewable energy options are intended to have equal opportunity alongside conventional supply-side options to satisfy future requirements. Indeed, such options have advantages in meeting short lead-time requirements"
(from the National Grid Protocol, 1992)

3.4.1 – Peak demand reduction

The key network related objective for the Solar Suburb is the deferral of infrastructure augmentation. This was achieved through the reduction of peak demand by 27%, compared to the Business as Usual scenario in the Detailed Business Case (DBC). The following pages discuss how the peak demand has changed compared to the estimates in the DBC, and also compared to other measures.

Figure 3.13 below shows the profile of the daily peak demand for Magnetic Island from July 2005 to June 2012. Note the peaks occurring above 4,000 kW which were January 2006 to 2009 (inclusive), and April 2007 to 2010 (inclusive); and the cable limit at 5,159 kW. The January data covers the festive summer season and the April data covers the Easter break. Both these periods are characterised by higher on-island populations coupled with warmer weather.

It is worth noting that Year-on-Year, the peak demand increased by 9% in from December 2007 to December 2008. The peak demand then decreased by 6.5% in 2009 (i.e. on 31 December 2009), it further decreased by 4.5% in 2010 (i.e. on 29 December 2010), down another 1.6% in 2011 (i.e. 27 December 2011), and now down another 4.1% (on 30th December 2012).

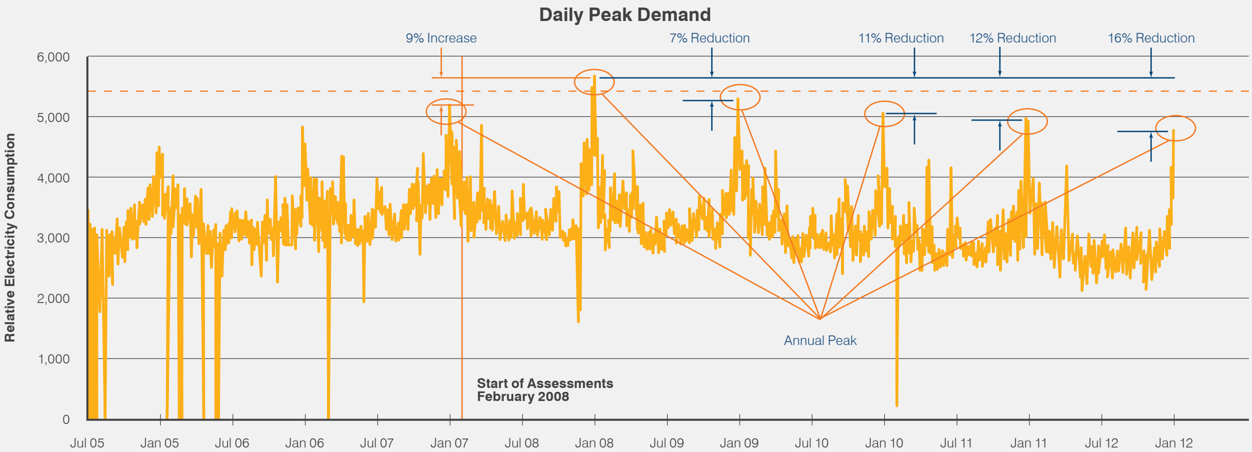

Figure 3.13 – profile of the daily peak demand

Using 31 December 2008 as the base year, peak demand decreased by 7% in 2009, it decreased to 11% in 2010, to a 12% decrease to December 2011, and in December 2012 it was 16% less than the 2008 peak, as summerised in Table 3.2.

FINANCIAL YEAR	DATE	MAX DEMAND KVA	CHANGE	
			KVA	%
2007-2008	01 Jan	5164	356	7.4%
2008-2009	31 Dec	5649	485	9.4%
2009-2010	29 Dec	5280	-369	-6.5%
2010-2011	30 Dec	5010	-240	-4.5%
2011-2012	27 Dec	4959	-87	-1.6%
2012-2013	30 Dec	4754	-205	-4.1%

Table 3.2 – Magnetic Island peak demand Year-on-Year

Compared to the DBC (medium growth scenario), annual peak demand measured last summer (in kVA) is 46% below the predicted annual peak demand for the island without the solar city project. This is 27% below the target set in the DBC and continuing to trend downwards, compared to the business as usual forecast which is trending upwards as shown on Figure 3.21.

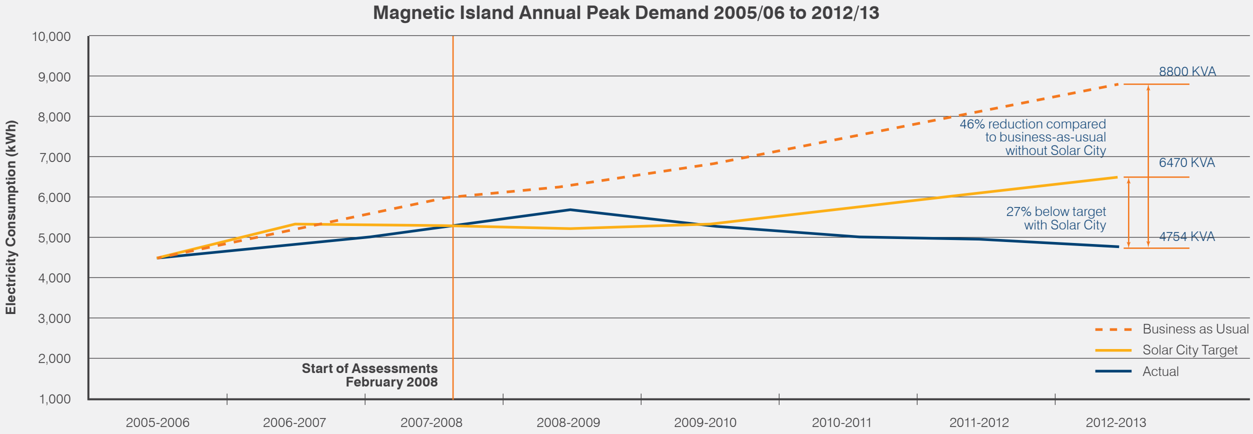

Figure 3.14 - Annual peak demand compared to business case

3.4.2 – Christmas – New Year peak

Between Christmas and New Year each year, the population of Magnetic Island doubles to around 5,000. The increase in population from visitors to the island has a dramatic impact on the island's electricity usage with electricity demand exceeding the cable's 5,430 kVA capacity for two and a half hours in December 2008, and almost reaching it in 2009. The following graphs show the electricity demand in relation to the cable limit over the summer period.

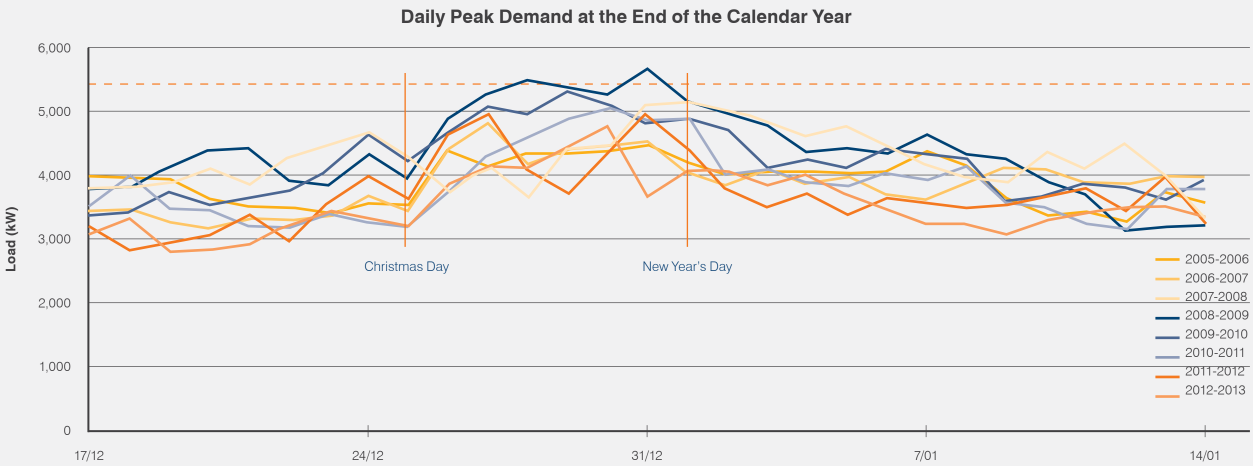

Figure 3.15 – Daily peak demand at the end of the calendar year

Figure 3.15 shows that between summer of 2005/6 and 2008/9, daily peak demand increased between Christmas Day and New Year's Day. In December 2008, the daily peak was above the cable limit which resulted in electricity security issues for Ergon Energy. With the cumulative effects of the Solar City Project, the peaks reversed this trend in 2009/10, 2010/11, 2011/12 and 2012/13.

As shown on the graph on Figure 3.16 below, on the peak day each year, the demand increases steadily all day and the maximum occurs between 5.30 pm and 8 pm (17:30 – 20:00) Fig 3.17 shows more detail of the peak hours.

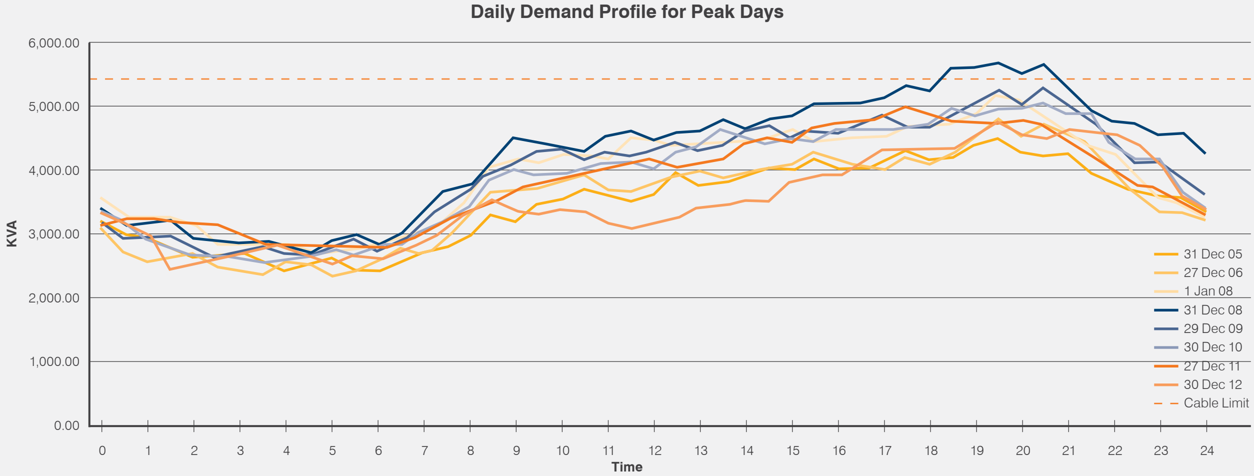

Figure 3.16 - Daily demand on the peak day at the end of the calendar year

3.4.3 – Easter peak

The increase in visitors to the island during Easter is not as significant as in the summer festive season but still poses a threat to the security of the electricity demand on the island.

The Easter peak is affected by the date of the holidays as well as other factors such as the weather, efficiency programs and population. Easter earlier in the year usually means hotter weather and higher demand. A later Easter can mean reduced electricity consumption even if efficiencies are lower.

There was a consistent increase in the Easter peak yearly demand from April 2006 to April 2008 followed by a reduction since the inception of Solar City, with significant reductions in April 2009 and 2010. It is particularly encouraging that the 2010 peak was lower than 2009, even though that Easter period was two weeks earlier. For Easters in April the encouraging trend continues, with the peak for 2012 less than that for 2011, which is in turn less than 2009, and has returned to similar levels as 2005. Further information on these Easter peaks can be found in the 2012 Annual Report.

The daily profile of the peak day in each Easter in Figure 3.17 shows a more pronounced morning peak than in the Christmas – New Year profile.

Easter in 2007 and 2012 occurred on exactly the same dates in April, enabling a representative comparison of demand during those two periods. The daily profile of the peak days in those years in Figure 3.18 shows that the daily demand this year returned to similar levels as in 2007, with a lower midday grid demand as that is now increasingly supplied by PV generation. Comparing Easter 2011 with 2012 and 2007 shows a similar picture, but the middle-of-the-day demand at Easter 2012 is less than in 2011, due in part to the PV generation.

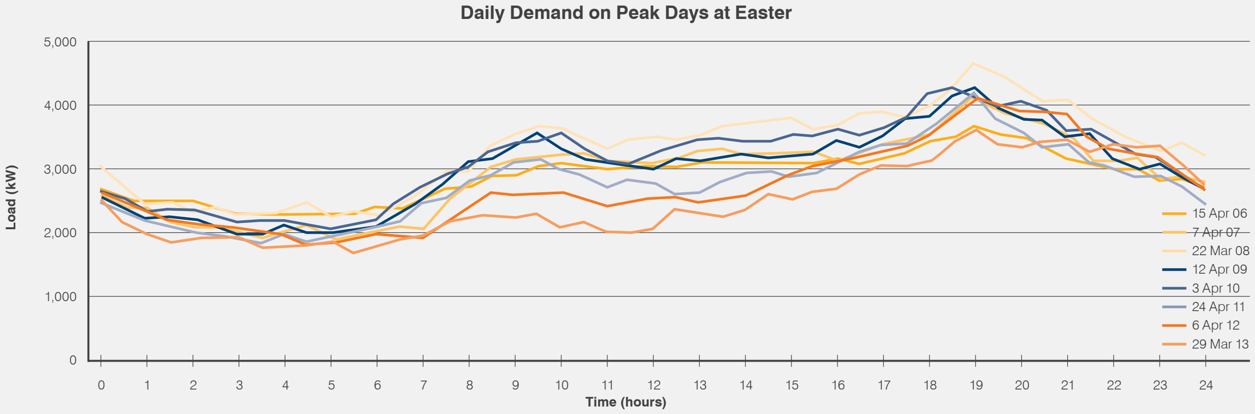

Figure 3.17 - Daily demand on peak days at Easter

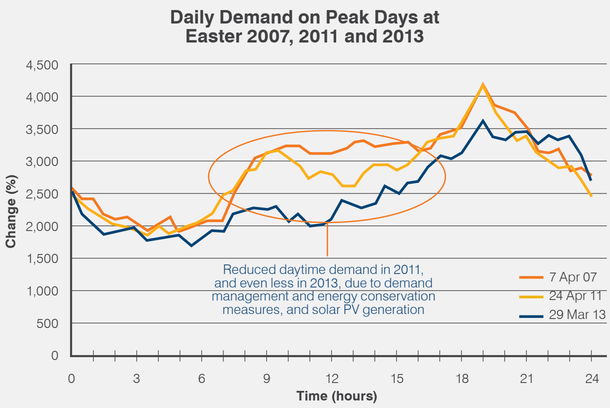

Figure 3.18 - Daily demand on peak days at Easter 2007, 2011 and 2013, with impact of PV generation in 2011 and 2012

3.4.4 – Trend in daily peak demand

Using a 12 month rolling average, the seasonal variations are smoothed, and any trend in the data becomes apparent as shown in Figure 3.19. As the peak demand occurs only once a year, a plot of the seasonalised peak demand for each day gives significant confidence that the actions being taken by the project are having effect throughout the year.

Prior to the start of the Solar City project, year-on-year peak demand was growing at 12% per year. Since the project commenced this has changed to a steady reduction. Seasonally adjusted, the daily peak demand has reduced by an average 2.5% each year since project commencement, up to late 2010, and has shown a steeper decrease since then to give an average reduction of 4.3% per year, as shown on Figure 3.19. The trend reversed briefly in the first quarter of 2012, due in part to the return to a normal consumption pattern compared to the supply interruption in 2011 following cyclone Yasi, but the downward trend resumed in the second quarter of 2012. A small increase in peak demand amidst an overall reduction trend occurred in the summers of 2009 and 2010, and reflects the fact that high energy use days vary across the summer from one year to the next.

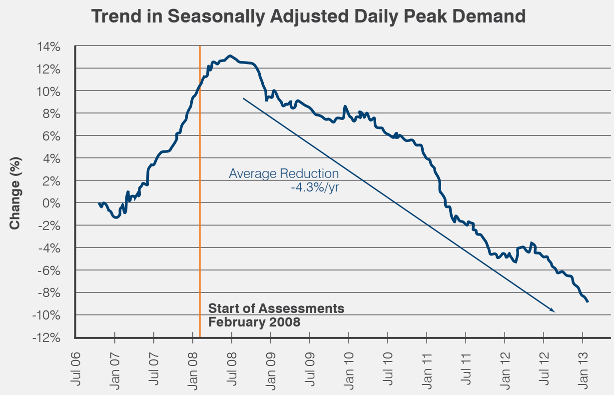

Figure 3.19 - Reducing trend in seasonally adjusted daily peak demand

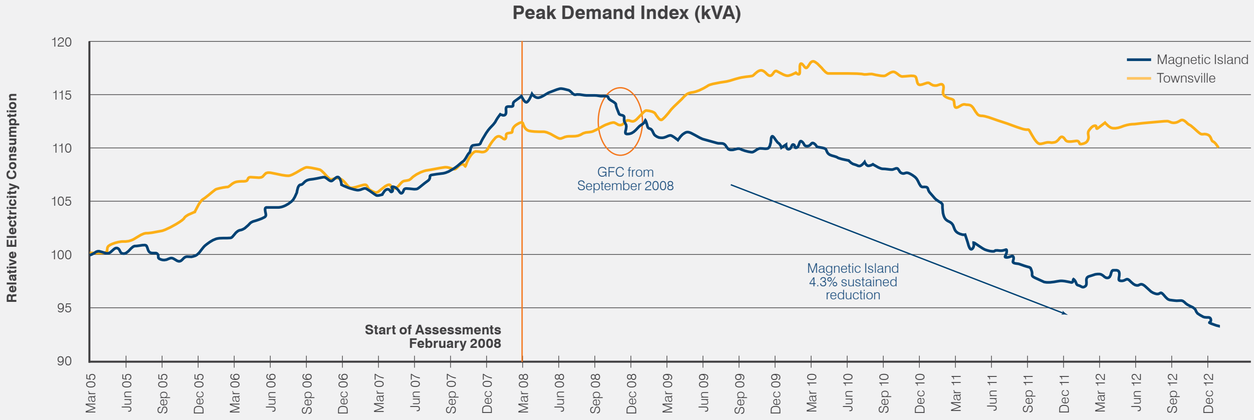

Figure 3.20 – Trend in seasonally adjusted total feeder daily peak demand

3.4.5 – Comparison with all of Townsville

A similar picture emerges when comparing the total feeder demand in the Townsville and Magnetic Island regions, and extracting the seasonally adjusted trends in each region relative to an index value of 100 on a starting date in February 2005. This is shown in Figure 3.20 above.

The chart in Figure 3.20 shows the trend of continuous reduction in daily peak demand on Magnetic Island, commencing soon after the energy assessments started, and continuing to reduce with some flat spots to the end of 2012. In contrast, daily peak demand in Townsville has been on an increasing trend from February 2005 to early 2010. There was no growth through much of 2010, and a decline in daily demand through 2011, though that was at a lower rate than on Magnetic Island. In 2012 peak demand is again flat. Contributing to the Townsville peak demand reduction in 2011 may be the community capacity building program by the Townsville City Council as part of their Citysolar program, Ergon Energy's general information program on demand reduction, the growing awareness of energy efficiency prompted by the climate change debate, and the general increase in the cost of electricity. The gradual change over to more efficient appliances and lighting may be a significant factor when taken over a whole community.

3.4.6 – Seasonally adjusted peak demand with control feeders

In order to ensure an independent evaluation of the success of the Solar City project a control was chosen from an area that was similar to the island but far enough away so as to be not affected by activities being undertaken on the island. Two feeders supplying residential and small business areas of Ayr, a coastal town 100km south of Townsville, have been used. The trends seen in the load of the feeders for Ayr were very similar to those observed on Magnetic Island in the years preceding the Solar City project. On this basis Ayr was selected as the control for the project. Figure 3.21 shows the daily peak demand for both Magnetic Island and Ayr, on a 12 month rolling average and reduced to an index for easy comparison.

Ayr and Magnetic Island were both tracking in a similar pattern, until, as can be seen below in January 2009, the island's seasonally adjusted peak demand began to fall away. At the same time peak demand in Ayr increased and continued to grow at an annual average rate of 2.5% until the third quarter of 2010, when the trend reversed, and since then it's been reducing. In 2012 the peak demand remained flat. The causes of these changes may be similar to those for Townsville – increase in general information and awareness, increase in appliance efficiency, and increasing prices.

The activities of the Solar City project have had the effect of reducing peak demand on the island since early 2009, such that's it's now falling by an average of 4.3% per annum. As shown in figure 3.21, the plots for Magnetic Island and Ayr are currently diverging, from a difference of 6% in early 2012 to 11% at the end of 2012.

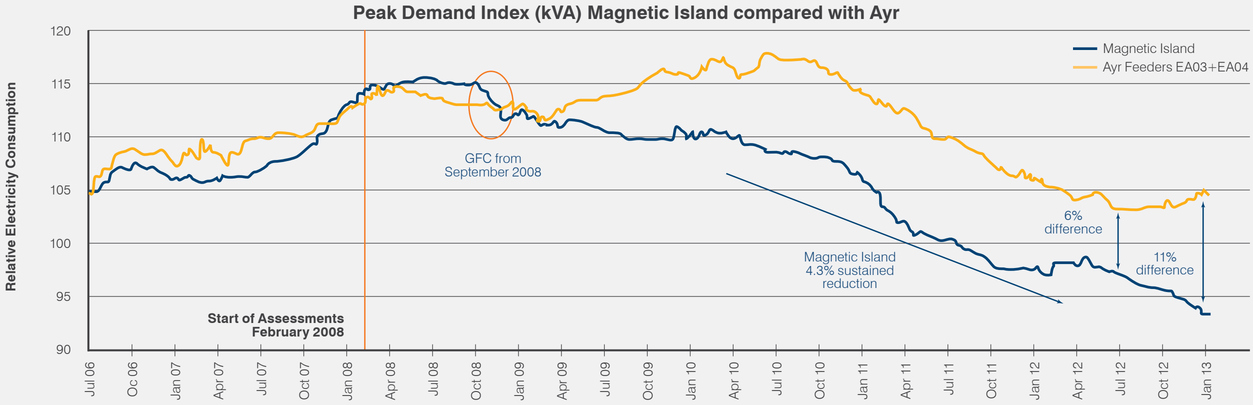

Figure 3.21 - Change in seasonally adjusted daily peak demand – East Ayr feeders compared to Magnetic Island feeders

Figure 3.22 below shows the duration of peak demand for Magnetic Island from 2008 to 2012 and the cable limit at 5,430kVA. It represents utilisation of the cable infrastructure. As summarised earlier in Figure 3.23 and 2.34, the maximum daily peak demand is showing a decreasing trend with 2011-12 as the lowest demand curve since inception of the project.

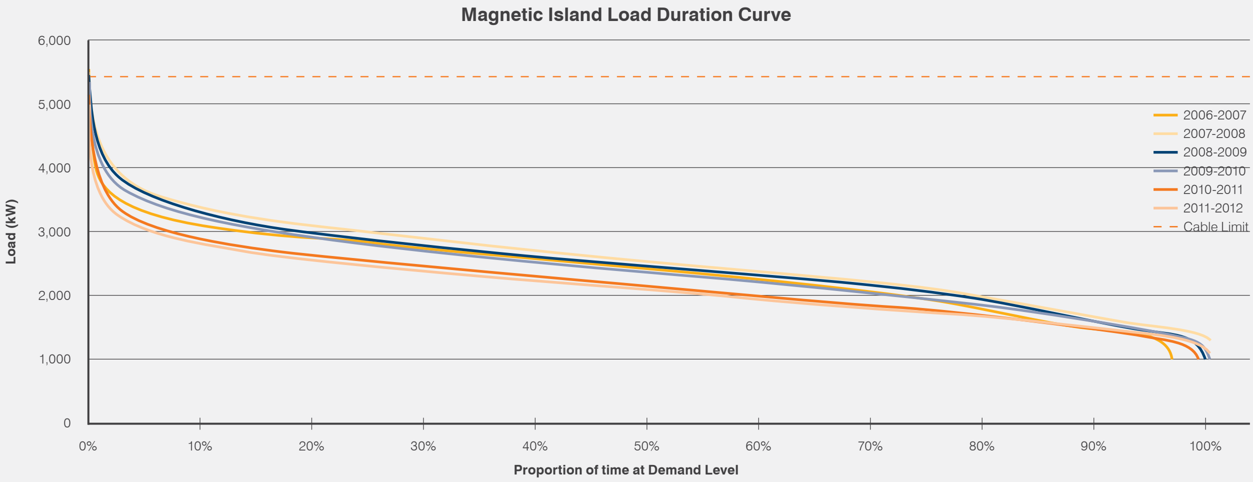

Figure 3.22 – Relative duration of demand on the Magnetic Island feeders in three financial years

The area under the curve is the total electricity delivered. For the 2008-2009 FY this was 20.89 GWh compared to 18.20 GWh in 2010-2011, a reduction of 2.69 GWh. This was discussed earlier under Electricity Consumption. It is worth noting that the electricity generation from the 712 kW PV installed on the island contributed to the lower profile for 2010-11 and 2011-12, but did not contribute significantly to the top 5% as these were recorded mostly in the evening.

The lower demand curve in 2012 results in the deferral of infrastructure. A high utilisation of infrastructure would require that demand to be spread evenly throughout the year.

The need for management of the peak demand is highlighted in Figure 3.23, showing the demand occurring on the highest 5% of days in a year.

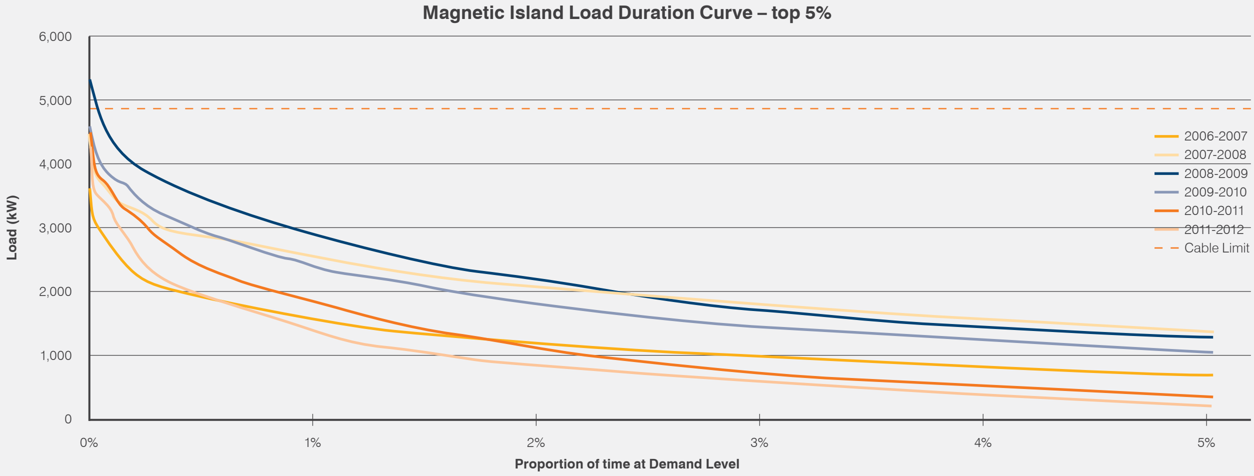

Figure 3.23 - Relative duration of demand on the Magnetic Island feeders on the days of the top 5% of demand in three financial years.

It is clear from the above graph that the 2012 demand curve is much lower than any of the demand curve in the previous four years and similar to 2006-7 before the project commenced. This is attributed to the Solar City project's broad energy efficiency initiatives.

3.5 – Deferment of cable augmentation and capital investment

As previously noted, a key objective of the Townsville Solar City Project was to defer augmentation of the cables feeding Magnetic Island. This augmentation was originally planned for 2007. The Solar City project was implemented to achieve deferment of the cable by community engagement, demand management, installation of solar generation and use of distributed diesel generation for peak lopping.

The Townsville Solar City Detailed Business Case (DBC) estimated the installation of an additional 1.5MVA on-island generation in March 2010, and a third submarine cable to be installed in summer 2013/14.

Figure 3.24 shows the original business case chart, where the 1.5MVA generation was to be installed in December 2009, the third submarine cable was to be installed in January 2014 and another generation module installed in December 2021.

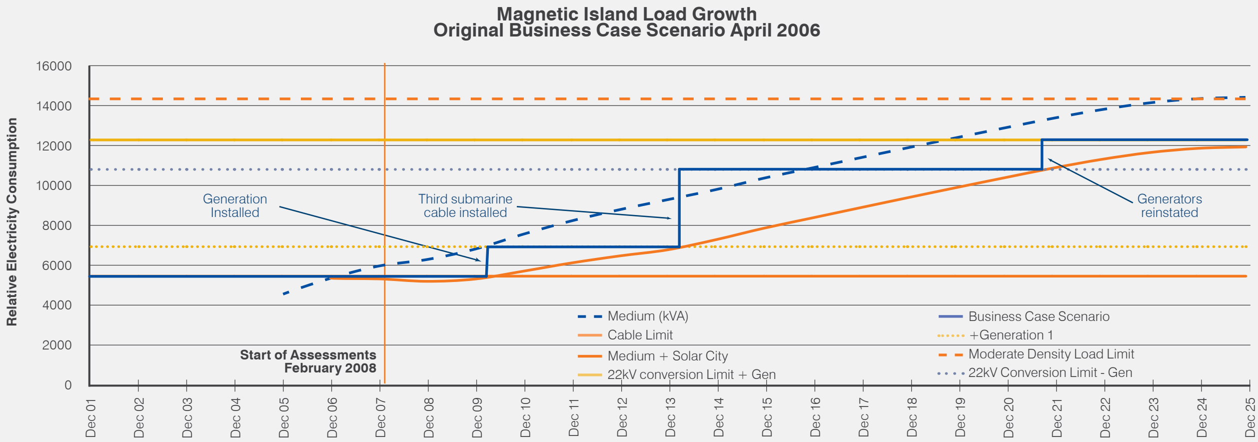

Figure 3.24 - Magnetic Island supply augmentation program in Detailed Business Case

Note that the supply to the island, despite being high voltage, presents security issues more like those of sub transmission systems where there can be a lack of supply options available. By way of example, in the event of a cable fault a lead time is required to locate the problem and once found, the cable needs to be hauled up on a barge to be repaired. The repair procedure requires fine weather and calm seas as water ingress into the repaired joint can cause it to fail again. Unsuitable weather conditions for this type of repair operation can last for weeks in northern Queensland.

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As a consequence, in the event of cable faults, the second cable needs to be able to meet the whole electrical demand of the island.

The reduction in electricity consumption, reduction in peak demand mentioned and the rollout of photovoltaic installation has greatly reduced the security concerns that existed for Magnetic Island prior to the commencement of the Solar City project.

In mid 2010 the security of the supply to Magnetic Island was reviewed on the basis of actual demand, and the dates proposed for these interventions were changed to:

- 1MVA additional generation in September 2011 (now deferred further due to low actual demand)
- 1MVA additional generation in September 2013 – a further 2 year deferment (but 0.5 MVA greater capacity)
- Commissioning of the third submarine cable in 2016 – a 2 year deferment of the commissioning phase

Figure 3.25 shows the revised generation and cable augmentation deferral as a direct result of the Solar City project i.e. the measure peak load continues to trend downwards, in the opposite direction to the medium business case.

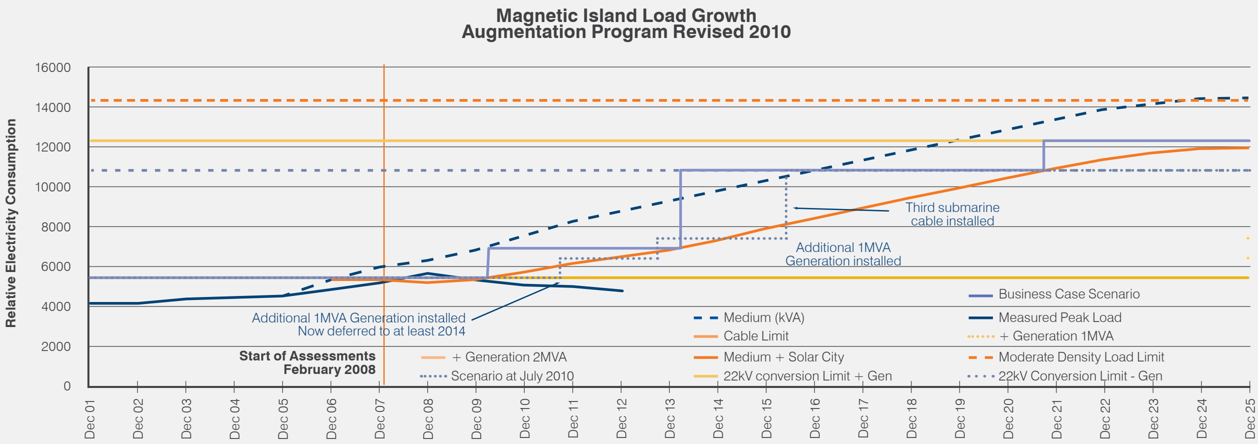

Figure 3.25 - Magnetic Island augmentation program – revised 2010

In 2010, the installation of the first generator was initially deferred from December 2009 to September 2011, a second generator scheduled for September 2013 and the third submarine cable was then planned to be installed in January 2015. This meant the deferral of $17 million investment in an additional cable by eight years from January 2007 due to the successful activities of the Solar City project.

In late 2012, a review for the 2012 Summer Preparedness Program determined that no action is needed. This means that the first generator has been deferred from September 2011 till at least September 2014. In addition, the current success in significantly reducing MVA at Magnetic Island has raised the likelihood of a long term or even a permanent deferral. A full planning review to assess cable installation will be carried out in late 2013.

3.6 – Customer savings

The Solar City Project had an aim to make over $1million in savings for customers, compared to business as usual.

Up to June 2012, the customer savings have been estimated to be around $1.784 million. This is based on the yearly electricity consumption of Magnetic Island (measured in GWh at the Townsville Marina Substation) compared to the medium growth business as usual scenario, adjusting for the Solar PV generation, and costing this using a conservative tariff value. The team easily achieved the project target of $1 million savings for customers compared with business as usual.

3.7 – Project activity views

For each bay on Magnetic Island the locations of each smart meter, energy assessment, PV system and IHD installations are illustrated and shown in the relevant sections of this report.

The map on Figure 3.26 shows the distribution of Energy Assessments in the four major populated and grid connected areas and an indication of the extent of the activity of the Solar City Project on Magnetic Island. The next section of the report highlights the results of the Energy Assessments.

Figure 3.26 - Magnetic Island energy assessment map

(L – R) Ergon Energy's CE Ian McLeod, celebrity carpenter Scott Cam and Solar City Manager Ian Cruickshank at the successful Sustainable Trades Expo, a partnership between the project and local sustainability businesses.

"All our incentives offered to participants were based on removing identified barriers to our six key behaviours and promoting the benefits of these positive energy behaviours."

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4.0 ENERGY ASSESSMENTS

Voluntary, free and thought provoking

4.1 – We combined many approaches when motivating people to change their behaviour

The Townsville Queensland Solar City has been successful in reducing peak electricity demand and total electricity consumption by using a comprehensive program of customer engagement to change behaviour.

The important, and somewhat surprising message that we found very early on in the project was that successful demand management was not so much about the technology; it was about people's behaviour when using the technology. For this long term behaviour change, a project needs buy-in from the customers and the backing of the community.

Our approach for our home energy assessments was to find out what was important to the customer, and using this, we then made our communications relevant to their important or salient beliefs, and then got a commitment from the customer to make the recommended changes based on personalised information from an authoritative source.

All our incentives offered to participants were based on removing identified barriers to our six key behaviours and promoting the benefits of these positive energy behaviours. The six behaviours were identified during early workshops by the consortium members and further refined using an impact and probability matrix. It is worth noting an important benefit from the overall project has been the identification of over 280 specific behaviours around energy use and this is explored further in the Townsville City Council section of this report.

This combination of essential elements around gaining customer commitment and engaging the community formed the Energy Behaviour Change Model. It is a new replicable framework that is based on the scientific theories and research that underpin Community Based Social Marketing (Dr Doug Mackenzie-Mohr) and Thematic Communication (Professor Sam Ham).

The Energy Behaviour Change Model was used in all our communications with the three audiences on the island – residential customers, businesses and the holiday makers who swell the population between Christmas and New Year, and make this the peak demand period on the island.

Our model engaged the community to find out what is important to them, brought them on board with the project and built support, used sound grassroots community engagement techniques to recruit participants, and therefore deliver energy assessments. These energy assessments then encouraged efficient behaviours and brought on the reduction in peak demand and the deferral of new infrastructure.

The themes that resonated with the residents and that we used in our communications were

- Energy Efficiency – to reduce peak demand and defer the need for network augmentation in the form of the undersea cable.
- Greenhouse abatement – for an island community located in a World Heritage listed area of the Great Barrier Reef Marine Park, considered one of the seven natural wonders of the world – any reduction in greenhouse emissions was seen as an important way to preserve the reef.
- Better place to live – the island was already being promoted as being relatively unspoilt and with a laid back lifestyle. We wanted to build on this culture of sustainability and that the project would make it a better place to live.

Being a small community it was important to enlist the support of a number of well-known and respected island residents to become community champions. These champions helped us understand the community better, improved our approaches and by their support increased the number of participants in the energy assessments.

The Energy Behaviour Change Model we developed is systematic, replicable, community based, and effective.

We found that there is no one silver bullet – we needed an integrated, multifaceted approach to motivate people to change their behaviour and associated energy use.

4.2 – Energy assessments

The electricity consumption reduction, peak demand reduction and cable deferment have both been achieved on the back of the energy assessments which were provided free to voluntary project participants.

In turn the energy assessment is the culmination of the

Energy Behaviour Change Model (ECBM) which starts with research, proceeds by developing a supportive community culture and then culminates with a personal interview with the customer which incorporates a range of proven and tailored interventions aimed at changing energy behaviours. This all combines to elicit written commitment from the customer to undertake changes to achieve greater energy efficiency. Using the model, residents, businesses and holiday makers on Magnetic Island were asked to join the project and take part in an energy assessment, with the aim of working together to reduce peak demand and electricity consumption.

For most of the project, energy assessments were carried out by a team consisting of an assessor and a support officer. The two person team was found necessary so that one person could record the data required by the project, and the other could still have meaningful discussions with the customer, maintaining their interest in the assessment. Up to two hours were allowed for each assessment. A one person assessment used occasionally was less successful, however is fine when less data collection is required.

Overall, 1425 or 82% of the island residential and commercial customers have participated in an energy assessment. Enthusiasm among residents and businesses remained high, however it was acknowledged that the remaining customers would not or could not be enrolled.

One of the key objectives of the energy assessments was to reduce electricity consumption through behaviour change. The graph in Figure 4.1 below shows the correlation between energy assessments and the reduction in electricity consumption at Magnetic Island since inception of the project.

As you can see, the rising electricity consumption in 2007 plateaued and started its downward trend soon after the energy assessments commenced in early 2008. The lower electricity consumption continued to the end of the project. Not since 2005 have we found a 12 month period with less electricity used.

The energy assessment team proved to be in great demand by the wider Ergon Energy business, with our assessors requested to undertake other projects in Queensland, including the Queensland Government/Ergon Energy partnerships, *powersavvy*, an energy efficiency program in the remote diesel powered communities, and *Energy Savers*, a trial energy auditing/demand management program in Mt Isa and the Northern Beaches area of Mackay.

4.3 – Energy assessments – a walk through your home

The heart of the Magnetic Island program is the residential energy assessment, a personal visit of up to two hours to participants' homes that incorporated an integrated program for gaining commitment – not just a single approach. It combines a number of essential elements around gaining customer commitment and engaging the community that come from the energy behaviour change model.

The barriers and benefits of increasing electricity efficiency were identified from the customers' viewpoint. Surveys and focus groups told us what was important to the community, avoiding the trap of thinking that what was important to us was relevant to the customers.

Each energy assessment was structured to amplify benefits and reduce barriers as they applied to the individual customer. For example a benefit that resonated with some

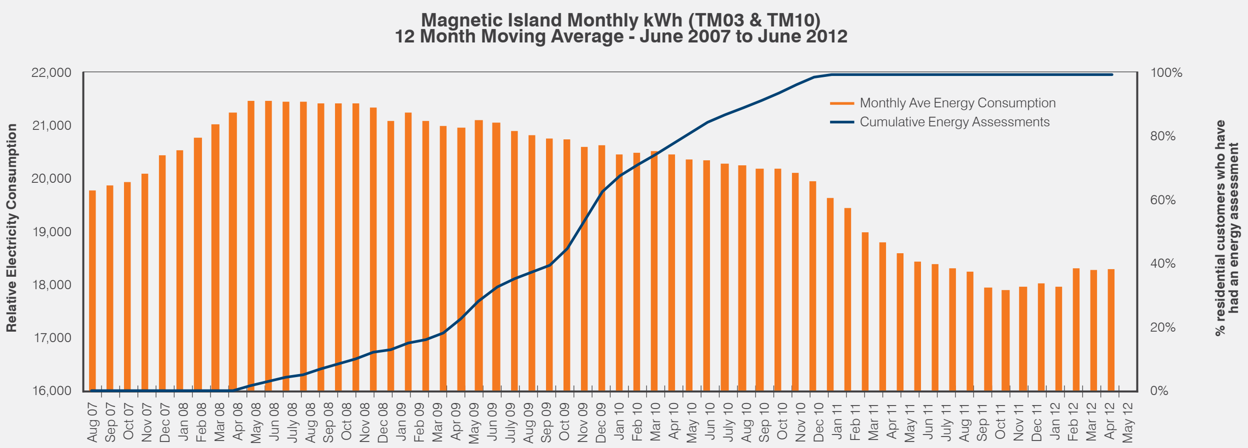

Figure 4.1 - Magnetic Island monthly average consumption and cumulative energy assessments.

residents was that reducing the carbon footprint is good for the Island, and so this was emphasised at the assessment.

A barrier to using efficient lighting such as compact fluorescents is actually installing the new luminaries. Hence the energy assessor changed out the lights and took away the old incandescent bulbs. We have removed a load of over 350 kW just by changing light bulbs. With the owner's permission, the assessor also changed out the shower heads for water efficient ones, so that these didn't just sit on the shelf.

Cost was also seen as a barrier so we gave a cash back voucher to anyone who was going to upgrade to energy efficient appliances. The voucher value was equivalent to the difference in price between an efficient and an inefficient appliance.

The assessor walked with the participant through each room and spoke about how to save electricity. With information they trust, the resident is primed to make a change. To further encourage the change, a reminder at the point of action or a prompt was left. A deliberately designed sticker on the airconditioner remote control reminded the householder to set the appliance to 25 degrees Celsius. The assessor had already explained that this is a reasonable level for comfort in a house, and a much more efficient way to run the airconditioner. On particularly hot days, a fan could be used to increase comfort rather than lower the air conditioning setting.

A sticker for the large green rubbish (or wheelie) bin was used to help create a community norm of support for the Solar City, make private behaviours public and also engender a feeling of exclusivity, while promoting a culture (or norm) of using electricity efficiently within the island community.

The most important aspect of the EBCM approach was to get a commitment to change behaviour. This was done by agreeing an action plan and getting the resident to sign it. The action plan, generated electronically and based on the recommendations made during the assessment, comprises a list of changes to behaviour, appliances or house fittings. It is then agreed with the participant who signs their name on the electronic data keeper to show their commitment.

As well, the two most important changes are written by the customer on a fridge magnet and also signed by all who participate. This is then attached to the fridge and acts as a gentle reminder, a prompt, a commitment and another way of creating a societal norm. A report detailing the action plan and with behavioural and technical changes as well as the participant's signature is later sent to confirm the agreement.

The structure of the residential energy assessment program focused on the three broad project objectives;

- Trying to shift load to better manage peak demand
- Motivate customer response to energy management opportunities
- Reduce electricity consumption and greenhouse gas emissions by encouraging the uptake of energy efficient options

To achieve these objectives we concentrated on six top desired behaviours are

- Switching appliances off at the wall to reduce standby load
- Switching to gas for cooking to reduce peak load
- Having four minute or shorter showers
- Buying high energy rated appliances
- Painting your roof white
- Switching to gas, solar or heat pump for hot water

All of these behaviours were actively addressed during the energy assessments and further reinforced by the voucher system introduced in April 2009. This system attracted more participants and delivered permanent changes in residents' homes.

Benefits of changing behaviour to increase energy efficiency were clearly identified, and consisted of the reduction in electricity bills, the reduction in greenhouse gases, and that people should be energy efficient 'for the benefit of all who live, work and play on Magnetic Island.' This last concept had not been considered in initial planning and only became recognised through the barriers and benefits investigation process. It is now used extensively and successfully by the project, and was reflected in feedback from the second community energy use survey in 2010.

Figure 4.2 shows the trend in electricity consumption during the Magnetic Island daily peak demand period (from 6 – 9 pm).

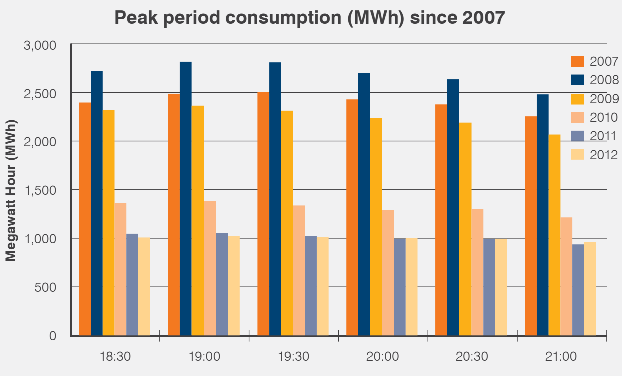

Figure 4.2 Magnetic Island peak period electricity consumption since 2007

The cost of removing old refrigerators from the island was identified as a significant barrier to energy efficiency. Old fridges were often kept because they were too expensive to take back to the mainland, or too difficult to dispose of, and then became beer fridges. The inefficiencies of 20 year old refrigerators were compounded by partial loading and poor thermal location in hot sheds or sunny back verandas. The project overcame this barrier by paying the participant to allow the fridge to be removed from the island for degassing and metal recycling, and picking up the fridges and freezers from the home and stockpiling them in large containers until a full load was achieved.

To date, eight container loads of old appliances have been removed. Other barriers included the cost difference between high efficiency appliances and lower rated ones, the lack of suppliers of efficient goods and services supplying the island and the lack of information on energy efficiency. These were each addressed by the project voucher system.

Further aspects of the ECBM have directed other facets of the energy assessment. Goodwill was built up with items that were given away to the participant. These included:

- Compact fluorescent lights (CFLs)
- Three-star Water Efficiency Labelling Standards (WELS)-rated shower heads
- Tap aerators
- Shower timers
- Room thermometers
- Trigger hose nozzles

The first three items were installed by the assessors, as one barrier identified from other projects was that people often did not install equipment given away free, either because of lack of technical skills, or simply apathy. All incandescent light bulbs and old shower heads were removed by the assessor.

Very early in the piece, the project encountered some community concern around the quality of CFLs and their lifespan in real conditions, and investigations were carried out into Island voltage and harmonic levels in areas where high failure rates have occurred. Results show CFL lifespan is questionable in non-perfect supply quality conditions. Along with greater energy efficiency, this was, at the time, one of the reasons to trial LED lights in commercial enterprises.

The team also assessed if the house is suitable to:

- Receive a free 'ecoMeter' In-House Display (IHD) unit which receives information from a smart meter to show the customer how much electricity is being used at a glance; and
- Host an Ergon Energy solar PV system on the roof

The benefits of these were explained during the assessment.

4.4 – Community participation

Townsville Solar City aimed to target 100% of the population of Magnetic Island for energy assessments through an extensive program of community engagement.

The analysis below shows that even with comprehensive community engagement and other incentives, for a number of different reasons both physical and technical, the most that has been enrolled is 82% of the residential customers. However it is a very pleasing statistic that since the beginning of the project, only 6% of the households contacted have declined to participate.

Project analysis showed some categories of customer connections included in the total did not lend themselves to energy assessments for demand management, such as the library van connection, temporary supplies for building sites, or connections that are better aggregated as one customer - for example, Council pump stations.

In 2011, the team placed a lot of emphasis on attracting those part-time Island residents who return to the southern states over summer, as there is a limited time period each year with which to interact with them. Later the focus returned to the rental and holiday rental markets as the permanent population drops away for the summer and more visitors are likely to roll in over December. This section of homeowners and holiday rental owners proved difficult to interact with, despite efforts on the part of some local agents.

As the number of new participants signing up for an energy assessment slowed down, a number of planning meetings aimed at designing new programs to appeal to those remaining of the Island's residents, were held. These included mail drops, a door knock program using existing collateral to target holiday home owners during school holidays, a community engagement program to generate and distribute energy champion gift vouchers by the assessors, the implementation of the 20+10 program in May 2010, solid participation in a community run Queensland Government funded "low carbon diet" program and a renewed focus on small business assessments.

The most successful strategy was the re-engagement of Ergon Energy's National Call Centre to focus on setting up energy assessment appointments from a list generated by the project team for these cold calls. Several attempts were made to contact each of those on this list. All were complete by June 2011, with the exception of a trickle of new arrivals. By this time over 75% of residential customers had participated.

Of the 1820 properties on the Island, 1546 were residential properties and 274 were commercial. Only 6% of residents declined the opportunity for an energy assessment due to various reasons including time pressure, indifference and lack of interest for the program. Another 19% could not be contacted despite repeated attempts. It is likely that some of these may have declined to participate if contact could be made.

4.5 – Energy assessment bookings

The project used several methods to contact the customers in order to obtain an energy assessment booking. An initial survey allowed respondents to register, customers might drop into the office at the Smart Lifestyle Centre, the project had a presence at community and other 'out and about' events, and a large emphasis was placed on cold calls to customers later in the project. Figure 4.3 shows how the energy assessments were booked on a monthly basis and figure 4.4 shows by type.

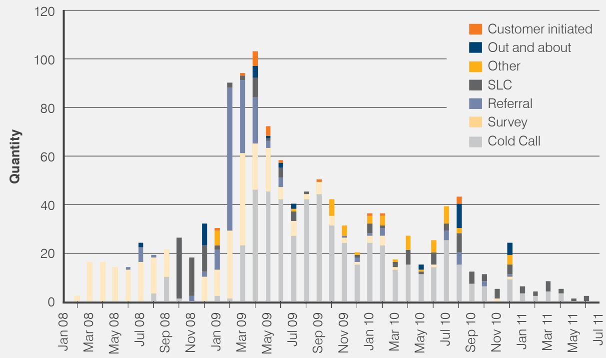

Figure 4.3 - Monthly energy assessment by booking type

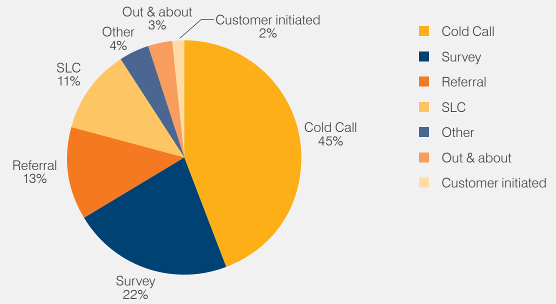

Figure 4.4 - Energy assessment – how assessments were booked

ENERGY ASSESSMENT –KEY FINDINGS	ISSUE	RESPONSE
Driving participation	Generate interest and awareness of the project and register project participants	2007 Energy Use Survey – a direct mail contact to gather household and appliance data and register participants for home assessment 40% response rate for residents and businesses and enrolled 22% (600) of total participants
	Lifting participation rates	45% registered by National Contact Centre cold calling. To get above 40% registrations, it was necessary to cold call residents. Effective later in the project as assessment numbers neared saturation levels for those keen to participate already contacted
	Generating word of mouth referrals	Ensure a positive experience during the energy assessment. Word of mouth referrals were responsible for 13% registrations
Local presence	Project accessibility	Smart Lifestyle Centre responsible for 11% registrations. More valuable as project office, location of energy efficient demonstrations and provision of authoritative advice directly to interested community members.
	Staff accessibility	It has been vital to the success of the project to have an office within the community and to employ staff who also live in the community. Team members must be suited to the job and keen, enthusiastic and knowledgeable with a strong customer service ethic.
Incentives	Barriers to voucher redemption	Barriers include cost, opportunity and a lack of ability to access services due to isolation. The project found that although a participant committed to a physical change (purchase 5 star fridges, paint roof white, change to off peak tariff, etc), there was likely to be a long lead time until the change was implemented. To speed up the change, the voucher strategy was implemented to provide reimbursement of some of the cost of purchasing energy efficient appliances or making efficiency changes to a house.
	Incentive size	The reimbursement generally reflects the cost difference to purchase the efficient item. The important learning from the voucher system is that, once committed, people will make a change quickly when given a small incentive. Large incentives have not been needed and the system was considered a success

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ENERGY ASSESSMENT –KEY FINDINGS	ISSUE	RESPONSE
	Only half the vouchers issued were redeemed	Number of vouchers redeemed found to be only 12 – 25% of recommendations made in Energy Savings Plans. To combat overoptimism in redeeming incentive vouchers, tie vouchers closely to written commitments and timeframes
	Improved take up of solar hot water vouchers	Slow start, then when combined with government rebates the rate improved to 33% take up
CFLs	Early technical limitations	Initial poor performance observed by participants that improved later in the project. We were able to demonstrate performance and combat community concerns around mercury by working to install suitable CFLs at selected public locations.

4.6 – Incentives

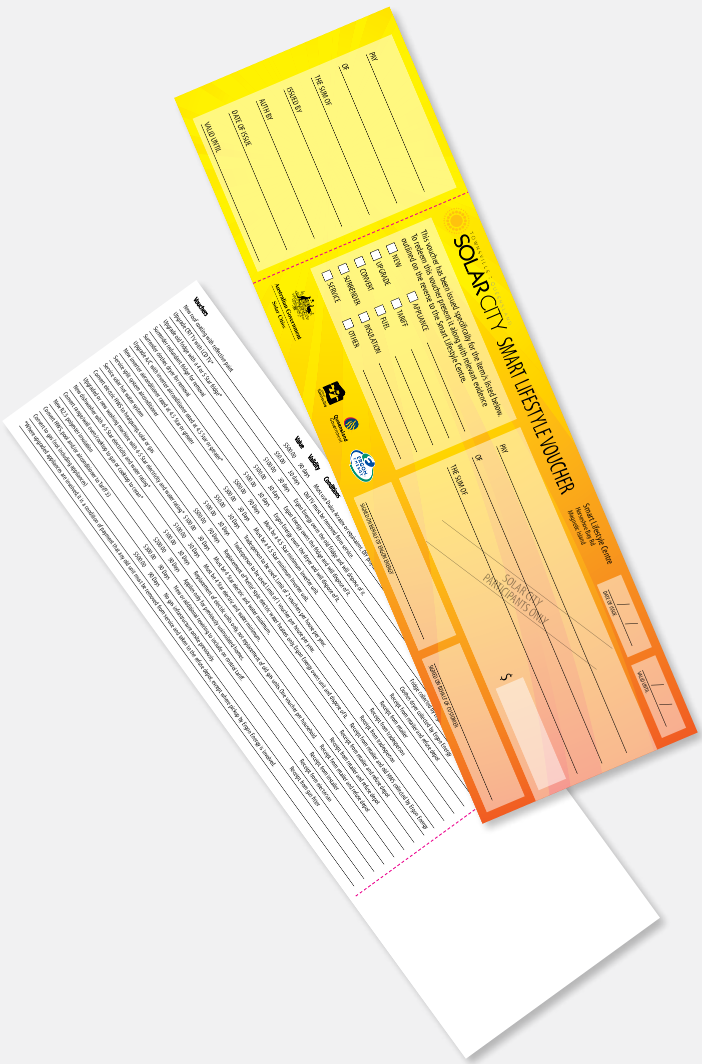
The Townsville Queensland Solar City has used incentives to encourage customers to participate in demand side management trials. It was found that although customers were keen to take up a recommendation e.g. changing to tariff 33, the actual actions were delayed particularly for the more costly items. To encourage customers to take up the recommendations within a timeframe that better suited the Solar City project, a series of incentives were given, of which the first was the implementation of a voucher redemption system – a 'cash-back' offer.

The vouchers promote the uptake of energy efficient behaviours in line with those the project has been promoting since its inception. They are specifically designed to look like cheques, have rebates based on kilowatts of demand alleviated and continue the important incorporation of CBSM principles in their development, promotion and utilisation. The most important finding from these vouchers has been that small incentives work in the removal of barriers often just as well as larger ones.

As the vouchers are only available to project participants, they were also designed to encourage residents and businesses to become involved with the project. It is also important to note that the voucher system was devised after the project commenced to encourage the most popular or most effective changes, and was designed by drawing on the energy assessment data. Many assessment recommendations were for behavioural change and hence did not lend themselves to vouchers.

The voucher incentive scheme operated for approximately 18 months and concluded in January 2011, and all vouchers had to be redeemed by April 2011.

The graphs below show the vouchers issued and redeemed against the recommendations made during energy assessments. While the rate redeemed for each is around half the voucher system providing incentives for energy use reduction, actions on infrastructure was also a success in encouraging project participation and those who have redeemed their vouchers have done so thoroughly and enthusiastically, with ongoing infrastructure benefits and associated reduced demand. Towards the end of the active assessment period, the vouchers were often the main reason residents proactively chose to become involved in the project and aided the project cause in thorough and effective community engagement.



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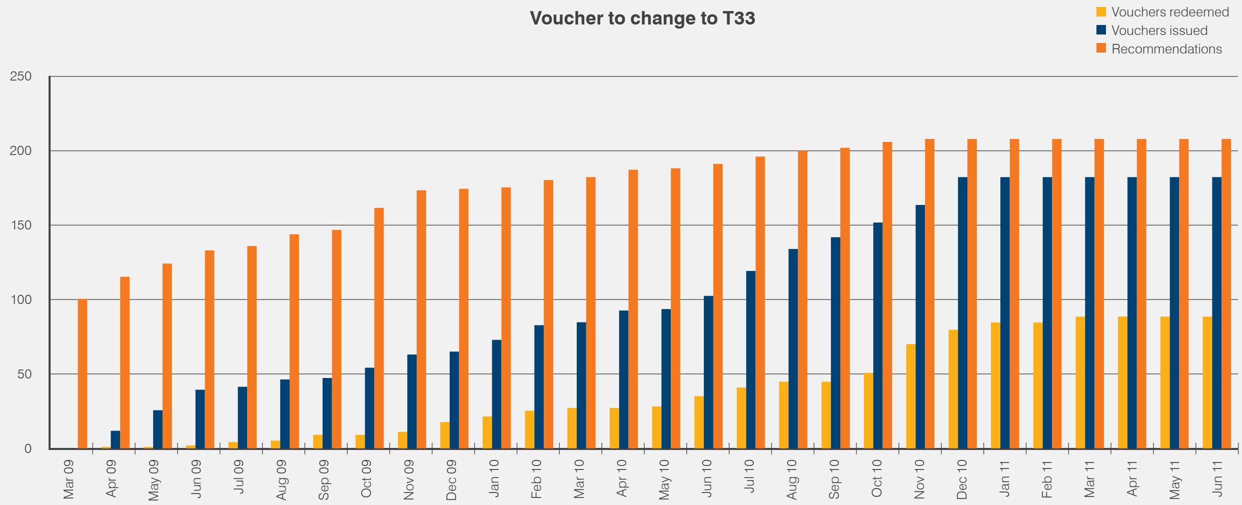

Figure 4.5 – Vouchers to convert to Tariff 33 (Economy Tariff)

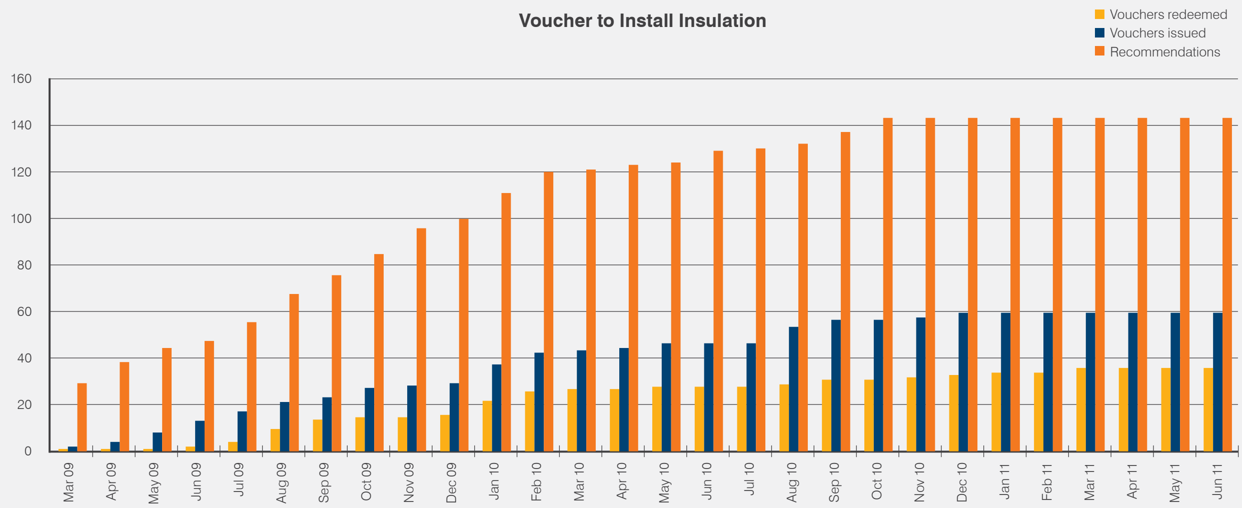

Figure 4.6 – Vouchers to install R2.5 insulation

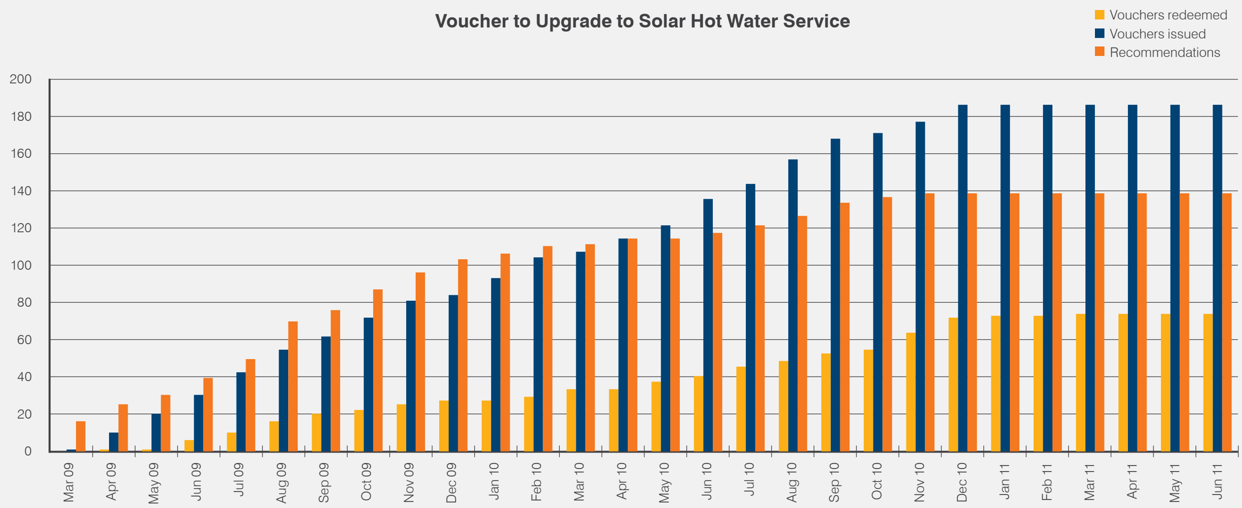

Figure 4.7 – Vouchers to switch from electric to energy efficient hot water (solar, heat pump, instantaneous gas)

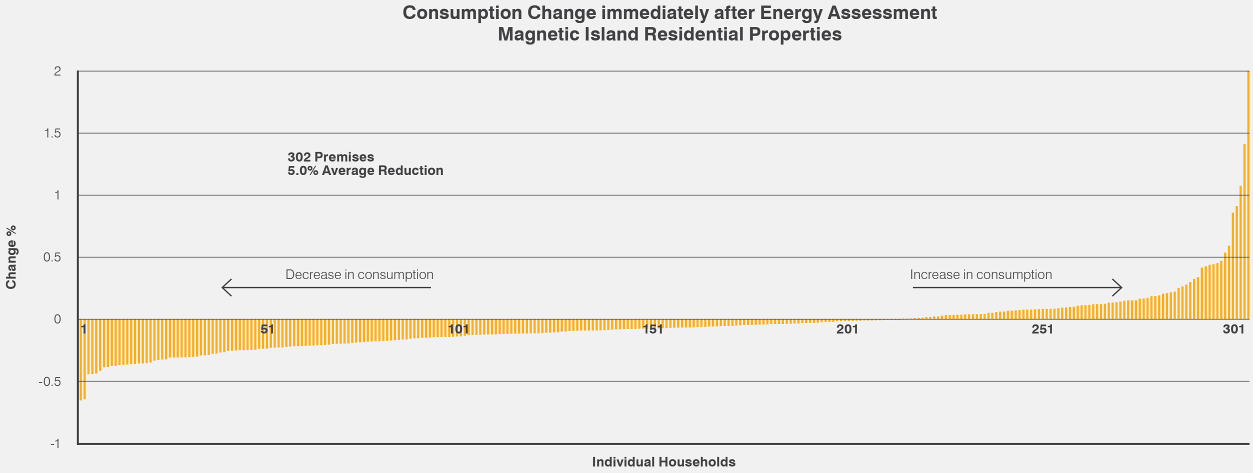

Figure 4.8 – Change in electricity consumption immediately after assessments

4.7 – Electricity savings after energy assessments

The Solar City project offered energy assessments to participants, who then chose to act on the recommendations made by the assessor. Recommendations ranged from behavioural change (turn off standby, set air conditioner temperature to 25 degrees) to appliance upgrades (five star fridge, solar hot water etc) to house modifications (shade western wall, paint roof white), and are all aimed at either reducing total electricity consumption or shifting load from the peak period, or both.

The effect of energy assessments has been to reduce consumption in about two thirds of the properties that undertook them. Immediately after the assessment, the average change in consumption across all assessed properties was around a 5% reduction. One year later the average consumption change was now a 9.5% reduction, and the proportion of those properties reducing their consumption had risen from 70% to 75%. Another year later the consumption change had increased to 12.7%, with 78% of properties reducing their consumption.

4.7.1 – Customers save 5% of their electricity usage immediately after energy assessments

Analysis of the three monthly consumption data used for billing was undertaken to measure the change in electricity consumption due to the energy assessment. Data for six month periods was analysed to reduce the seasonal effects, including Easter. Only premises with the same customer for the whole analysis period were used.

Premises that used less than a minimum of electricity in any quarter were excluded to eliminate holiday houses and other houses only partially occupied. Ultimately, half year electricity consumption at 302 occupied residential properties was compared in equivalent half yearly periods before and immediately after their energy assessment. Also for these properties, their electricity consumption in two successive twelve month periods was compared.

Immediately after the energy assessment, 70% of properties reduced their consumption, and the average change over all properties was around a 5.0% consumption reduction. The distribution of consumption changes resembled a normal distribution, with outliers ranging from a 138% increase to a 34% reduction.

For comparison, during this same period, residential houses in Townsville increased their electricity consumption slightly. Analysis of 7568 premises in the suburbs of Townsville, using the same criteria as for Magnetic Island, showed an increase of 0.4%.

These results are a clear indication that energy assessments do impact consumption behaviour in around two thirds of the households in which they are conducted. Earlier analysis with fewer properties showed that this is consistent as more data is available from more properties over successive quarters.

The graph on Figures 4.8 and 4.9 shows the change in electricity consumption for six months after an energy assessment compared to the same six months in the previous year. Overall, customers saved about 5.0% on their electricity use.

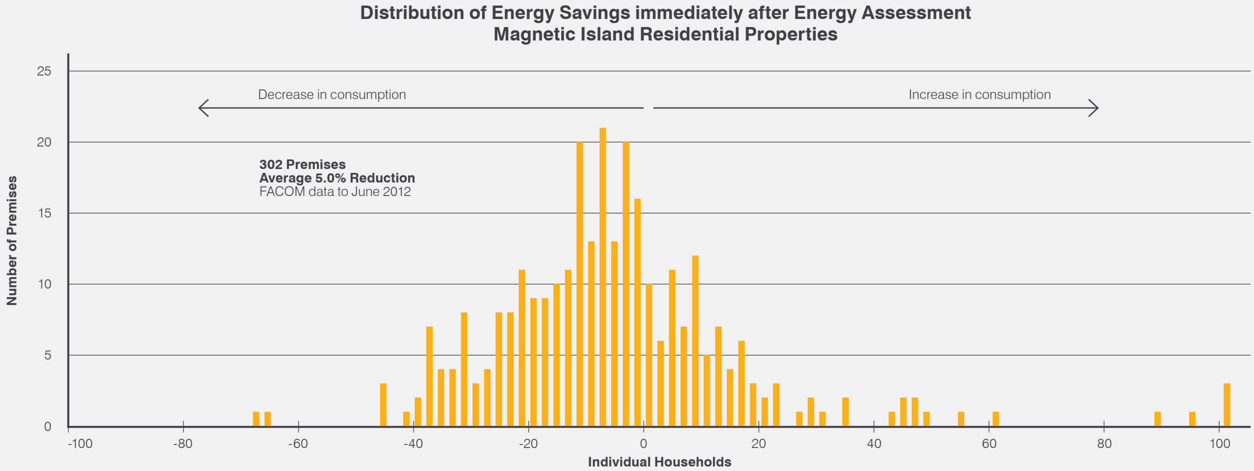

Figure 4.9 - Distribution of electricity savings immediately after assessments

4.7.2 – Customers increase their savings 12 months after their energy assessment

Again, using consumption data used for billing, the half year consumption at occupied residential properties was compared in equivalent half year before and at least 12 months after their energy assessment, i.e. a year later than the first analysis.

Of these, 75% reduced their consumption, and average consumption saving was 9.5%. Thus households a year after an energy assessment almost doubled the reduction achieved immediately after the assessment. Also more households had some reduction after 12 months than immediately after the assessment. The project attributes this increased reduction to ongoing or sustainable behaviour change and the installation of energy efficient appliances.

In the same period, households in suburban Townsville reduced their energy consumption by 6.9%. This drop may have come about as customers started to react to the general greater awareness of energy efficiency brought about by factors such as the global financial crisis, the rising price of electricity, Ergon Energy's state-wide campaign to make customers aware of how to save power, withdrawal of incandescent light bulbs from the market, and the public debate about climate change, the energy trading scheme and the carbon tax.

Overall the reduction on Magnetic Island 12 months after an energy assessment was still greater than the drop in Townsville, by 2.6%.

The distribution of consumption changes on Magnetic Island again resembled a normal distribution, but much flatter and wider than the previous graph, and outliers ranging from a 157% increase to a 72% reduction. The shape of the distribution shows a pronounced shift towards reduced consumption, spread over a wider range of reductions.

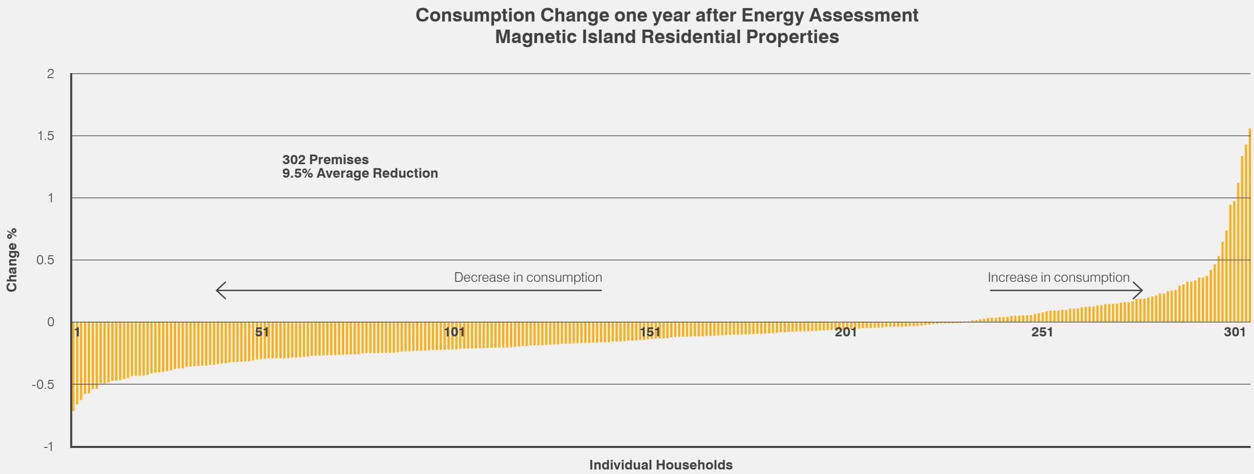

Figure 4.10 – Change in electricity consumption one year after assessments

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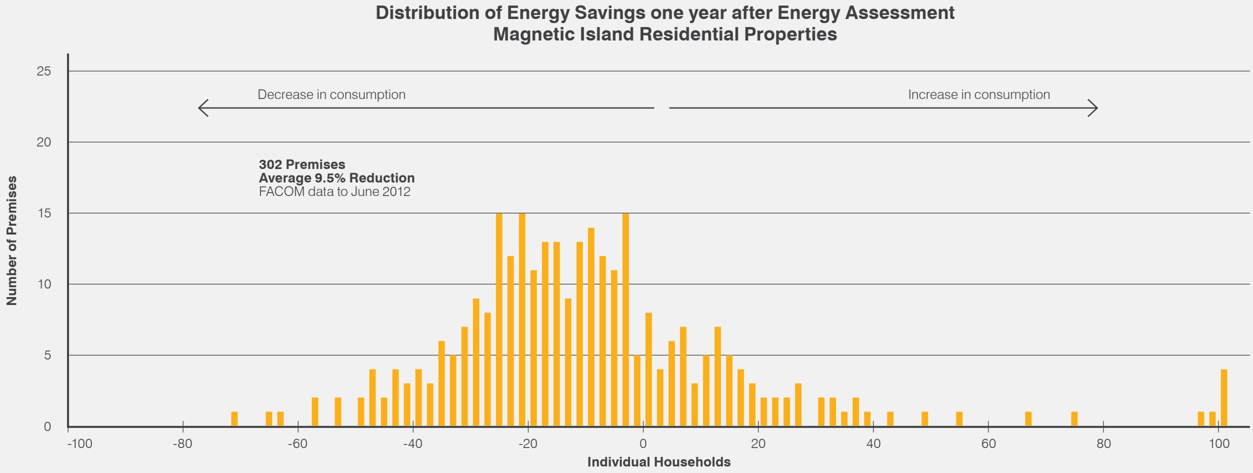

Figure 4.11 - Distribution of electricity savings one year after assessments

4.7.3 – More savings, 24 months later

As in the above analysis, electricity consumption at occupied residential properties was compared in equivalent six month periods before and at least 24 months after their energy assessment, i.e. two years after the first analysis. This is shown on Figures 4.12 and 4.13.

Data limitations reduced the number of properties with comparable before and after consumption data across this time span to 259. Of these, 78% continued to reduce their consumption, and average consumption saving was 12.7%. Thus households two years after an energy assessment had a greater magnitude of reduction than the reduction achieved immediately after the assessment, or that achieved one year after the assessment.

In the same period, households in suburban Townsville reduced their energy consumption by 4.9%. The general factors encouraging energy efficient behaviour continued in this period, and this is reflected in the continuing drop in consumption across Townsville.

Overall the reduction on Magnetic Island 12 months after an energy assessment was still greater than the drop in Townsville, by 7.8%. This is consistent with Figure 3.12 (in the results section on p 28) which shows that the overall electricity consumption was falling faster on Magnetic Island than in Townsville during this period.

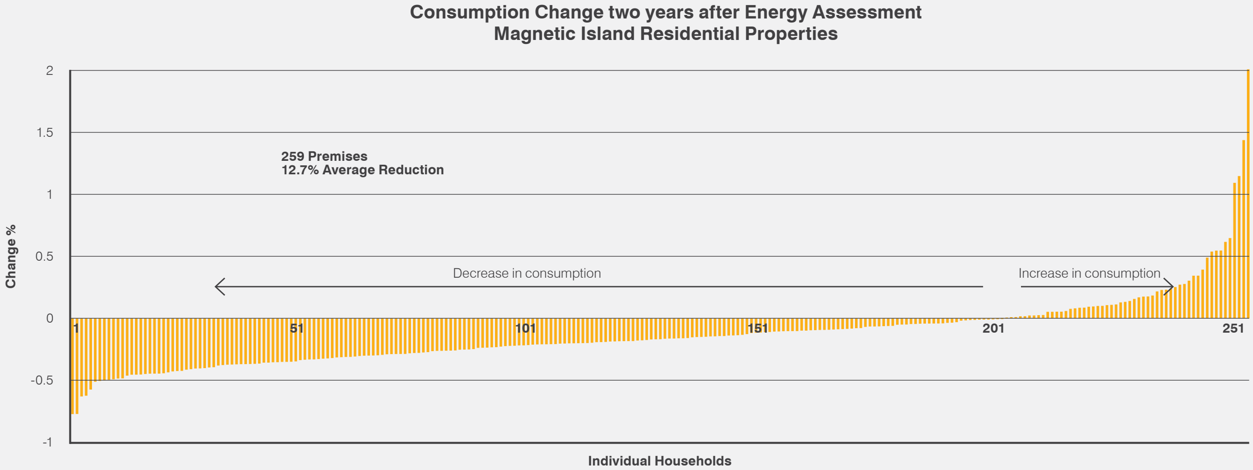

Figure 4.12 - Distribution of electricity savings two years after assessments

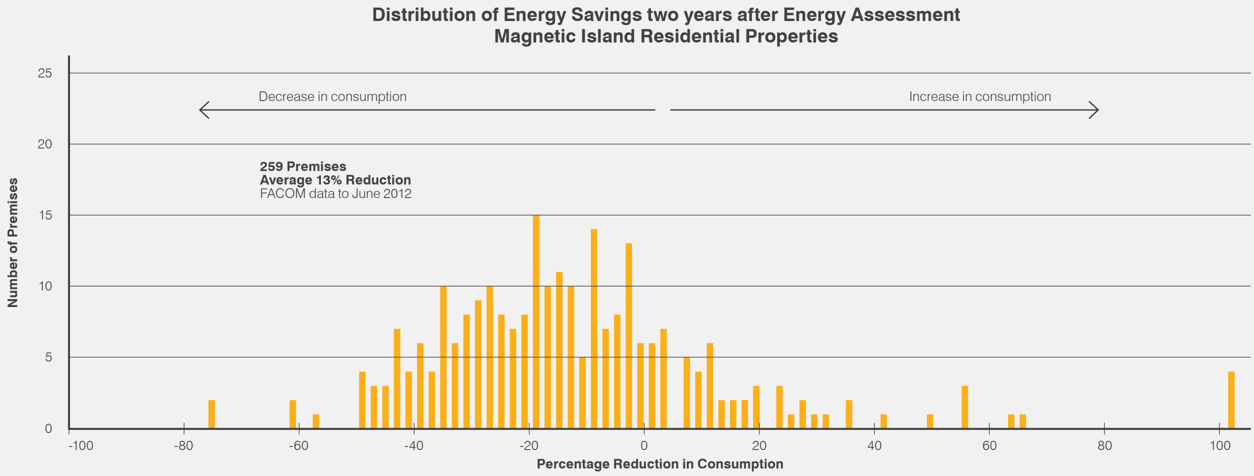

Figure 4.13 – Distribution of Energy Savings more than two years after Energy assessments

4.8 – Commercial energy assessments

As commercial businesses on Magnetic Island are significant individual energy users it was important for the Solar City project to involve them. Energy assessments for commercial premises were based on the principles of our Energy Behaviour Change Model and were focussed on the needs of the business and its operational processes, as well as the potential for major efficiency improvements through appliance upgrades and education for behaviour change.

Enthusiasm among participant businesses was high, particularly given the number of energy efficiency options available to them.

Early businesses contacted were asked to become a case study, allowing the results of energy efficient changes to be used to encourage similar businesses to become more efficient.

Over the project, 155 out of 156 businesses on Magnetic Island had been assessed. There are some 118 other connections that appear commercial but are either temporary or duplicate connections, or the connection for a water pump or similar and not able to be assessed, or simply vacant.

The project has been working with commercial enterprises to change their energy use by upgrading appliances, installing heat pump hot water systems, efficient lighting and heat reflective roofing. As in the residential assessment area, the project has enjoyed significant support from all levels of commercial enterprise on the island, with many hosting solar panels and some participating more actively by replacing appliances, painting roofs white and replacing electric hot water systems with heat pumps. Results have been immediate, with one resort reporting a $700 drop in monthly power bills and another reducing hot water system related demand from 53.5kW to 8.5kW (a drop of 80% in demand, largely at the crucial peak time) following the installation of heat pumps by both businesses.

A number of demonstrations have been implemented in commercial businesses and public buildings across the Island, showcasing known energy efficiency improvements as well as new products and concepts such as refrigeration control/efficiency improvement equipment. The project has focussed on demonstrating the gains from efficiency changes through case studies as it became apparent that commercial customers wanted to see cutting edge and high efficiency equipment in operation to be able to believe in its effectiveness and reliability. Also some new equipment had to be tested before making public claims of efficiency gains.

Case studies for commercial premises were produced during 2009/10 showing the benefits of these demonstration sites and included in the 2009 -10 Annual Report.

Energy efficiency measures taken by participating commercial customers included:

- Solar and heat pump hot water systems
- Efficient air conditioning
- Heat reflective roof paint
- DRED controlled hot water and air conditioning
- Low Voltage regulator (LVR)
- ERA off peak refrigeration
- Redflow battery systems
- Fluorescent tube controllers
- Refrigerant flow maximisers
- Refrigeration compressor controllers

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- LED lighting change-outs in supermarkets, a tavern, resort garden lighting and an art gallery.
- Full scale Level 2 AS3598 Audit of a supermarket
- Solar Street Lights

As with the rest of the project, the commercial assessments are underpinned by the principles of the Energy Behaviour Change Model and Community Based Social Marketing. The project has found a number of barriers that stop commercial customers from implementing energy efficient measures in their businesses. One of the major barriers is cost, another opportunity and time to manage the changes, and another lack of services due to isolation. Some of these barriers have been addressed by the project locating suppliers, obtaining quotations, and presenting these to the customer who then only needs to contract for the service with their chosen supplier. In some cases the project has also coordinated the installation. Incentives have been supplied by the voucher system, and based on the deferred kVA value.

The project trialled the replacement of halogen lights with CFLs and LEDs in commercial applications. Halogen lights are widespread, inefficient, cheap, and able to be dimmed and there is currently a lack of alternatives in a commercial environment for such an application. The team worked with an Art Gallery, two restaurants, three supermarkets, a resort and two hotels to remove halogens and replace them with either LED or CFL lights that are suitable for the application and focused on premises that have lights on 24 hours a day. In 2010 / 11 a difficulty identified by these trials was the lack of dimmable LEDs for the desired ambience in a restaurant, and for the smaller retail food store, the quality of LED light was not appropriate for fresh food displays. Later trials of newer LEDs, from a carefully evaluated new supplier, were all NATA tested, dimmable and able to replace all halogen applications, and therefore more successful.

Large resorts and high end energy consumers on the Island continue to open their doors to the project, and are willing to be "guinea pigs" for new energy efficiency trials. The project has consistently found that good advice becomes very valuable to those who become aware of its availability and accuracy, and the clear demonstration of payback periods and upfront costs by providing a detailed Marginal Abatement Cost (MAC) curve. However, clear measurement of initiatives is required to get the granularity of data needed for a curve. This requires more detailed planning at the inception of the demand management project.

4.9 – Engaging the holidaymakers

The third group of consumers on Magnetic Island are visiting family and friends, whether staying for a few days or longer in the numerous accommodation options on the island, including resorts, holiday houses and small accommodation providers. The population of Magnetic Island swells by up to 100% in the peak times, and significantly increases the peak demand which is inevitable around the Christmas – New Year holiday period.

The project set out to engage with holiday makers to encourage them to adopt energy efficient behaviour while on Magnetic Island. Using the Energy Behaviour Change Model, they became part of the project by letting them know about peak demand, providing reminders they were on a special island and enlisting them to help keep it that way, primarily by putting prompts at the point of action to remind them not to use washing machines and dishwashers between 6pm and 9pm, and to turn off lights; and by giving them postcards, stickers and kids' activities to encourage participation and prompt energy efficient thinking.

As the sheer volume of holidaymakers adds so much to peak demand, this engagement with holiday makers was essential, and the reduction in peak demand demonstrates the success of the program. As well, once they saw the success at the initial trial location, other accommodation providers asked to be a part of it, effortlessly spreading the reach and the effectiveness of the engagement campaign.

4.10 – Customer relations database

The activity undertaken through the demand management stream was captured on a hand held PDA for residential energy assessments and in MS Excel for commercial assessments. Files from the PDA were synchronised to the Customer Relations Management (CRM) to facilitate reporting, with commercial assessments loaded through MS Excel.

CRM DATABASE – KEY FINDINGS	ISSUE	RESPONSE
Database management	Unclear or not specific funding body guidelines on data collection and management	More time spent up front in determining specific data to be collected and it's specific purpose
	Data problem resolution	Engage data software engineer and have available earlier in project timeline
	Data uploading requirements	Funding body database should be defined and embedded from program inception
	Data validation	Data validation should be included at all stages of collection and storage
	Avoid repetition	Automate manually repetitive data processing to improve efficiency and data quality
Suppliers	Contract management	Review contracts regularly to ensure effective service delivery

4.11 – Demographics

The data captured from the CRM database has been mainly demographic and household data. In general, the demography of Magnetic Island is similar to the general Queensland profile, except there are fewer 10 – 34 year olds, and more over 55s. This is not unusual in a regional area or coastal suburb. Please also note that this data relates to residential customers only who make up 89% of the total participants (by premise number) on Magnetic Island and has been collected during the residential energy assessments.

Age demographics

Participant Age Demographic - Inception to June 2011

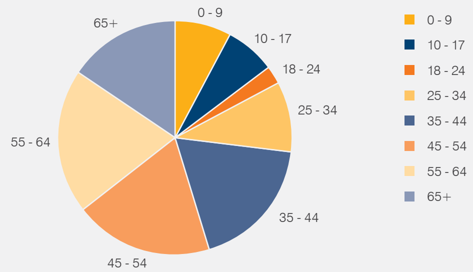

Figure 4.14 – Participant age demographic

The above shows that the majority of the participants are aged 45 and over accounting for 59% of participants since inception of the project. Those aged between 35 – 44 account for 19%, those aged 18 – 24 account for 3%, teenagers account for 7% and those below 10 years account for 8% of participants.

Household groupings

Household Grouping - Inception to June 2011

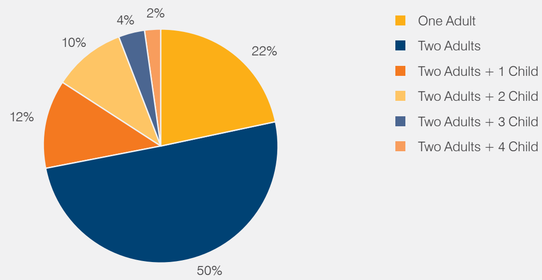

Figure 4.15 – Household groupings

The above shows that 72% of households are one or two adults only, and 28% of participant households so far have children.

Home ownership

Home Ownership - Inception to June 2011

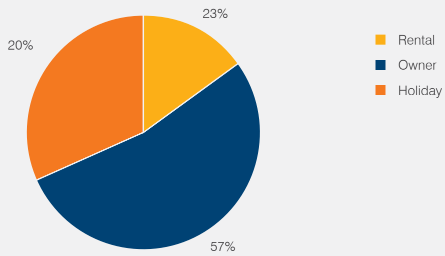

Figure 4.16 – Household Ownership

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The previous chart shows that 57% of participants are homeowners, 23% are tenants and 20% are owned holiday homes or units. In terms of the recommendations made during the energy assessments, the homeowner segment has more options and can action the recommendations immediately. Those participants who are renting have limited options as they need the owner's permission and support for building and fitting improvements. The holiday home/unit owners tend to be less likely to make the changes and need following up to action any agreed actions as they reside on the mainland or overseas and are only on the island for a limited time.

Work status

Figure 4.17 shows the work status of participants with 60% employed, 23% retired and the remainder unknown, unemployed or children. In some cases contacting those residents who worked on the mainland became a challenge. This was overcome by providing residents with a week-end energy assessment option, a method not initially preferred due to limited resources and the added time pressures for customers on weekends.

Work Status - Inception to June 2011

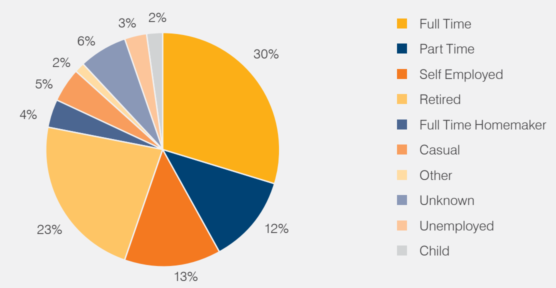


Figure 4.17 – Work status

Household income

Household Income - Inception to June 2011

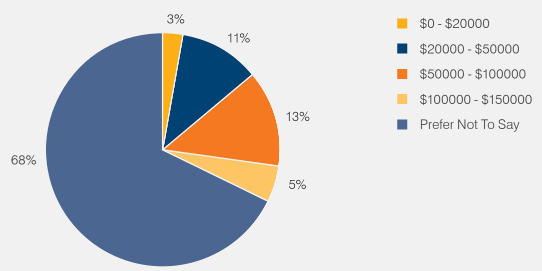


Figure 4.18 – Household income

68% of participants preferred not to comment on their household income due to privacy issues, which made segmentation on the basis of income less useful.

Air conditioning

Proportion of participants with air conditioning units

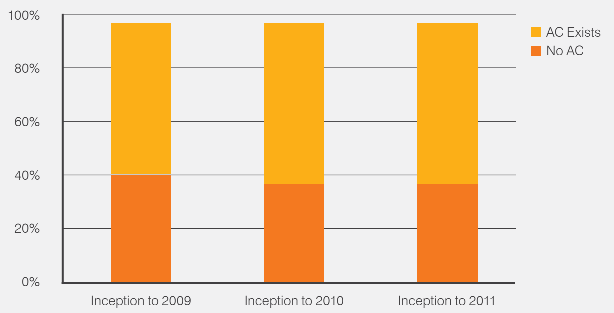


Figure 4.19 Participants with air conditioning

The above graph shows that the proportion of participants with air conditioning units continues to increase over time which is one of the major contributors to the increase in peak demand in other parts of Queensland. Participants in the Solar City project are encouraged to maintain their level of comfort and educated on the impact of high energy rated appliances on peak demand and on their electricity bills. The discussion centres on efficient appliances, the need to eliminate leakages in the building, positioning of the units in the building and maintenance of the units. The next chart shows the air conditioning units by types ie. single unit (box) or split-systems used by participants.

Air conditioning - Inception to June 2011

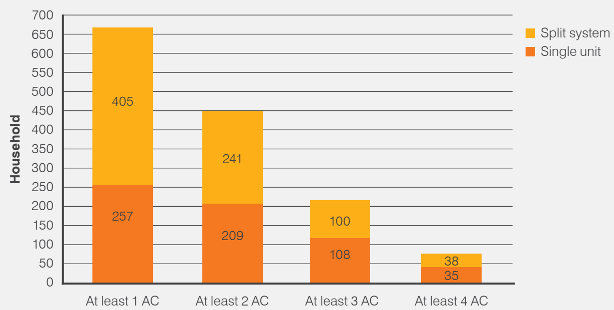


Figure 4.20 – Air conditioning

In the early years of the project, those with single unit air conditioners were normally more than 50% of the population. As can be noted above, the number of participants with split systems is now more than those with single unit before registering for the Energy Assessments. This together with the higher number of LCD TV shows that later participants are geared towards sustainable appliances at the beginning of their journey with the Solar City project.

Lighting count

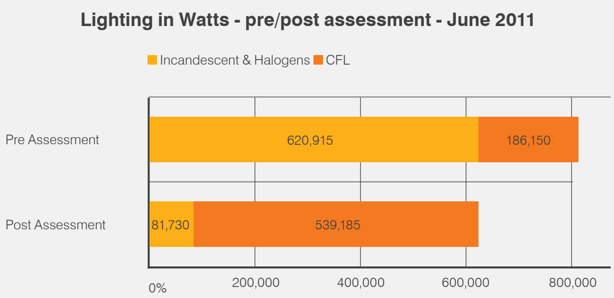


Figure 4.21 – Lighting count

During the energy assessments, one of the assessors would replace the high wattage incandescent and halogen lights with compact fluorescent lights (CFL). Each replacement was recorded and tallied and it's pleasing to note the low-cost-high impact of the CFL replacement on the project results. Figure 4.21 shows that prior to the energy assessments, a total of 186,150 watts CFLs were installed in houses across the island. After the energy assessments and the replacement of the high electricity consuming lights, a total of 353,035 watts of CFLs were installed. This brought the total CFL wattage to 539,185 watts which is the equivalent of an additional 353kW of PV system on the island. The cost of the 353 kW CFLs and their installation during the assessment is only a fraction of the cost of the equivalent 353 kW PV system.

Television type

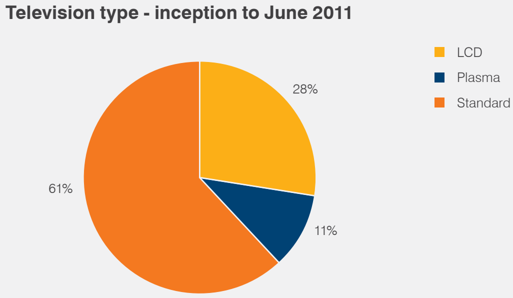
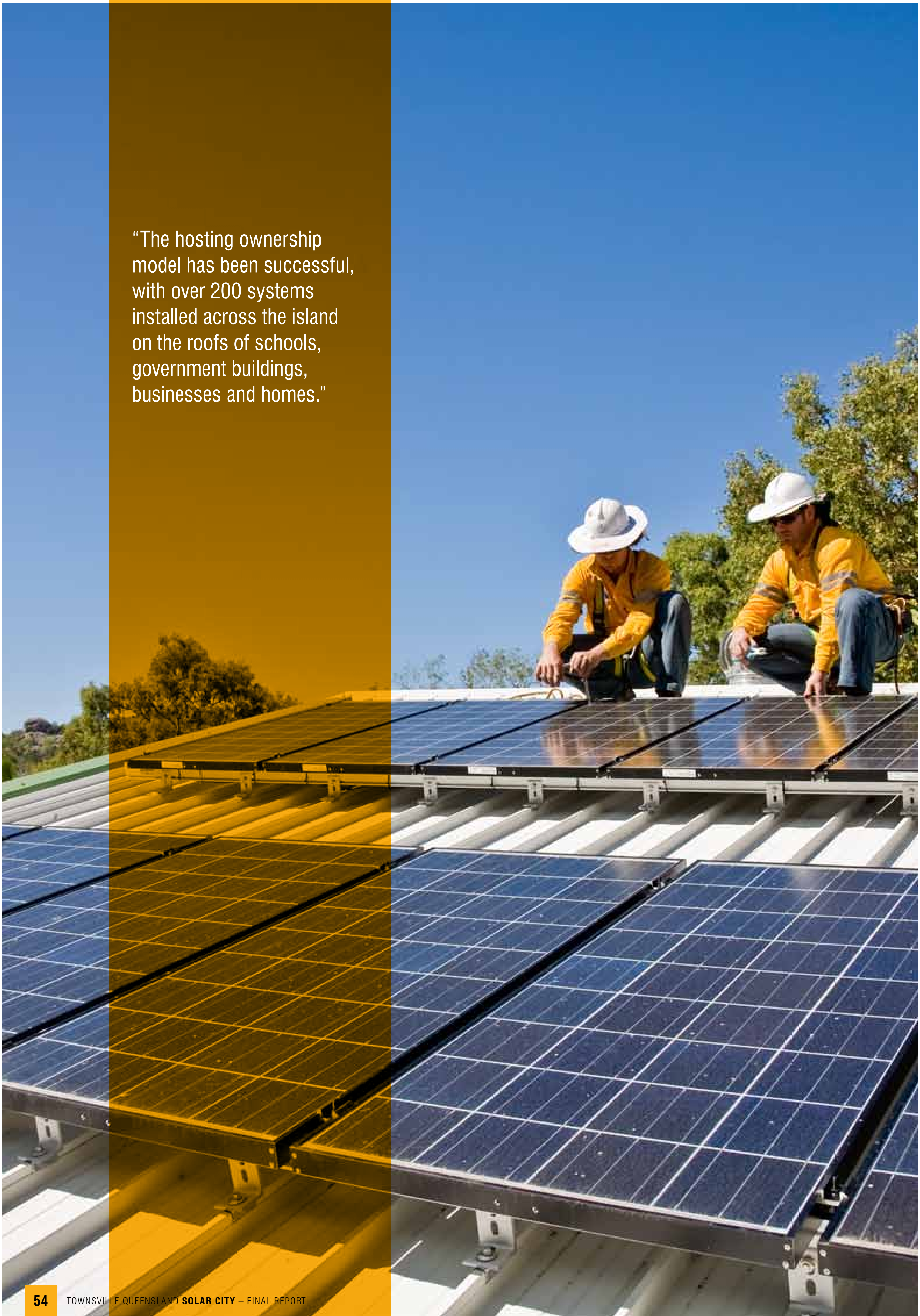


Figure 4.22 – Television type

It is interesting to note that the proportion of participants with LCD TV increased significantly from 6% in 2008 to 28% in June 2011.



"The hosting ownership model has been successful, with over 200 systems installed across the island on the roofs of schools, government buildings, businesses and homes."

05

05. TECHNOLOGY TRIALS

Are more successful when the community is engaged

The Townsville Queensland Solar City project trialled a new sustainable model for electricity supply through the use of distributed solar photovoltaic (PV) technologies, energy efficiency, load management, smart meters and cost-reflective pricing combined in large-scale grid-connected urban sites.

The detailed results for solar PV are reported in section 5.1 which includes PV hosting, installations, and analysis of generation. Section 5.2 discusses the trial where the solar inverters were used for reactive power and voltage testing. The Pole Power trial is discussed in Section 5.3, Section 5.4 outlines the environmental refrigeration alternative trial, section 5.5 reports on the electricity storage and 5.6 details the results of the smart meter trial.

The map in Figure 5.1 shows the distribution of the 210 PV installations in the four populated and grid connected bays of Magnetic Island. The largest group or 44% of the PV installations were at Nelly Bay (close to the centre of the island), followed by Horseshoe Bay (the cluster at northeast) with 33%, Arcadia made up 14% and Picnic Bay to south making up with 10% of the installations.

These installations are hosted for no financial gain on the roofs of residential, commercial customer premises as well as a Solar Skate Park at Horseshoe Bay. Residential systems range from 1.56 kW to around 5 kW, commercial system sizes are between 8 and 23 kW, and there is a 100 kW array forming the roof – and shade - at the Solar Skate Park and associated control room facilities.

Figure 5.1 - Distribution of Solar PV at Magnetic Island

5.1 – Solar photovoltaic (PV) trial

The use of distributed solar photovoltaic (PV) technologies came with its own challenges. This section of the report looks at the hosting model used, PV generation and effects of orientation, the contribution of PV electricity generation to meeting Magnetic Island demand, the Solar Skate Park 100 kW installation and the 348 kW Annandale Solar Power Station at the Townsville RSL Stadium.

5.1.1 – Hosting PV systems

The business model trialled by the Townsville Queensland Solar City project was designed so that Ergon Energy - as the electricity distributor - would own the PV systems, and rent space on the roofs of residences and businesses to host the systems for no financial gain to the owner of the roof. The power generated would then flow directly into the network.

After reviewing the customer research on the PV hosting model, it was found that people would host panels for many reasons – reduce greenhouse gases, helping the community generate its own power, increase renewable energy, assist with demonstrating the viability of solar power, etc, but no one mentioned payment for their roof space. Hence the model adopted paid only a peppercorn rent for the roof space and the host allowed the distributor to install PV panels on their roof for no direct benefit.

During the energy assessment the roof of the premises was assessed as to whether it was suitable for hosting a PV system. If the roof seemed suitable to the assessor, the resident or business person was asked if they were interested in hosting a PV system. If they agreed, a member of the installation team visited the premises and carried out a detailed pre-installation survey, deciding the suitability of the roof, the size of the system and the location of panels, conduits and inverter. Once the owner of the premises had signed the project hosting agreement, the installation team installed the PV system.

The roof space is rented from the owner at a nominal rate, so effectively the owner is allowing Ergon Energy to install a PV system on their roof for the general good of the community. The customer gains their financial advantage through savings from the energy assessment, using renewable clean energy at the standard tariff and directly reducing greenhouse gases.

The hosting ownership model has been successful, with over 200 systems installed across the island on the roofs of schools, government buildings, businesses and homes.

5.1.2 – Outcomes from directly engaging PV hosts

1127 premises were visited for pre-installation survey. The results are shown in Figure 5.1 below. Of these, the number deemed unsuitable by the assessor was 521 or 46%. This number included old, highly shaded or asbestos roofs, and also multi-dwelling premises and rental houses where the project team could not meet with the owner.

On closer inspection, 53 of the 606 premises that were deemed suitable at first viewing were found to be unsuitable.

Of the 553 premises with suitable roofs, 364 did not proceed. The reasons are discussed in Section 5.1.3.

PV systems were installed on the remaining 210 premises.

This should be compared to the original project aim of installing 500 systems. It was always seen as a challenge to install a system on virtually every suitable roof.

Outcomes of Assessment for Suitability

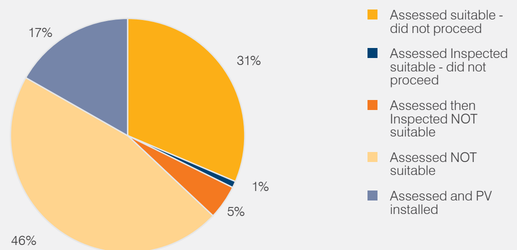


Figure 5.1 - Outcomes of assessment of roofs for suitability for hosting PV

5.1.3 – Reasons for not hosting

The reasons for not hosting are summarised in Figure 5.2. Of the houses with suitable roofs, only 24 or 4% declined due to lack of financial incentives. Of the remaining, various reasons were recorded for 54 premises, and 48 simply declined.

No reasons were recorded for the remaining 238. The project had separate data recording systems for the Energy assessments and the PV Installations, and did not have a formal system for handover of data from one to the other. This resulted in issues with following up on likely roof sites. Some sites were not actioned quickly following an energy assessment, which may have led to these sites not having a pre installation inspection, or the owner losing interest in hosting. A recent energy assessment is seen as important in the decision to host, as the altruistic aims of the project and the goodwill towards the project are still fresh in the customers' minds. The reasons for not proceeding were not always recorded due to the same handover issues. It is recommended that in future the two data sets are linked.

Difficulties with making contact with the residents may also account for some premises not hosting.

Reasons for Not Hosting

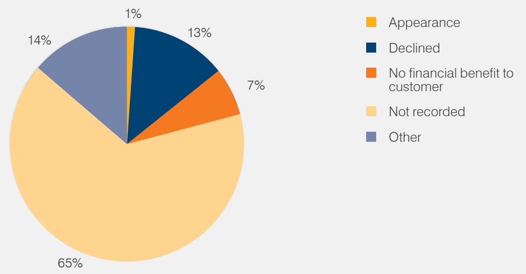


Figure 5.2 - Reasons for not hosting PV systems

Overall the model of requesting hosting for a nominal payment has been successful, although the aim of 500 systems has not been reached. There were a number of houses that should have been followed up more diligently. There were very few residents who did not want to host purely because of the lack of financial incentive, although the large number of unrecorded reasons for not hosting would undoubtedly include more of these. It is unknown what level of incentive would be needed.

Despite this, the Solar City Project achieved its target of 1 Megawatt of PV installation, with the total capacity of 1.068 MW installed by the project.

5.1.4 – Measuring the output PV generation

The metering technology used (as noted in section 5.5) posed a challenge to the project in terms of reconciling the number of meters recording PV generation data (as per the National Electricity Market file - NEM12 file) and the estimated PV generation based on the PV kW installed. With ongoing meter communication problems, the number of meters recording PV panel generation found in the NEM12 data files continues to lag the installed panel capacity, and the gap widened, as shown in Figure 5.6 below. This is due to the smart meter data issues which are discussed in section 5.6 of this report. The PV generation results have consequently been updated to estimate the generation of all installed panels, even if their meter data wasn't recorded.

The total estimated PV generation to the end of June 2012 was 2,008,400 kWh, approximately double that a year earlier. The general trend of monthly generation in Figure 5.3 shows the growth with increasing installation capacity, overlaid with the seasonal pattern of lower generation in winter months, increasing to higher generation in the summer. The months of peak generation were November and December 2011, in the lead-up the wet season.

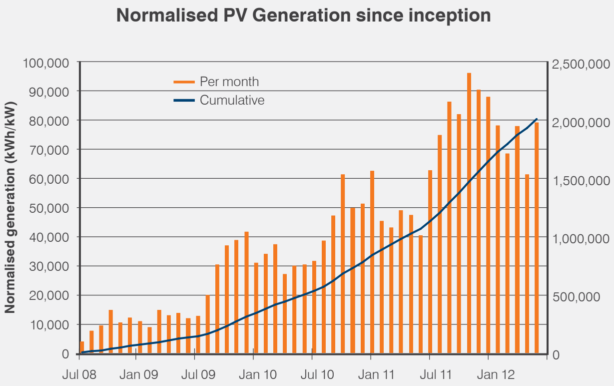


Figure 5.3 – PV generation since project inception

When normalised by installed capacity each month (i.e. by dividing the kWh output by the kW installed), as shown in Figure 5.4, the monthly trend of indicative generation eliminates the increase in installation capacity, but still shows the seasonal trend, The reduction in normalised generation from the 2009-10 to 2010-11 wet seasons has been somewhat reversed in the most recent wet season. When seasonalised, using a 12 month rolling average to eliminate seasonal variations, the normalised indicative generation trend shows a return to 110kWh per installed kW over the last wet season, after a pronounced fall through 2010 to around 98kWh per installed kW.

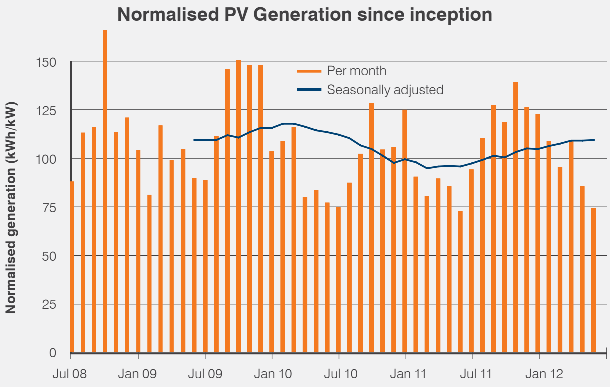


Figure 5.4 – Normalised PV generation since project inception

5.1.5 – PV panel orientation effects

Four PV systems with similar capacities (between 1.56 and 1.756 kW capacity) installed facing the four compass points were selected to compare their normalised generation performance over the financial year. Table 5.1 summarises the results, showing the annual normalised generation of each panel in comparison to the lowest producing site.

The north-facing panel in Figure 5.9 was the best performer overall, generating 29% more electricity than the worst-performing south-facing panel. The east and west facing panels generated 22% and 13% more electricity respectively than the south-facing one. Generation by the best performing north-facing panel peaked at midday, and was generally greater than 50% of its panel rating at that time in every month. Generation through the months at midday was consistently in the range of 50% to 76% of panel capacity.

PANEL NMI	RATING	ORIENTATION		ANNUAL GERNERATION	NORMALISED GENERATION	% INCREASE
	KW	DEGREES	DIRECTION	KWH	KWH/KW	COMPARED TO LOWEST
SOLPV00129	1.62	0	North	2,519	1,555	29.3%
SOLPV00116	1.62	85	East	2,372	1,464	21.8%
SOLPV00096	3.24	270	West	4,409	1,361	13.2%
SOLPV00091	1.756	225	South	2,111	1,202	-

Table 5.1 – Solar panel generation as a function of panel orientation

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For the South facing solar panel, the range of peak generation achieved through the months was greater than for the north facing panel, but that range was concentrated around a lower average, resulting in a much lower annual generation. The effect of the west facing system was the offset in the peak demand between 12:30 and 13:30pm. The range of peak generation achieved through the month was similar to that of the east facing panel, though around a lower mean than for the east facing panel. Hence this panel generated less than its east facing counterpart.

Summarising these results, the chart showing PV generation by the four panels through the financial year in Figure 5.5 below shows the distinction between the four orientations. The north-facing panel performed best in September, and the south, east and west-facing panels in November, with performance degrading through the wet season due to rain and less direct sunlight due to humidity. June was the worst performing month for all panels. The data problems in March and June for the south-facing panel are clearly evident.

The north-facing panel performed somewhat better than the others in the winter months from February to September, and similarly to the other panels in summer, ensuring its annual generation was better than the others. The east-facing panel was the best summer performer, but second best in winter. The west-facing panel performed similarly to the east-facing panel all year, but at a lower level. The south-facing panel was worse than all the others in all but 3 wet-season months, so overall was the worst across the 12 months.

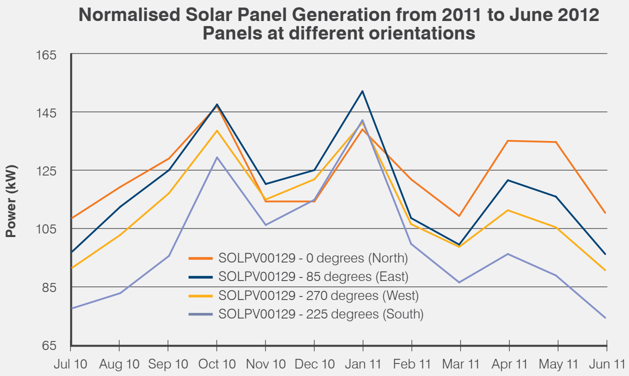

Figure 5.5 - Solar panels' monthly electricity generation at different orientations

The analysis timescale was widened to examine the performance of these panels from the date of their installation to June 2012 and the year on year performance in each season shows little change in the relative position of each panel.

5.1.6 – PV contribution to Magnetic Island demand.

The Solar City PV systems supply directly into the electricity network, and displace electricity generated by coal power stations in southern Queensland. On sunny days when PV generation peaks, renewable energy forms a substantial amount of the load, with the maximum measured on one feeder of 39%.

It is important to note here that the PV installations on Magnetic Island were ***not*** targeted to reduce peak demand between 6 – 9 pm (peak period) but to trial PV installation in grid connected premises to obtain lessons learned for a distribution and network provider.

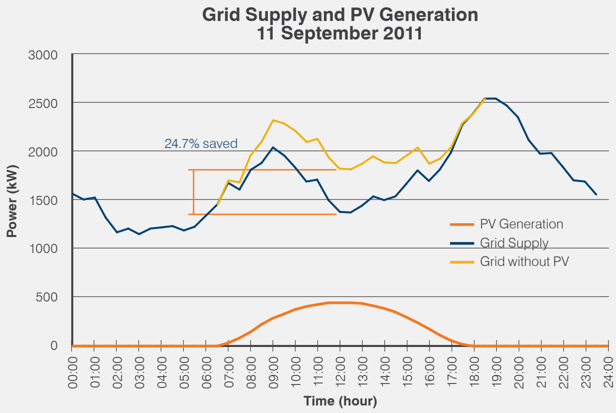

Figure 5.6 – Grid supply and PV generation for all Magnetic Island – 11 September 2011

Magnetic Island has two separate feeders, and there is more PV generation capacity on one of these (TOMA10) mostly as the Solar Skate Park is located on this part of the island. On the peak day analysed, on this feeder alone the PV systems installed by the Solar City Project supplied 39% of the electricity required by the customers.

Ergon Energy, as the owner of the panels, has agreed to maintain and clean these panels while they are hosted and for the term of the panels useful life. Ergon Energy does not directly receive payment for the energy generated by the hosted panels, however it then needs to buy less coal fired electricity. Thus, the value of the energy generated by the panels to Ergon Energy is only what a coal fired generator receives, which is much less than the cost of energy to the consumer and barely covers the cost of the maintenance and cleaning program to date.

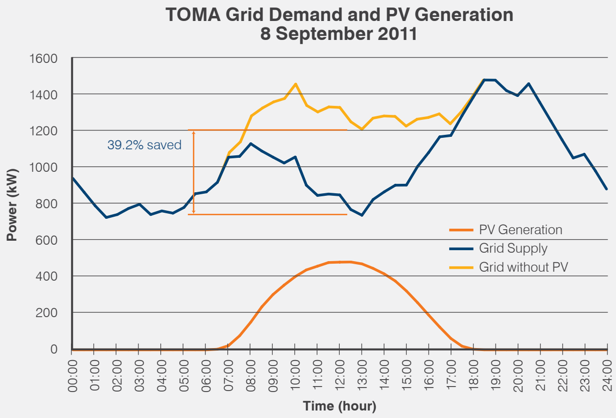

Figure 5.7 – feeder level impact of grid-connected PV on 8/9/2011

PV hosting agreement – key lessons

The hosting agreement for the Solar City project was the first of its kind in Ergon Energy and covered the utility owned systems for servicing and maintenance for the life of the project and beyond.

The agreement and associated talking points and FAQs attempted to cover all eventualities around ownership, hosting and use of the panels.

Host feedback received as the project draws to an end indicates that despite verbal communications and indications in the hosting agreement that the panels would continue to be owned by the utility past the end of the project until the end of the panels useful life, it is important to spell this out. It is also important to include key project milestones and closure dates, to give a clear picture on what will happen to the hosted systems at the end of the project.

Importantly, hosts require certainty when signing the agreement around the end of project arrangements or it will create undue community concern and possible reputational damage to both the project and the business at the end of the project.

5.1.7 – PV installation in the tropics

One of the key problems with respect to installing PV systems in the tropics is high rainfall, high humidity and high temperatures when working on a roof during the summer period. Installation ebbs during the summer months due to the wet season and high temperatures.

5.1.8 – Solar Skate Park

The Solar Skate Park (SSP) was officially opened by the Hon Mark Dreyfus, QC MP, Parliamentary Secretary for Climate Change and Energy Efficiency on 23 July 2011. This sub-project was included in the DBC to trial a large iconic PV installation with a community engagement element. Since its opening, there have been a lot of interest and enquiries on the model used.

Although no record is available for the total number of visitors to the SSP, the utilisation by residents and visitors on the island is known to be very high especially during the holiday seasons. In addition, the responses from the community and also visitors have been very positive.

In the last 12 months, no major disruption or vandalism was noted which is a testament to the community's support for the SSP and the model used.

As well, Ergon Energy has been able to test how reactive power from grid connected solar PV inverter systems can be used to influence the levels of voltage on Low Voltage (LV) distribution network.

There have been no significant technology issues. The LED lights have been working well with no complaints from users of the park or surrounding neighbours. The inverters, interval meters and solar panels have all been working as planned.

The electricity power generated by the SSP PV panels on a number of its best days in 2012 is presented in the following chart (Figure 5.8). The chart shows the relative consistency of generation on peak days, and the impact of random events such as cloud cover through the peak midday period. The midday peak exceeded 90% of panel capacity on 9 days in 2012.

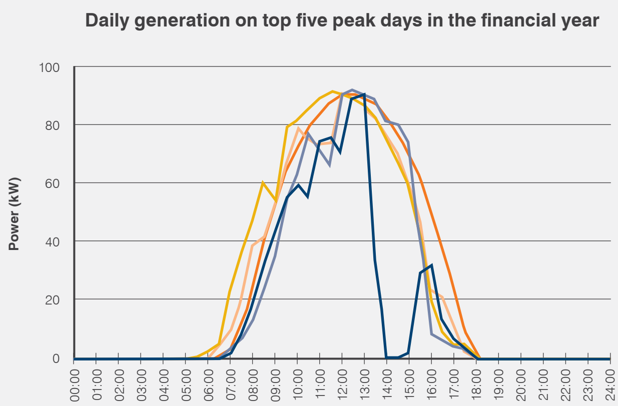

Figure 5.8 – Solar Skate Park daily generation in 2012

Figure 5.9 shows the average daily energy generation from the skate park through the year. The drop in the data in October 2011 was due to data loss in that month.

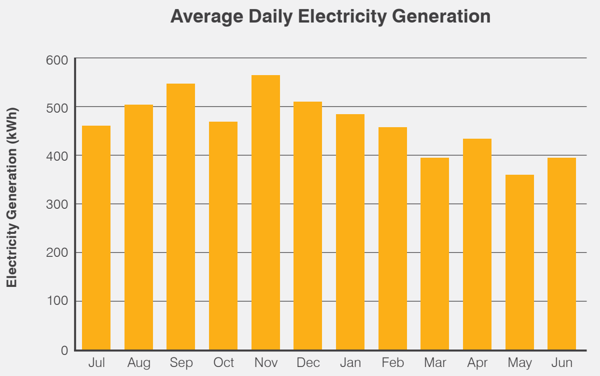

Figure 5.9 – Solar Skate Park daily generation in 2012

SOLAR SKATE PARK – KEY FINDINGS	ISSUE	RESPONSE
Design	Community buy-in	Early, consultative and consistent engagement with the community on the location and design is crucial to achieve community buy-in.
	Impartial technical advice	Engage a talented and collaborative architect to work with a community elected reference group on a design that meets project, technical and community design specifications.
	Cost overruns	Ensure both process and design is within project budget parameters and funding, and use internal resources where possible to reduce costs and save time.
	Community ownership	A community reference framework, with community elected members and a reasonable timeframe will increase community ownership.
	Community acceptance of major project legacy installation	By selecting a high performing team and enlisting community advocates, a better legacy result can be achieved for both project and community.

In summary, the Solar Skate Park installation involved a huge amount of collaboration and cooperation between the key parties; the Magnetic Island Community, Townsville City Council and Ergon Energy and also the smaller entities involved in the project. The success of the project was achieved through project flexibility, effective communication and interactions between all the parties, and the use of Community Based Social Marketing (CBSM) as the underlying methodology of communication.

5.1.9 – Annandale Solar Power Station PV installation

In June 2012 Ergon Energy commissioned the 348 kW Annandale Solar Power Station which is located on the roof of the Townsville RSL Stadium in Annandale, Townsville. This is the only Ergon Energy Solar City installation on the mainland, complementing the 211 systems on Magnetic Island.

The Honourable Mark Dreyfus, QC MP, the Parliamentary Secretary for Climate Change and Energy Efficiency opened the power station on 28 August 2012.

The installation consists of 348kW of photovoltaic solar panels, 28 inverters and various switchboards housing isolating, metering and protection equipment. The system is directly connected to the grid and can supply up to half the load of the Stadium. In times when the load from the Stadium is low, the excess generation is fed into the 11kV local system via the Stadium's dedicated distribution transformer.

The main type of inverter used is the Sunny Tripower, which produces a balanced 3 phase output and has reactive power capabilities. There are also Power One Aurora 4.2 kW inverters (SOLAR 3) installed and a single Sunny Mini Central (SOLAR 1) single phase inverter. A total of 1811 Kyocera Solar Modules have been installed, 825 x KD135GH-2P and 986 x KD240GX-LFB.

Figure 5.10 below shows the electricity generated from the Annandale Solar Power Station reaching its maximum output in August 2012 at above 120 kWh between noon and 1pm.

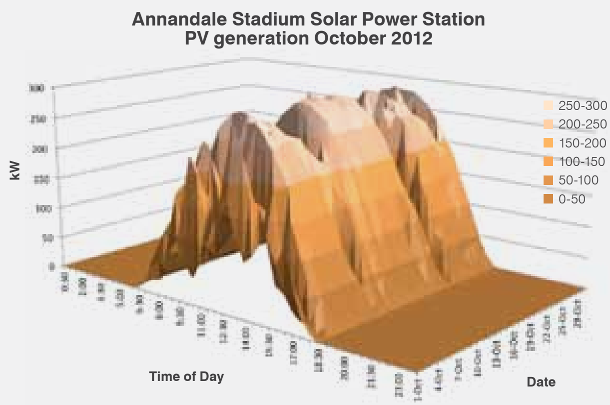

Figure 5.10 – Annandale Solar Power Station generation – October 2012

As noted in the previous section, the period September to December is most productive for PV systems for the Townsville region.

5.1.10 Townsville City Council solar installations

Under the Townsville Queensland Solar City Project, the Townsville City Council has installed the following solar systems:

TOWNSVILLE CITY COUNCIL SOLAR INSTALLATIONS 2007 – 2012	
2007	Sharp 2kW system installed above Northtown library 1.5kW system installed at the CBAR on the strand 1.5kW system installed at the Thuringowa waste management centre
2008	Kyocera 4kW system located at Thuringowa Civic Centre near the library
2009	Built In Photovoltaic Schott 1.5kW located at Rowes Bay Sustainability Centre Kyocera 1kW located on the Roof of the Rowes Bay Sustainability Centre Origin Sliver 20kW system located on roof of Townsville City Council Administration building
2010	Solyndra 3kW system located at Townsville City Council Administration building KissTiles 1.5kW Solar PV and Solar Hot Water system at Rowes Bay Sustainability Centre
2011	Schott 52.88kW system located on Thuringowa Civic Centre roof 54.19kW Kyocera panels installed at the Flinders Square Pavilion
2012	Built In Photovoltaic (BIPV) Schott 1.5kW located at the Learnscape on Castle Hill. 40kW Kyocera panels plus battery storage installed on Tony Ireland Stadium in Townsville.
Total	**141.57kW of PV installed by Citysolar.**

5.2 – Using PV inverters to supply reactive power

Trials were undertaken to see how reactive power from grid connected Solar Photovoltaic (PV) inverter energy systems can be used to influence the levels of voltage on the Low Voltage (LV) distribution network. More information and the detailed report, “Grid Connected Solar PV and Reactive Power in a Low Voltage Distribution Network, by Dean Condon can be found on the TQSC website.

The 100 kW PV system at the Solar Skate Park was constructed with inverters capable of producing both real and reactive power and became our test site. There are seven SMA Sunny Tripower grid connected three phase inverters, and the reactive power control of these units is managed via a SMA power reducer box.

During the design phase of the project, a PV voltage rise model was produced with the Solar Skate Park connected to the adjacent low voltage (LV) network. This model predicted an 18V rise at the Solar Skate Park, which was excessive and resulted in a change to the connection arrangement. The new arrangement has the Solar Skate Park connected to the Medium Voltage (MV) network via a dedicated distribution transformer - which results in a low impedance connection to the network.

The ability of the Solar Skate Park to produce and consume reactive power and its corresponding impact on the LV network voltage was tested whilst still connected to the dedicated transformer (ie a low impedance connection) and with the Solar Skate Park connected to adjacent LV network (ie a high impedance connection).

5.2.1 – Reactive power testing with low impedance network connections

The ability of reactive power produced by the inverters to influence levels of the LV network was first tested whist the Solar Skate Park was connected to the dedicated transformer. Power factors of unity, 0.8 overexcited and 0.8 under excited were trialled.

Below are graphs of the power output from the solar system and the mains voltage for the under excited (consuming reactive power) trail. They show the power output and the maximum midday values of real power ~ 72 kW and apparent power ~ 90 kVA. The reactive power has a maximum midday value of ~ 54 kVAr.

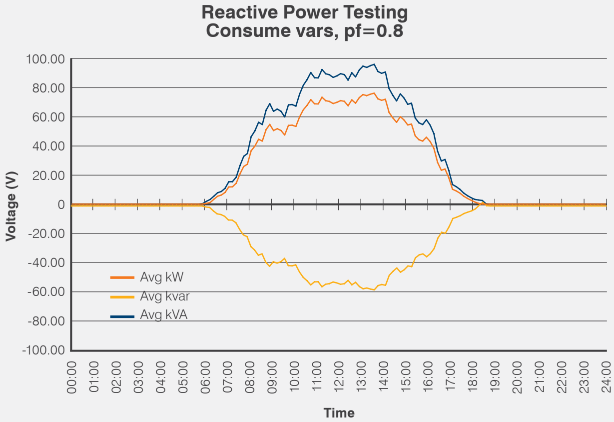

Figure 5.11 - Power values with pf = 0.8, under excited

The voltage profile is shown below in Figure 5.12 and has a flatter profile with a maximum midday value of approximately 245V compared with 248V for unity power factor, and 250V for the overexcited case.

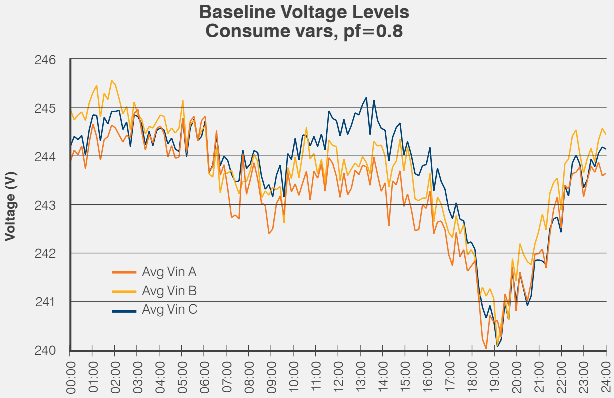

Figure 5.12 - Voltage levels with pf = 0.8, under excited

The testing proves the concept that reactive power can be used to influence the levels of voltage on the LV network. The change in maximum midday value from 245V to 248V for the under excited case was 3V (1.25%) and 248V to 250V for the over excited case was 2V (0.83%). These are small changes; however the Solar Skate Park connection to the network is very low impedance and hence would only expect to see small changes.

5.2.2 – Reactive power testing and high impedance networks

The Solar Skate Park was manually disconnected from the dedicated transformer linking directly to the MV network, and then connected to the adjacent LV network. By making this connection change, the impacts of having a large PV system connected to the end of a high impedance LV network can be tested.

Tests were carried out on reactive power in a high impedance LV network. Three levels of power factor were tested and measurements were taken at the Solar Skate Park, at the LV transformer some 400m away and at an intermediate point.

The tests showed that reactive power from a solar PV system's inverter can be used to reduce voltage in an LV network by up to 5%.

5.2.3 – PV Inverters can be used to influence voltage on the distribution network

The ability of reactive power to influence the voltage levels on the Low Voltage distribution network was shown for both a low impedance and high impedance network. The reactive power produced a voltage change of approximate 1% in the low impedance network and 5% change in high impedance network. In the high impedance network case, 25 kVAr was required to be supplied by the network to enable the Solar Skate Park to remain connected to the grid.

The trial was successful, but manual control of power factor is unlikely to satisfy network requirements. Ergon Energy is trialling various automatic control systems during 2013.

Inverters capable of reactive power with automatic control systems will become an essential tool for managing voltage rise in LV networks in the near future.

5.3 – PolePower trial

Polepower is a small scale photovoltaic system that is designed to be attached to electricity distribution poles with the energy generated being fed directly into the Low Voltage (LV) distribution system. Ergon Energy entered into an agreement with Energy Innovations Pty Ltd in June 2009, for the development and trial of Polepower.

During the trial seven Polepower systems were installed on Magnetic Island with the assistance of the Townsville Queensland Solar City project PV installation team.

In 2010 the Polepower project was extended to include the replacement of inverters with Grid Smart enabled inverters – which included reactive power and online monitoring and control functionality.

The seven Polepower systems have been in operation since February 2010, during this time North Queensland has experience three (one severe) tropical cyclones. No mechanical damage to the Polepower systems was incurred as a result of the cyclones and no maintenance was required to remove debris from the systems. The systems proved to be easily installed, mechanically robust and warranted minimal maintenance. The Polepower system can only be installed on poles that contain overhead Low Voltage conductors, as the inverters are low voltage.

The pre-trial testing predicted the average annual energy generation per system on Magnetic Island to be 121kWh. Energy production readings taken approximately 5 months into the trial indicated that the original estimates were likely to be exceeded. The full 12 months measured energy production figures for the systems were approximately 20% less than the expected value and are most likely attributable to the un-seasonally wet weather experienced in the Townsville area during 2010/2011, and the north facing aspect of the systems. When the tropical sun is in the southern sky (for about 10 weeks in Townsville), the Polepower system is less efficient. Thus the Polepower is best suited to latitudes south the tropic of Capricorn, i.e. where the sun is always in the north.

As a pure real power energy generator, the Polepower system is at present expensive for the annual energy yield of approximately 120kWh per system. Inverters with Grid Smart capabilities have the added benefit of reactive power production and online monitoring and control – including monitoring of the low voltage network parameters of voltage, frequency etc. Benefit value of the reactive power and online monitoring have not been estimated, but would add to the commercial attractiveness of the system.

The trial was successful with all objectives realised – including time, cost quality and safety goals. Ergon Energy has gained significant experience in the design, installation, maintenance, operation and control of this unique type of distributed generation system. However more development is required before the system becomes a commercial proposition.

5.4 – Environmental Refrigeration Alternatives – ERA trial

The concept of the ERA trial was to shift the peak demand of air conditioning, water heating and refrigeration loads through the use of thermal storage and provide a more energy efficient option. The thermal storage would be cooled during off-peak and high solar availability times and used during peak times. The thermal storage concept has been proven through many technologies and locally used through the use of large scale chilled-water storage at Ergon Energy's successful demonstration project at James Cook University in Townsville. The ERA system has the unique advantage of its small footprint due to its innovative and unique storage medium, suiting domestic and small commercial scale application.

The key challenges experienced in this trial were:

- Reliability in operation
- Meeting needs of the site – sizing and temperature setting
- Power quality impacts
- Poor data quality for analysis and assessment

As a result of the above challenges, other key aspects of the assessment were not able to be undertaken; such as the energy efficiency of the product, performance characteristics in reducing peak loading and utilising solar and off-peak energy and cost benefit analysis of such systems.

The product did achieve success in showing that with improvements in design, the power quality issues could be overcome; if appropriately sized, the units can provide effective cooling and thermal storage can manage compressor operation through nominated peak loading times. Maturation of the product development could address these aspects. Reliability can gained through experience, better system knowledge and proactive fault diagnosis at trial stage.

5.5 – Deep cycle batteries – Redflow commercial and residential units

The deep cycle battery systems was a trial of emerging technology which was funded independently of the Townsville Queensland Solar City Project, and located on Magnetic Island to increase the synergies and outcomes of both projects.

Eight deep cycle battery systems, using zinc bromide flow technology, ranging from 5kWh to 20kWh were installed on Magnetic Island, at both Ergon Energy and at customer premises hosting project PV systems. These units stored electricity generated by the solar arrays and then discharged it at peak load times. The aim of this trial was to gain an understanding on how the battery storage system performs and how it can be used to support the network during peak demand periods, as well as the resource required and the community engagement necessary for such deployment.

The trial enabled Ergon Energy to gain a deeper understanding of battery storage systems and build on this understanding in developing its second generation grid connected battery storage and injection systems.

The trial showed that battery storage systems are able to successfully support the network for peak demand management as they can be programmed to discharge at certain pre-programmed times. It was successful, demonstrating the zinc bromide flow technology, however further work is required for commercialisation.

5.6 – Smart meter trial

Meters with smart control, recording and reporting features have been installed throughout Magnetic Island to provide data for evaluating the success or otherwise of the various interventions under the project. The Solar City has trialled the first installation of smart meters by Ergon Energy, prior to more comprehensive rollouts in other areas, if approved by the State Government.

The smart meter system installed by the project is capable of:

- recording electricity consumption from two channels every half hour of the day
- sending data to an in-house display (IHD)
- receiving data by a radio wave from a water meter
- sending data to a data concentrator via a power line carrier
- collating data in a back office database
- two way communication from the back office to the smart meter and IHD.

Figure 5.13 shows the distribution of the 1356 smart meters on houses and businesses at Magnetic Island. The majority or 47% were installed at Nelly Bay, 20% installed at Horseshoe Bay, 14% at Arcadia and 11% at Picnic Bay. An additional 8% was installed at Ayr (the Control Group location) which is not shown in Figure 5.13. It should be noted that in suburbs with older houses, the penetration rate was much lower due to the difficulties in upgrading the distribution boards.

Figure 5.13 – map of the smart meter installed at Magnetic Island

Since the beginning of the project, over 110 million data readings of electricity consumed in half hourly periods were collected and added to the Solar Cities database in Canberra.

As there were no Australian standards for smart meters in 2008, and no locally available systems, an overseas system with local adaptions was chosen. The smart meter system selected had been widely used in Europe (mainly in high rise environments). Adaptation and development of the system was required for it to operate effectively in a low density single dwelling environment. This resulted in the development phase taking about a year longer than had been anticipated in the project plan.

However, it is worth noting that Townsville was the first Solar City to have an operational system that included the IHD, smart meter, data concentrator and back office application.

Table 5.2 below summarises the smart meter status.

A total of 1679 smart meters have been installed since inception of the project (1469 revenue meters and 210 PV Data Loggers).

SMART METER STATUS	ACTUAL	TARGET
Revenue meter installations (Qty)	1,356	1,100
Control Group Revenue meter installation (Qty)	113	100
PV Data Loggers (Qty)	210	480
Total smart meters installed (Qty)	1679	1680
In-house display (Qty)	355	1150
Data concentrator installations (Qty)	51	50

Table 5.2 - Smart meter status

The smart meters measured the electricity consumed each half hour and sent this to the back office database via the distribution power lines, to a data concentrator and then via a phone link to Ergon Energy's Meter Data Manager. The actual data received at the back office was mostly about 80% of all data available, and towards the end of the project dropped to less than 60%. At this stage a manual reading system was employed to ensure sufficient project data was available.

The main reasons for the less than 100% market ready data are:

- Unreliable data concentrators
- Smart meter faults
- Communication faults between the meter and data concentrator
- Communication faults between the data concentrator and the back office database at the Meter Data Manager end
- Power outages
- Climatic conditions being at the edge of the design range for electronic components.

The major lesson to be learned is that a high reliability should not be expected for technologies not proven in the working environment.

5.6.1 – In House Displays help people manage their electricity use

During the project, a total of 355 In House Displays (IHD) were installed. This was only one third of the target and was due to the time and technical issues associated with the initial pairing (connection) of the in house display with the smart meter. As pairing required staff both on site and in the back office, and a reliable communications path from the back office to the in house display, a decision was made that it was not cost effective to continue installation of in house displays past December 2011.

The issues noted from installations of in house display are as follows:

- Reliability of the wireless communication link between IHD and revenue meter depends on:
  - Distance between switchboard and in house display
  - Number of walls between the switchboard and in house display
  - Interference from other wireless equipment with nearby frequencies.
- The process to 'pair' each individual in house display with its meter is complicated and resource intensive, requiring trained staff on site and in the 'back office' at the time of pairing
- Initially the software controlling the pairing restricted when pairing could occur, resulting in the need to undertake reworking which customers found frustrating. These problems were resolved with new software.
- The integrity of the smart meter to data concentrator to back office communications link. Small dropouts in the communications links at time of pairing caused great frustration to customers and staff and wasted resources.
- It was not possible to update the tariff prices so the dollar figure was always accurate.
- If the in house display went off line, often it was not possible to pair it again, and the display was removed.

Due to the limitations of numbers of IHDs installed, and the problems in pairing them with their revenue meter, it was possible to analyse the effect of IHD installation on electricity consumption at only a small number of properties. Although the sample is too small to draw definite conclusions, the change in consumption seemed to generally follow the same pattern as for energy assessments with small initial savings increasing in the second year.

5.6.2 Honeycombes Holborn Apartments and smart meters

As part of the sustainable building trial at Holborn Apartments, Ergon Energy installed 67 smart meters, and Honeycombes obtained consent from the owners for use of their data in the project. The meters were linked by data cable to a data concentrator which then used a phone connection to the Meter Data Manager.

This system has been very successful in collecting and delivering data to the central Solar Cities database.

5.6.3 – Smart meter key findings

SMART METERS	ISSUE	RESPONSE
New technology	Unfamiliar technology for project and internal Ergon Energy staff	Experience gained with smart meters, in house displays and with the management of large quantities of meter data has been invaluable to Ergon Energy.
	New business requirements for project and internal Ergon Energy staff	Technology chosen must suit the working environment
	Customer concerns	Well trained and motivated installation staff with rigorous processes supported by solid documentation greatly reduces customer dissatisfaction – less than 1% complaints in this case
Residential	Meter board quality	Quality of household distribution boards in older properties will not allow comprehensive roll out of new meters without some major upgrades.
	In house displays	Feedback from customers on the in house displays was positive, with the visual and colour display helping them monitor their electricity usage
		Use of the in house display varied with some customers putting it away after a short time or only using it in summer
Commercial	New technology has the potential to adversely affect commercial situations	For a commercial roll out, only proven technology should be used. Additional time should be allowed for development and customisation where new equipment and systems are to be used. Adequate staff training in the new systems must be provided

"PDRT participants showed an overall reduction at peak times of more than 25% during the 18 month trial, and reduced their total consumption by 23% over the same period as well."

06. COST REFLECTIVE PRICING TRIALS

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It's about how people use the technology

The load management component of the Solar Suburb Demand Management trials was initially focused on the optimisation of customer tariff arrangements to both save money for the customer and provide Ergon Energy with load control options under existing arrangements (in Queensland Tariff 31 and 33 are control tariffs). The change in the Queensland electricity industry to full retail contestability provided Ergon Energy with the opportunity to develop a range of cost-reflective pricing arrangements outside the franchise tariff arrangements using both network and retail initiatives.

The objectives of the Solar Suburb cost-reflective pricing trials were to:

- signal to customers the impact of peak demand (rather than total energy) as a driver of network cost;
- provide customer behaviour incentives to align them with desired distribution system demand outcomes;
- reflect costs incurred in energy procurement and network charges in the delivered cost of energy;
- manage risk exposure to pool price volatility;
- differentiate Ergon Energy in a competitive market; and
- comply with Queensland Government undertakings to customers and minimisation of Community Service Obligation liabilities

6.1 – Background on notified prices charged

Ergon Energy is unique in the Australian electricity market because of its geographic size – Ergon supplies an area which is six times the size of Victoria, and which covers 97% of Queensland. As a participant in the National Electricity Market (NEM), the Australian Energy Regulator (AER) regulates the revenues Ergon Energy can earn.

Since 2007, the above notified-prices have been increasing consistently on an annual basis. These increases were mainly due to the increase in the cost of transporting electricity from the generators to customers (network costs). The residential tariffs in Queensland have been constant since June 2011 as a result of the Queensland Government's determination not to increase Tariff 11 in April 2012.

Estimates show that the increase in network cost is expected to continue into the future driven by the increase in peak demand. The key project aim of reducing the peak demand contributes to lowering the pressure on network costs and hence the pressure to increase prices. With the impact of the project, peak demand on Magnetic Island bucks this trend.

6.2 – Tariff trials

As part of the Townsville Queensland Solar City project scope of works, cost reflective Tariff Trials were to be conducted on Magnetic Island. As a non-competitive retailer, EEQ is only permitted to supply its customer's standard contracts at notified prices. A waiver from this provision has been granted to allow tariff trials to take place by the project. As many tariff trials have already been undertaken by Ergon Energy, by other utilities in Australia and by utilities overseas, the project has developed the following innovative trials - Peak Demand Reduction Trial (PDRT), Demand Response Enabling Devices (DREDs) and the Alternate Off Peak (AOP) trial described below. The TQSC acknowledges Wayne Preston, Ergon Energy Solar City Tariff Trial Manager for the management of the trials and the information provided for this report.

6.2.1 – Peak Demand Reduction Trial

The 18 month Peak Demand Reduction Trial section of the Solar City project investigated the impacts of cost reflective incentive options for Magnetic Island residential customers and their ability to reduce and shift daily load during the peak demand times of between 6pm to 9pm daily. Residential customers were targeted for inclusion in this small trial as the vast majority of interval meters had been installed in residential properties.

The overall target audience number was restricted to 210 customers who had In-House-Displays (IHDs) installed, or who had 12 months continuous interval meter data, resulting in the final trial size of 81 participants.

6.2.2 – How did it work?

An amount of $15/month was paid to participants when a 15% reduction in Tariff 11 supplied electricity consumption was achieved between the peak demand periods of 6pm to 9pm daily for that month compared to the same month in the previous year. A further payment of $1 was made for every additional per cent point reduction in electricity consumption above 15% in peak time for that month compared to the same month in the previous year up to a total of 25% or a total of $25month, and paid quarterly. On completion of the trial, $100 was payable to the participant after the completion of the exit survey.

Payments were made quarterly and competition was high amongst trial participants keen to achieve the maximum payment of $75 for that quarter. It was often a point of discussion on the morning commuter ferry between trial participants and this informal discussion both reinforced the energy conserving efforts and promoted the benefits of the trial.

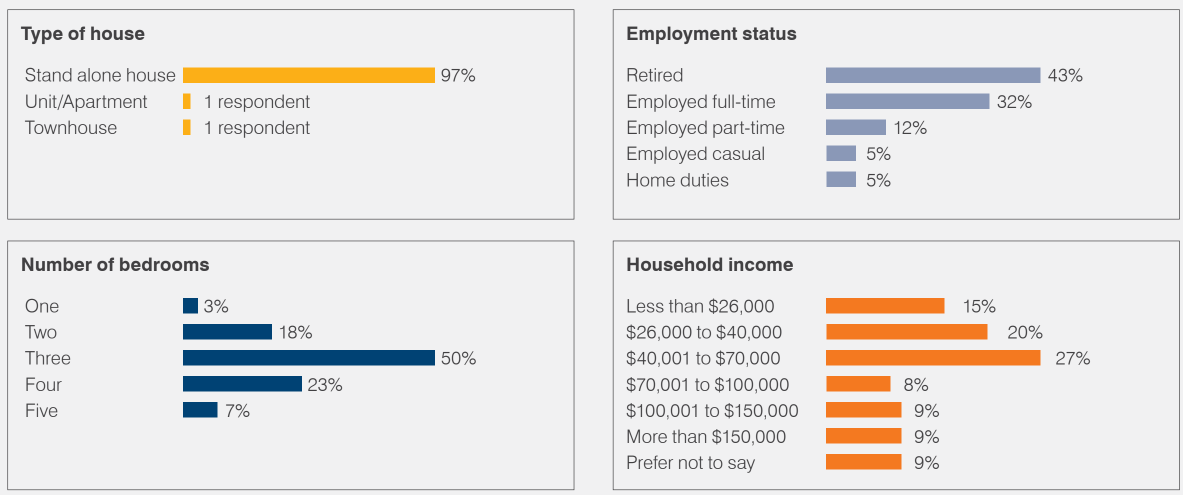
The potential benefits to be derived from the Peak Demand Rebate trial were measured in several ways -

- Reduced network demand during peak demand period of between 6pm and 9pm daily ;
- The potential to delay the need to invest in the upgrade and installation of expensive network capital; and
- Alternative options to current tariffs

This trial provided the opportunity to educate customers on the effects of peak demand on the network. It also allowed the project to incentivise customers with payments by using a "carrots not sticks" approach for those who were able to shift or lower their average usage of electricity during the peak demand period of between 6pm and 9pm daily.

6.2.3 – Trial demographics

A total of 81 participants (5% of Magnetic Island premises) participated in the trial. Figure 6.1 below shows that 69% of participants are greater than 55 years old, 61% with only two people in the premise and 62% without children. 97% of the trial participants have stand-alone houses, 43% have retired from the workforce, 80% were those with 3 - 7 bedrooms and 27% have incomes between $40,000 to $70,000.



Base: All respondents (n= 74) D8 Which of the following best describes the type of house you live in? D9 How many bedrooms do you have in your home? D10 Which of the following best describes your employment status? D11 Approximately what is your current annual household income before tax?

Figure 6.1 – Peak Demand Reduction Trial demographics

In relation to participants' appliances, more than half of the participants have two fridges (54%) and one stand-alone freezer (54%) in the household. The most common type of household hot water system was an electric hot water system (on controlled tariff).

It was interesting to note that nearly three in four participants reported that they had received an In-House Display (IHD) monitor as part of the Solar City IHD trial. It was also noted that IHD usage was high amongst those who had an IHD monitor installed – ie participants in this trial paid close attention to their IHD and relied on it for information on managing their energy use.

Of those that received an IHD, 37 participants or 70% used the IHD through-out the trial, 19% did not use the IHD and 11% could not use the IHD or no longer use it as it was not functioning properly.

As well, 65% of the 37 people who received In-House Display Monitor used it on a very regular basis, 16% used it on an occasional basis and 19% hardly used it at all. The satisfaction with the IHD monitor as a tool to assist participants throughout the Trial was moderate (mean score 7.6). Satisfaction was significantly higher among those who received over $300 in rebates than those who received $201 to $300 in rebates. Overall, the satisfaction with IHD as a monitoring device was high at 65%.

6.2.4 – Summary of Project Outcomes

Energy savings derived by the PDRT were 0.918kW per participant during the three hour peak period (6pm to 9pm). Below is the 18 month (total project) reduction in peak period energy usage and total energy usage. Overall the stretch target of 25% reduction to peak period energy consumption was surpassed over the 18 month trial. The added bonus to the trial was the reduction in total consumption of 23% (or 193,758 kWh) for trial participants.

	BASE FIGURES KWH	TRIAL FIGURES KWH	REDUCTION KWH	TARGET %	REDUCTION %
6-9pm Peak Consumption (18 months)	154,192	112,243	41,949	25%	27%
24 hr period Total Energy Consumption (18 months)	847,037	653,278	193,759	55%	23%

Table 6.1 PDRT Results

6.2.5 – PDRT exit survey

Research was conducted with households on Magnetic Island who participated in the Peak Demand Reduction Trial. A telephone survey was conducted in early May 2012 with a total of 74 surveys completed (out of 81 participants).

Follow-up face-to-face interviews were conducted with six (6) households to probe further on key areas and to video record comments for use internally within Ergon Energy.

Key findings from the exit survey are listed below, with feedback on the overall trial extremely positive among the majority of participants.

- **Pre - registration**
  - Nearly all participants recalled receiving an initial invitation letter from Ergon Energy (93%) and an information letter and customer agreement pack (93%).
- **Registration**
  - Key drivers of participation were the possible savings on energy bills, the cash incentives over 18 months and the ability to reduce electricity usage. The combination of these three is a strong motivator and highlights household concerns about rising energy bills.
- **Communication**
  - Trial participants were very satisfied with:
  - The written communication received from Ergon Energy overall (mean score 9.0); and
  - Its content (including ease of understanding the information, the amount of information and the ease of understanding household performance during the trial, all achieving an average score of 9.1 out of 10).
- **Feedback on the Trial**
  - Usage of the In-House Display (IHD) monitor was high (70%) amongst those who received one during the Trial (72%).
  - 65% of participants who received an IHD monitor used it on a very regular basis and were moderately satisfied with it (mean score 7.6).
  - A high proportion of participants reported that they had installed energy efficient light globes (70%) and had an energy assessment as part of the Solar City project (66%) as a result of being registered in the Trial
- **Household Behaviour**
  - During the Trial, participants were conscious about turning off lights (45%) and being more careful about what appliances were used during peak time (38%). About one in four stopped running appliances such as dishwashers and clothes dryers during peak times.
  - To reduce electricity consumption during peak time, the majority of participants reported that:
  - They stopped using an electric heater or a dishwasher (60%); and
  - Reduced usage of an electric cook top/oven (53%).
- **Incentives**
  - Overall satisfaction with the trial's financial incentives is very high, particularly given how reasonable the incentive payment amounts were (mean score 8.4).
  - Whilst satisfaction with the delivery of the incentives via cheque is high (mean score 8.3), nearly half would have preferred to receive the incentives deducted off their electricity bill (47%).

- **Qualitative Insights**
  - For some of the participants, particularly those whose target achievement had not improved dramatically or who were not meeting their targets, it was felt that a follow-up after six months would be beneficial to see if what they are doing is correct and if there is anything more that could be done. The follow-up could take the form of a phone call if another on-site visit was too resource-intensive.
  - A lack of knowing what other specific behaviours could be undertaken during peak time to further reduce usage was a key area noted for additional information.
  - Providing case studies or stories about what other participants are doing was mentioned as a way of extending participants' knowledge.
  - Receiving ongoing performance results was beneficial to boost motivation and also encourage even greater efforts over time.
  - Some frustration does creep in among those not meeting targets as it can be difficult to understand what is contributing to this outcome. This finding links to the suggestion above for a follow-up after the initial assessment.
  - From a behavioural perspective, the interviews unveiled two different segments of participants, one of whom struggled with meeting the targets and eventually barely participated (this was the minority group) and the other segment of participants had used the experience to quite radically and deliberately change their behaviour during peak time and other times. These participants tended to make both structural changes to their houses as well as behavioural changes in terms of appliance use and cooking etc. These participants were somewhat more environmentally conscious but also highly community-minded about the future of Magnetic Island.

A full report of the PDRT trial and exit survey findings was provided in the TQSC 2012 Annual Report

6.2.3 – PDRT key findings

PEAK DEMAND REDUCTION TRIAL (PDRT)	ISSUE	RESPONSE
Participant recruitment	Only a small pool of possible participants so recruitment methods crucial for success	Recruiting customers and explaining the program face-to-face required dedicated resources. Face-to-face recruitment, however, provided an excellent engagement opportunity on the objectives of the wider Solar City project and – importantly - a reminder to maintain efficiencies
	Participation rate	A drop off rate of only 6% was recorded for the trial over the 18 month period
Technology	New business systems and new technology	Technology failure resulted in data integrity issues during the trial. A backup option of manual on site reading of smart meters was deployed which resolved the issue at an additional cost for the project
Behaviour changes	Behaviour Change communications were effective	The majority of participants on the trial were able to lower or shift their energy consumption during peak demand periods (6pm to 9pm)
	Sustained peak demand reduction from behaviour change	Participants were able to reduce their electricity consumption during peak periods and also sustain their energy reductions longer term
	Sustained electricity consumption reduction from behaviour change	The ability to reduce electricity consumption during the peak demand period remained consistent throughout the trial (27% average p/month)
Incentives		Participants were responsive to the incentive payments offered to shift or lower their energy use during peak demand periods
		Small incentives offered by this trial were just as effective as those larger ones offered in the wider solar suburb project
Seasonal weather effects		There was a seasonal difference in energy savings during the trial with reductions ranging from 20% in the cooler months through to 34% in the warmer months (peak demand period)
Added benefits	Peak demand	Targeting peak demand reduction also resulted in total electricity consumption reduction
Exit Survey		Survey results confirmed a positive response to the trial, the delivery of the trial and the financial incentives offered in return for a reduction in energy consumption during peak demand periods

6.3 – Eco-pool pump trial

This small Eco-Pool Pump trial was designed to investigate the impact of replacing standard pool pump motors with variable energy efficient pool pump motors. Both water quality and energy reduction were targeted as part of the trial, to ensure that:-

1) Significant energy and monetary savings can be made by switching to a eco pool pump
2) Water quality remains the same when switching to an eco-pool pump

Three sites were selected for trial and three standard pool pumps were replaced with energy efficient pool pumps.

Energy savings were compared against the existing standard pumps that were replaced.

The results were as indicated below:-

Participant 1 – 79% energy saving

Participant 2 – 65% energy saving

Participant 3 – 69% energy saving

The end results from the trial were extremely pleasing with significant savings achieved by all participants. There were no technical failures during the 12 month trial. Trial participants were extremely happy with the performance and savings achieved by the energy efficient pool pumps.

ECO-POOL PUMPS	ISSUE	RESPONSE
Trial preparation	Water Quality	Ensure that water quality is tested prior to the pump installation to establish a baseline measurement to customer and project satisfaction.
	Participation rate	A drop off rate of only 6% was recorded for the trial over the 18 month period
		Maintain visual checks on pools with eco pumps fitted over the first week's duration to ensure it is working correctly.
	Behaviour Change communications were effective	The majority of participants on the trial were able to lower or shift their energy consumption during peak demand periods (6pm to 9pm)
Pool location	Set rates for pumps may differ according to location	Pools may require eco pumps to work on a higher power setting if the filtration and pumping system is located well below the pool.
	Sustained electricity consumption reduction from behaviour change	The ability to reduce electricity consumption during the peak demand period remained consistent throughout the trial (27% average p/month)
Participant familiarity with new equipment	Pump effectiveness	Detailed training is likely to be required to ensure the participant is aware of the correct operation.
		Small incentives offered by this trial were just as effective as those larger ones offered in the wider solar suburb project
Trial benefits	Customer satisfaction	Participants were very receptive to installing an eco-pool pump once they were aware of its energy and money saving capabilities.

6.4 – Load limiting devices

Other technology trials consisted of demand control through load limiting devices, innovative storage batteries and voltage regulation at customer premises.

Load control for hot water and air conditioning has been trialled at One Bright Point apartments. This was part of the Ergon Energy Airconditioning Program also known as the Demand Response Enabling Devices (DREDs) project. This involved the installation of the DREDs onto 60 hot water units and 40 air conditioning units.

6.4.1 – Air conditioners

Testing ran between 1 February and 30 April 2009 and the same periods in 2010 and 2011. The schedule and regime allowed a growing amount of control (both in duration and level of demand reduction) to assess if there was a threshold past which control was unreasonable. The maximum desired control was a 50% load reduction for six hours with no customer discomfort recorded (manifesting as customer calls to Ergon Energy).

The main finding over the three years of the trial was that customers did not complain at all during the control

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periods, suggesting they did not notice any change in comfort levels. Other findings from the DRED project are:

- despite using an unsophisticated emulated load control methodology (using AS 4755.3.1 non-compliant air conditioning units), air conditioning can be successfully placed under a measure of control within a tropical geographic area without noticeably impacting upon customer comfort levels
- the level of control exercised (up to six hours in some instances) saw a conservative average load curtailment of 0.8 kW per customer on the program for a weekday evening, supporting the results from last year's activity
- participants on the program accepted that control was taken of their air conditioning and they were used as advocates if necessary
- the air conditioning industry and the regulatory bodies are working toward making distributor control of air conditioners an easier proposition (AS4755.3.1 compliance). In 2012, several major brands, including Panasonic and Fujitsu had market ready PeakSmart air conditioners in their range

Ergon Energy's role could then be to make purchasing this type of unit attractive to customers through connection to a control tariff with an incentive such as an appropriate discount.

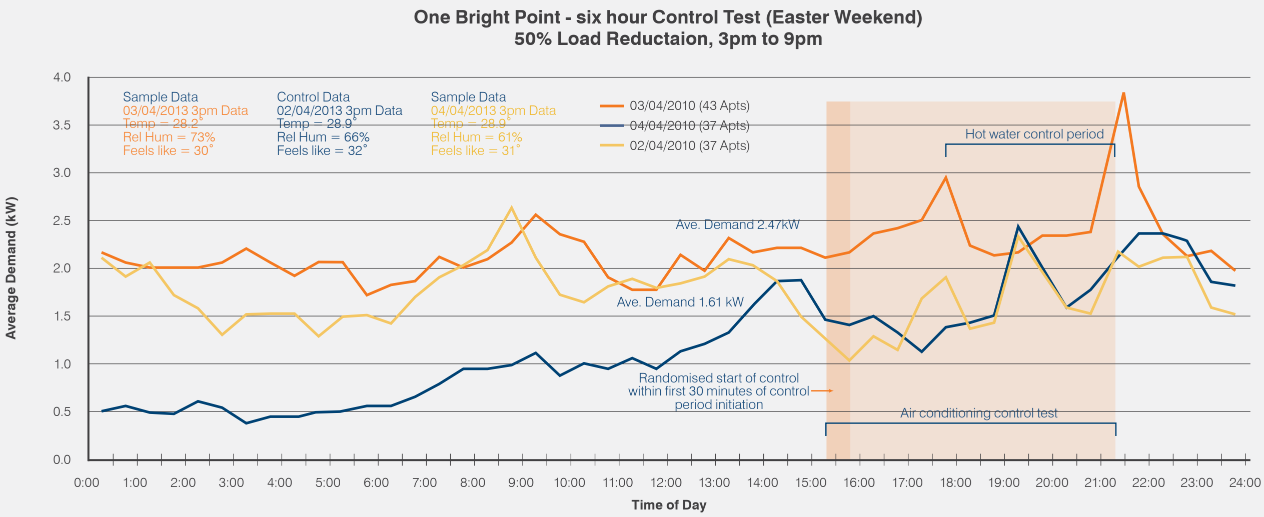


Figure 6.2 – One Bright Point – six hour DREDs control test

Using the data from One Bright Point, the load reduction is 0.8 kW (average weekday, 15.00 – 21.00). This equates to a 32% reduction in overall load profile during these times. This is an excellent result and compares favourably with the previous year's trial.

As well, at One Bright Point 60 hot water services have been on DRED control. This has also resulted in reduced load at peak times.

6.5 – Alternate Off Peak trial

The Alternate Off Peak trial (AOP) trial was designed to test customer take up and administrative issues associated with the take-up of installing Demand Response Enabling Devices (DREDs) as a substitute for Tariff 33 off peak power and provide participants with rebate payments in return for load control. The main focus of this initiative was to place Tariff 33 load control conditions onto Tariff 11 powered pool pumps and hot water systems where there was difficulty in customers acquiring Tariff 33 off peak power, particularly in unit blocks where Tariff 33 was not offered.

Unfortunately, the project did not go ahead on Magnetic Island specifically as the participant take up was deemed too small to gain any statistical data. Thanks to the efforts of the Solar City project, many Island residents had already switched their high energy use appliances such as pool pumps and hot water systems across to off peak tariffs as they took advantage of the incentive rebates offered by the project.

The concept of the project was however, revised and partly transferred across the Townsville mainland and rolled out under Ergon Energy's Energy Sense Community project. The project is currently underway with 200 electric storage hot water systems in unit complexes under load control, including 60 in holiday apartments on Magnetic Island.

To date the outcomes of the trial have been positive, with only one customer withdrawing, and no complaints due to hot water running out. It was found that people with short term rental leases were generally not interested in taking part. The trial is finding the administrative aspects of managing customer turnover to be significant, although these are currently mostly manual.

The trial will increase in number to around 400 units under DRED control, and will continue until 2014 and then, if high value for both the customer and the distributor is demonstrated, alternate off peak control could be incorporated in the appliance tariffs being developed in Queensland.

"… one measure of Solar City success is the increased awareness of sustainable design in the community."

07. HOUSING AND BUILDING TRIALS

07

Keeping cool in the tropics

7.1 – Honeycombes (HPG) medium density residential development

Honeycombes Property Group (HPG) is one of Queensland's most dynamic property development companies with a strong focus on regional growth corridors and in particular, Townsville.

HPG initially became involved with the Townsville Queensland Solar City project by proposing to incorporate Environmental Sustainable Design (ESD) measures in the first stage of the Riverway Apartments known as Itara – a Medium Density Residential Development.

Itara at Riverway was completed in December 2008. It contains 52 one, two and three bedroom apartments, situated on the banks of the Ross River. This development was HPG's first, under the Solar City banner, to earn industry accolades when it was awarded for Excellence in Sustainable Development by the UDIA (QLD).

Itara contains three separate four storey buildings located over basement car parking. The more obvious ESD measures throughout the development are central gas hot water plant, DRED ready A/C, WELS 5 star rated tap ware and energy efficient lighting. In addition to these measures the development features comfortone glazing for more efficient cooling, cross flow ventilation, northern orientation, additional façade treatments ($1M over and above industry standards) and a green roof over the basement.

Due to a change in the market for apartments in Townsville, Honeycombes moved their further Solar City work to the inner-city Central development.

Central 2 - Holborn Apartments is the second residential stage of the master planned CBD development and was completed in February 2011. It features 78 one, two and three bedroom apartments constructed over 1,400sqm of ground floor retail space and basement. The development is contained in a four storey and a nine storey tower on the banks of the Ross Creek.

During the Islington sales campaign (Stage 1 of Central), the focus of the market shifted and was driven more heavily by investors seeking affordable properties with a distinct price point in mind. Holborn was developed specifically to meet this need and the integration of the same ESD principles as those incorporated in to Itara were integral in delivering a cost effective product for the owners seeking strong net returns on their investment.

In meeting the objectives of the Solar City partnership, HPG again incorporated a central gas hot water plant, DRED ready A/C, WELS 5 star rated tap ware and energy efficient lighting. Tinted glazing was installed throughout the retail tenancies and the same principles of cross flow ventilation and northern orientation were again a prominent design feature.

The installation of Smart Meters has also allowed the consumption patterns of the Holborn residents to be added to the national Solar Cities database.

This range of measures incorporated into the building thermal envelope resulted in an average AccuRate rating of 7.7 stars for Holborn.

Central 3 - Kensington Apartments is the third stage of Central, which was completed in September 2012. This stage contains 44 one and two bed apartments in a ten storey tower. In continuing with the theme of market affordably and sustainability, Kensington was priced relative to Holborn, whilst acknowledging a slightly reduced level of amenity and recreation space. This reduction in scope is also in recognition of an ever changing market, where operational costs have a significant bearing on the buyers and their notion of what represents good buying.

As part of HPG's ongoing analysis of the ESD initiatives, the hot water alternatives underwent substantial review. Itara and Holborn both utilised a central gas system as the most cost effective design, albeit still above the "business as usual" measures of other Townsville Projects. It was decided with Kensington that although a central heat pump system was a more expensive option, it provided a significant cost saving to the end users.

Other initiatives implemented throughout the project in accordance with the agreed objectives included DRED Ready A/C, Energy Efficient Lighting, WELS 5 Star Rated Tap ware. These ESD features were a commercial success, with the Kensington apartments 100% sold by February 2012 – seven months prior to completion.

07

Honeycombes has also achieved the following key milestones -

- Hosted the IBM workshop at the Holborn Apartment's ground floor which was attended by 200 participants
- A joint workshop was conducted with Citysolar and our contractors with the aim of embedding the ESD measures on our partners. This was considered a success as all parties were able to share their understanding and experiences and map a way forward for ESD measures.
- Hosting consortium meetings and tours of the Holborn Apartments and Kensington Apartments to show case the ESD measures and features installed and lessons learned and

The lessons learned by HPG during the project are -

- the residential market apparently recognises the benefits of ESD initiatives in new projects and the potential savings in operational costs that these provide
- unfortunately, local buyers still don't appear willing to pay any extra for these benefits.

7.2 – Cafalo Pty Ltd – Green[t] high rise CBD office building

Cafalo has been an active consortium member since before the Solar City project officially commenced. Director Bill Spee considers Cafalo's involvement in the Solar Cities program to be inspirational in connecting the firm to leaders in the field of sustainable design and has helped to develop skills necessary to communicate green design with architects who work on Cafalo projects.

Cafalo was tasked with investigating, and if possible construct, an exemplary CBD commercial building suitable for the dry tropical climate of northern Australia. They found that there were a number of significant challenges to achieving this, and ended up exploring five distinct options for the site via extensive consultation and community workshops.

The community favourite out of this became known as the 'Green[t]' building. A number of design variations of 'Green[t]' were tendered for various proposals, but to this date, none have been accepted for construction. Cafalo is continually evolving the design and are hopeful that it will be built in the medium term.

A report exploring Sustainable Design and Energy Efficiency as it applies to a central business district high rise office buildings was produced and submitted in 2010.

Cafalo is also active is sharing the lessons learned from the design of sustainability buildings and sustainable projects. These can be accessed from http://cafalo.com/

One measure of the success of the Solar City project is the increased awareness of sustainable design in the community. As Bill Spee says "at the start of 2006, I think it would be fair to say that 'green' design and development did not figure highly in Townsville. Today it is a totally different story, and we believe that Townsville's Solar City consortium had a very big impact in raising awareness in the local construction industry of the need to 'build sustainably'."

Their principal finding from Cafalo's part of the project was that – done from inception – cost should not be a barrier to sustainable building design.

7.3 – Lend Lease – Rocky Springs master planned housing development

Lend Lease (Delfin) commenced their association with the Solar City project with plans to develop a sustainable fully integrated master planned community at Rocky Springs (Serene Valley) 15 km south of Townsville CBD. The site itself is 1609ha and can provide for approximately 38,000 people on completion, with a development timeframe in excess of 35 years. It is intended to include a town centre, four neighbourhood centres, commercial and industrial land, up to 12 schools and a range of housing options. District level open space of over 200 ha of bushland reserves are also planned as part of the community.

In addition, Lend Lease intended to work in conjunction with a selection of local architects, builders, energy efficiency consultants, Townsville City Council and the Centre for Excellence in Tropical Design to develop a compendium of "Low Energy" Tropical Design Features that will represent current best practice. Marketing support was also planned to develop awareness and identify via Community Based Social Marketing methods what factors influence attitudes and behaviours. These include the barriers and benefits to changing behaviour to ensure that appropriate energy conservation, production and demand side management benefits are understood.

The development has not progressed as anticipated due to unexpected issues arising out of the approval process across all three levels of government.

A number of alternative initiatives were explored when it was identified that it would be difficult to deliver the original initiatives within the timeframes of the Solar

“For overall project success, it was imperative the community had education and information on new technologies, renewable energy, energy efficiency and importantly the motivation to act in order to achieve the project objectives.”

City program. These initiatives included a Solar Pergola demonstration project (focused on education and awareness) and a solar farm (up to 2MW). Townsville City Council was able to take over the plans and deliver the Solar Pergola demonstration project on top of Castle Hill, however partners for the solar farm were not able to be finalised so the project did not proceed.

Lend Lease have been an active and supportive consortium member as well as successfully trialling energy efficiency guidelines leading to a comprehensive covenant on sustainable building design for all houses on the Rocky Springs Development.

7.4 – Chester Holdings - greening Federation Place

Retrofitting Federation Place in Townsville for a Sustainable Future

Chester Holdings officially joined the Townsville Queensland Solar City with its project of greening Federation Place in July 2011. The key objective is to retrofit a Federation era building with sustainable measures that make it an attractive modern office environment.

Federation Place is a prominent and extremely rare heritage listed building located in the Townsville CBD. The 128 year old building constructed in 1885 exemplifies the style of commercial development of the late Victorian era. The building has over the years served northern Australia as a warehouse receiving goods direct from Britain in the late 1800's; in times of war as the war room for the Australian defence forces and later as the Commonwealth Government offices. It is now professional offices, a place of business and is itself a business. The late Victorian classical style facade makes a substantial contribution to the townscape of the city. Internally the majestic wooden staircase and spacious common area serve as a gallery for a significant local art collection. The building by day is accessible to visitors and from time to time hosts soirées and balls.

The greening of Federation Place was flagged as a unique demonstration of how heritage or older style buildings can evolve into sustainable buildings in the northern dry tropics, which in turn could become a benchmark for other heritage buildings located in tropical regions around the world. Including the Australian Government's Solar Cities funding, the total project value is more than half a million dollars.

The owner's visions for the project were:

- A high NABERS rating
- The greening of Federation Place targeted three principal sustainable initiatives:-
  - Energy efficiency: reduction of heat intrusion , a high level of efficiency of mechanical devices and better management of cool air;
  - Alternative energy sourcing: district cooling and solar power;
  - Interactive community program: Occupants and visitors would see how the project reduced the buildings impact on the environment and at the same time improved the environment within the building. This would be done via an interpretive centre located in the buildings foyer enabling the story to be presented to the wider community

The design work commenced in September 2011 which was initiated by a workshop involving GHD, Ergon Energy and the building owners. The outcome of the workshop was a road map with the following initiatives targeted:

- water chilling system air condition
- photovoltaic (PV) solar generation system
- painting the following white
- roof
- external brick wall
- energy efficient lighting and natural ventilation of the common area; and
- information feedback through the establishment of an interpretive centre.

Energy saving projections for the partnership project were made in three key areas –

- Install a chilled water plant and save 42.5% on energy costs
- Install a rooftop photovoltaic system for a saving of around 10%
- Paint the roof and western wall white – a saving of 6.1%

Chilled Water Air Conditioning connectable to a CBD District Cooling system

At the date of this report, a 62 kW air conditioning water chiller system has been installed which will significantly reduce the electricity demand and usage in the building. It is estimated that the system has a 15-20% efficiency gain on site and increasing to greater than 40% off site. An added benefit is that the system is connectable to a future district wide water chilling system.

Roof mounted 17kW solar PV system

A 17 kW PV system has also been installed. This system will contribute an estimated 27000 kWh in a year. At the current commercial tariff, the system will have a payback period of less than ten years without the state government's feed-in-tariff.

Paint the roof and wall white

Approximately 1230 square meters of roof space and western wall was painted with reflective cool white paint resulting in significant reduction to the temperature in the building. It is estimated that 16000 kWh of electricity will be saved in a year resulting in a payback period of less than three years.

Energy efficient lighting systems and ventilated common area

Energy efficient lighting systems were installed which are suited to an office environment. The common area has also been ventilated and overhead transom door closers installed to keep the heat from the roadway out and contain the cold air from the water chilling air conditioning unit from escaping the building.

Interpretive Centre

An Interpretive Centre has been established in the foyer of the building and project and building performance information is available to the tenants as well as the general public. Information is initially based on the Building Management System which directly monitors the performance of air conditioning, power consumption and production. As well, a large wall plaque displays a history of the building, as well as the partnership with the Solar City project. It is an evolving story and the Interpretive Centre concept is to be transformed, becoming web-based, open and accessible to anyone who is interested, as well as located in the foyer.

Through networking opportunities provided by the project consortium members, Chester Holdings also engaged ScienceMob and their PhD students from James Cook University to enable the whole concept to become cloud based. This was achieved by installing ScienceMob's low cost measurement devices throughout the building and merging them with the building management system and interpretive centre.

Federation Place reduced its energy footprint.

The measure of efficiency for the building is any change in the energy imported, ie the amount of electricity drawn from the network. The bills for electricity consumption in 2011-12 and 2012-13 were compared.

The building imported 26,000 kWh less power from the grid over the four months of summer 2012-13 than the previous year. This 25% reduction shows that the greening of Federation Place initiatives have succeeded in making the building more sustainable.

Federation Place Electricity Comsumption

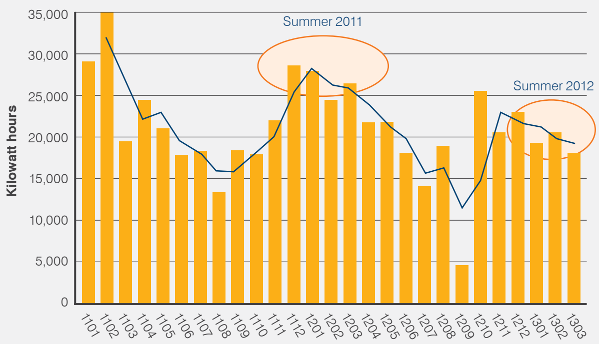


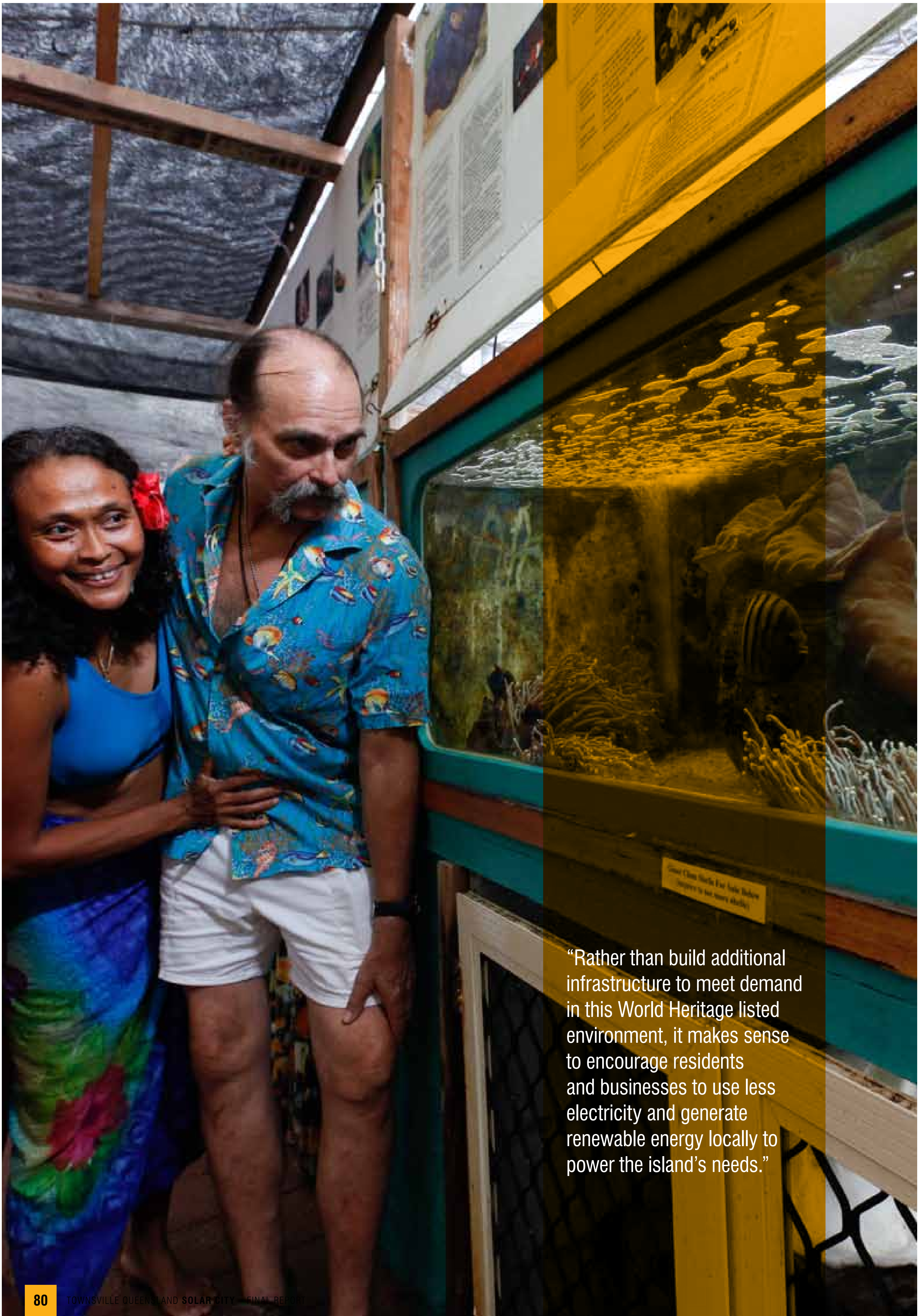
Figure 7.9.1 – Federation Place electricity consumption

What can we learn from the greening project?

The lessons learnt from the project in greening and retrofitting an historic building include -

- considerable expense is required in establishing the basis from which to build a green building;
- significant carbon abatement can be achieved;
- long-term and direct short term benefits can be achieved through the fitting new technologies
- new technologies leads to other opportunities such as the future Townsville CBD district Cooling
- Open data architecture is achievable for sharing of information

The inclusion of Chester Holdings was exciting for the project. The rate of progress is encouraging with all new technologies installed in the first 12 months of joining the consortium. Greening Federation Place provides an excellent opportunity to showcase energy efficiency in an Heritage listed office building as part of the Townsville Queensland Solar City project.



“Rather than build additional infrastructure to meet demand in this World Heritage listed environment, it makes sense to encourage residents and businesses to use less electricity and generate renewable energy locally to power the island’s needs.”

08. MAGNETIC ISLAND COMMUNITY ENGAGEMENT

08

It underpins all our project activities.

For overall project success, it was imperative that the community had the education and information on new technologies, renewable energy, energy efficiency and – importantly - the motivation to act in order to achieve the project objectives.

This section of the report discusses the community engagement case studies and results. To understand the results, the methodology used at Magnetic Island and the behaviour change impacts since inception of the project is discussed first.

8.1 – Maggie – a small island making a big difference

The iconic Townsville Queensland Solar City project has captured public imagination, enlisted local support and changed customer behaviour across the entire Magnetic Island community. Rather than build additional infrastructure to meet demand in this World Heritage Listed environment, it makes sense to encourage residents and businesses to use less electricity and generate renewable energy locally to power the island's needs.

To effectively engage the community, the project team worked with leading-edge communication specialists Dr Doug McKenzie Mohr (community based social marketing - CBSM) and Professor Sam Ham (thematic communication) to refine the approach to communicating for sustainable behavioural change. Local research into beliefs, behaviours and areas of compliance and non-compliance guided key project messages.

Significant effort was expended early in the project to ensure that all communication was consistent with the project aims of reducing overall energy consumption by 25%, reduce peak demand by 27% and lowering greenhouse gas emissions by 50,000 tonnes over its seven year life.

After five years, the project has engaged 82% of the community via voluntary energy assessments, reduced electricity consumption by 29% below the target in the DBC, achieved reduced GHG emissions by more than the targeted amount, has generated over four Gigawatt hours of electricity from hosted PV systems (enough to power a 1200 student school for four years) and deferred network augmentation by more than eight years.

To achieve this, Ergon Energy led a consortium of willing partners in a bid that was heavily focused on community engagement and influencing the way people behave in relation to sustainable living.

The Magnetic Island Solar Suburb project has also assisted the long term goal of establishing Townsville as a model sustainable city both nationally and internationally.

8.2 – Community engagement support for project objectives

Initially, there were three priorities for community engagement:

- to raise awareness in the community about the project,
- to enrol participants and
- to implement effective strategies to support the overall project goals of reducing energy consumption by 25%, reducing peak demand by 27% and lowering greenhouse gas emissions by 50,000 over the seven year project span.

The project team used a multi-faceted approach to improving energy efficiency on Magnetic Island which included adoption of new technologies, energy efficiency and demand management supported by energy assessments, and underpinned by community engagement to create a Solar Suburb.

To foster long term behaviour change by voluntary participants, we needed buy-in from customers and the backing of the community, and good engagement along with consistent and relevant communications.

8.3 – The Townsville Queensland Solar City difference

Focus groups conducted on the island in 2006 identified a community that was suited to the trial in many ways. From a community perspective, Magnetic Islanders regularly polled 'greenest' of all the Townsville electorates and the focus groups showed they were keen to participate. For an electricity utility facing significant and costly network augmentation by adding a third undersea cable to meet forecast peak demand, the island made an ideal, and easily monitored, test case.

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Feedback from these early groups informed the 2007 Energy Use survey, sent via direct mail to all island residents and businesses. The ninety minute survey was developed in accordance with community based social marketing (CBSM) principles and designed to elicit information about appliances, their use, ownership of the premise, specific demographic data and the respondents perceived barriers and benefits to energy efficiency.

The survey also provided an avenue for enrolling participants in the project, and with an unheard of return rate of 40% (usual response rates for direct mail-outs are around 12%), the team found themselves with over 500 Islanders keen to participate.

Analysis of the survey data gave the team clear indication of where to focus their activities and six key energy efficient behaviours were identified to support the project aims while being in line with the survey information. These six were identified from a long list of energy efficient behaviours by using the CBSM impact and probability matrix to produce a list that contained a range of once only, high impact, low probability behaviours (paint your roof white, switch to gas appliances, install an energy efficient hot water system) as well as some that were repetitive, low impact and high probability (switch lights off when not in use, turn appliances off at the wall and have shorter showers). There is no fresh water source on the Island so the team included water conservation behaviours and supporting collateral.

PROJECT OBJECTIVE	ENERGY EFFICIENT BEHAVIOUR*	SUPPORTING COLLATERAL*
Reduce peak demand by 27%	Purchase and use of high star rated appliances Paint roof white Switch to gas for cooking Keep Aircon at 25 degrees	Voucher program Voucher program Voucher program Visual prompt – sticker on remote control
Reduce overall energy consumption by 25%	Have shorter showers Turn off appliances at the wall Switch lights off when not in use Switch to gas for cooking Upgrade to high energy star rated appliances	Shower timers Info booklet –standby power Prompt - Light Danglers Voucher program Voucher program
Cut greenhouse gas emissions by 50,000 tonnes over seven years	Switch to gas for cooking Turn lights off when not in use Paint your roof white Upgrade to high energy star rated appliances	Info booklet – savings with gas Prompt - Light Danglers Voucher program Info booklet

Table 8.1 – Project objectives and behaviour change matrix

** Behaviours and collateral will ideally support more than one project objective*

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8.4 – Community Based Social Marketing (CBSM)

Most initiatives aimed at fostering sustainable behaviour rely upon mass communications or information campaigns, primarily utilising education and/or advertising to encourage behavioural change. Doug McKenzie Mohr, founder of CBSM, notes that this alone rarely leads to sustainable behavioural change and that initiatives delivered at a 'community level' utilising specific 'tools' of behaviour change are the primary drivers in community based social marketing programs.

CBSM draws on social science and especially psychological research to develop a variety of tools for promoting behavioural change. The effectiveness of these tools is often enhanced by using a number of them simultaneously.

The CBSM tool-kit includes the following:

- A written, public commitment, preferably sought in groups and freely given where people commit to change to a desired behaviour.
- Judicious use of prompts, directly addressing forgetfulness' and reminding people to perform particular activities. When using prompts, it is important to make them noticeable, self-explanatory, located at the point of action and prompting positive actions.
- Creating community norms, which serve as long-term guides to behaviour, which should be visible to generate awareness and reinforced via personal contact.
- Communications programs should be relevant to the audience, credible, easy to remember, positive, contain goals and information on how to achieve them and be delivered via personal contact, with provision for feedback.
- Incentives have been shown to have a substantial impact on a variety of sustainable behaviours including energy efficiency. They are especially useful when motivation to engage in a particular action is low or people are not engaged as effectively as they could be. Incentives used in a CBSM program should closely pair the incentive and the behaviour, reward positive behaviour, be visible, appropriately sized and carefully withdrawn. Non-monetary incentives can be just as effectives and small incentives work just as well as larger ones in most cases.

The tools described above are strongly focused on addressing internal barriers to behaviour change. However, it is recognised that such strategies' impact will be limited or constrained by significant external barriers. For CBSM programs, it is important that such external barriers are identified and strategies developed to ameliorate them. In doing so, McKenzie-Mohr points out that it is important to "assess whether you have the resources to overcome the external barriers you identify. If you do not, carefully consider whether you wish to implement a program."

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Identifying barriers is an essential first step in designing a successful program. CBSM programs must be able to sort through the competing theories and discover the actual barriers that inhibit individuals from engaging in the activity they wish to promote.

Uncovering barriers involves three steps – a review of relevant articles and reports, conducting focus groups to explore in-depth attitudes and behaviours of community residents and then building on the information obtained from the focus groups, a phone survey is then conducted with a random sample of residents. Then you can consider what behaviour influencing tools you can use to overcome these barriers.

8.5 – Thematic Communication

Thematic Communication is a tool that can help you get your message across and inspire change in your audience. Ergon Energy's Solar City project has been using Thematic Communication as part of its innovative community engagement strategy over the five year life of the project. It has assisted the Magnetic Island project to inspire and provoke their audience towards acting on key messages in terms of energy use.

Successful communication has four qualities – it is thematic, organised, relevant and entertaining – the four components of Professor Sam Ham's TORE model. This model is based on two centuries of research, and when all four qualities are in place, successful communication is guaranteed. Success, in this case, means that audiences pay attention and are provoked to think about the point (theme). Themes can provoke people to think, even if they forget isolated facts.

By communicating strong themes, you're planting seeds – or beliefs – that can ultimately influence how people think, feel and behave with respect to the things you are communicating about. While Thematic Communication is simply an approach to communicating, it is aimed at provoking people to have their own thoughts, not just 'teaching' them the facts. At its best, thematic communication has a strong theme that is delivered in an organised, relevant and entertaining way.

8.6 – Energy Behaviour Change Model (EBCM)

The project combined both Community Based Social Marketing (CBSM) and Thematic Communication to develop a model for sustainable behaviour change. More details of the model the project developed – the Energy Behaviour Change Model, or EBCM – can be found earlier in this report on pages 39-41.

8.7 – Putting the 'smarts' in Lifestyle Centres

While preparing for the first assessment in February 2008, the team made a strategic decision to base themselves in a shopfront in busy Nelly Bay. This shopfront was directly located on a major route to the island ferry terminal so attracted a lot of passing traffic and made it very easy for people to register for their free energy assessment and begin participating in the project. This strategy paid dividends by reinforcing the project presence and contributing to a surge in energy assessment registrations.

As well, two key community facing project positions were filled with well qualified locals, which contributed to a feeling of ease with the project by the Islanders. A house was rented for the community engagement manager, giving the team another base, and enabling a deeper level of engagement rather than simply commuting from Townsville each day, and allowing the CEM to attend after hours community meetings, develop relationships and build project champions.

The team occupied the Nelly Bay shopfront until it was time to move into the – as one paper called it – 'spiffingly re-vamped' Smart Lifestyle Centre, opened in September 2008 by then Environment, Water, Heritage and the Arts Minister Peter Garrett.

The Smart Lifestyle Centre showcased information and products available to enable households, communities and businesses to reduce their everyday environmental impacts. The centre was open to visitors for demonstrations, gathering information, discovering new products, comparing what's in the market and making informed decisions. The 'recycling' of the building meant significant resources were saved by refurbishing rather than rebuilding.

The Smart Lifestyle Centre also acted as a team base and project office, and provided an easily accessible community location for those interested in energy and renewable advice, or to register for a free energy assessment. The centre boasted new technologies such as the battery storage, solar PV, smart meters, alternative refrigeration solutions, LED lights, interactive displays and educational materials that targeted a range of audiences in a fun and effective way.

The centre regularly played hosts to school and public events. Additionally, the facility was visited by key representatives of all levels of government, international delegations and businesses wanting to learn more about best-practice sustainability initiatives.

8.8 – A combination of approaches and channels to enrol participants

A number of avenues were used to enrol participants into the Solar City program, with the initial approach being registrations via the 2007 energy use survey. This was closely followed by the establishment of the shopfront, allowing those passing by to easily register, and then strategies were developed to drive registrations at the Smart Lifestyle Centre which also proved successful.

Word of mouth played a part as the energy assessments became popular. The energy saving advice, giveaways and targeted energy efficiency information proved a good drawcard. The project also focussed their efforts on the community and leveraged existing community events, such as markets or acted as a venue for community fundraisers to attract enrolments and raise awareness.

Team members gave up their own time to stand at the ferry during the high traffic commuter periods once the flow of registration slowed, and the incentive voucher program that was only available to participants also boosted the numbers. While the voucher program design and delivery were managed by community engagement, the effects were felt in demand management and are a clear demonstration of effective engagement strategies enhancing both overall and peak demand reductions.

Not all voucher programs ran well for the project. A smaller initiative designed to specifically promote outdoor activities over the peak summer holiday period and the 20+10 voucher rebate program did not enjoy good success. The summer voucher delivery method was complicated, and the terms and conditions for the 20+10 were – by necessity – convoluted and confusing to the community.

The team tried many different delivery methods, including door-knocking holiday let properties and in the case of the 20+10 program writing letters to eligible participants, however the program terms and conditions proved too much for many and elicited a poor response. Having said that, there was a core group of participants in the 20+10 program who managed to continually reduce their energy consumption and reap the rewards.

The establishment and launch of the Smart Lifestyle Centre required the Solar City engagement team to develop communications collateral that would complement the key messages of the project and effectively engage the audience.

From the beginning of the project, the team has used themes in all communication channels, backed up with CBSM tools and techniques and bound together with robust community engagement strategies.

As well, bright, bold and colourful elements were designed around the simple key messages of energy, sustainability, water and conservation. The elements incorporated icons to reinforce messages and allow for flexibility when creating communications material, which were also used to reinforce the thematic communication principles and community based social marketing.

08

Once a community presence is established, it's essential for successful engagement programs to continue to develop as well as be visible and active in that community. The best engagement methods are responsive to community needs, so following feedback from the community on the lack of information on energy efficient products, a Trade Expo was held at the Smart Lifestyle Centre. This proved very successful with 24 businesses from the island and Townsville displaying their products. Feedback from exhibitors and the community proved this exercise was worthwhile, and the addition of celebrity handyman and builder Scott Cam as MC was appreciated by both school students (a special assembly was held and energy efficient products distributed) and by the wider community at the Expo itself.

8.9 – Strategic partnerships

The Magnetic Island team has a proud and strong supporter of the community in which it operates. Partnerships with key community organisations and sponsorship of community events provided the Solar City team with an opportunity to engage face-to-face with the community to convey the sustainability message.

In addition to supporting the many school and community visits to the Smart Lifestyle Centre, hosting workshops and tours, visiting households and businesses, the Solar City team sponsored and attended many community events. The targeted sponsorship program allowed Solar City to raise awareness of its aims and objectives.

Supporting the Magnetic Island community through sponsorships has helped the project conduct over 1400 residential and commercial assessments. The on-the-ground opportunities to engage with the public and provide communications material face-to-face has played an important part in the success of the Solar City project.

Strategic annual partnerships, awarded in line with Ergon Energy's rigorous sponsorship guidelines, have been with the following organisations, each targeting a specific demographic or audience.

- Magnetic Island Bowls Club – the Annual Magic Magnetic Weekend of Bowls
- Magnetic Island Community Development Association – information website development, Bay Days Festival, community development stage 2 plan partnership with MICDA and Peter Kenyon of the Bank of I.D.E.A.S.
- Tropical Talent Junior Artists – three annual exhibitions and community celebrations
- Magnetic Island Country Club – Annual Golf Championships
- Magnetic Island Nature Carers Association – two annual Short Film Festivals with carbon reduction and energy efficiency themes
- MI Magpies – Junior AFL football club – major sponsor of only land based junior sporting club on Magnetic Island

8.10 – One Bright Point.... the brief

The One Bright Point energy reduction project required the development of a comprehensive suite of communication collateral that would effectively target sustainable behaviour of guests. Utilising a mix of Thematic Communication, Community Based Social Marketing and by working closely with the supportive One Bright Point management, the project has the simple aim of keeping Maggie beautiful!

The team researched and carefully considered the behaviour of visitors to Magnetic Island and specifically One Bright Point, and found that guests sometimes turn on the air-conditioning and leave doors and windows open and run the clothes dryer and dishwasher during peak hours. Thematic collateral was developed that targets these behaviours by establishing a theme and continually reinforcing our key messages via this theme to conserve energy, especially during the all-important peak demand period.

The 'I helped Keep Maggie Beautiful' theme was rolled out in collateral including bumper stickers, postcards, light danglers, children's activity sheets and incorporated prompts and tools such as messaged dish liquid and laundry powder. Each piece of communication material was carefully designed to gain buy-in from the audience. The thematic communication efforts, in addition to energy assessments, smart metering and technology interventions resulted in significant energy reductions for the One Bright Point facility as well as the owners of holiday let units.

Importantly, we generated baseline data to be used in conjunction with programs put in place by the Solar City project team such as resetting hot water system temperatures and turning off stand-by power when units are not in use. This data clearly shows that combining a behavioural approach with technology gives better results than either used alone.

The first of its kind, the One Bright Point project was a great success, and at the request of other accommodation providers, has been rolled out across Magnetic Island.

8.11 – Solar Skate Park engagement campaign

In 2009, the Townsville Queensland Solar City project embarked on an ambitious and challenging initiative – a 100 kilowatt solar park to generate renewable energy for the Magnetic Island community. The solar park made a significant contribution toward an overall project goal to provide a megawatt of renewable power generation and reduce greenhouse gas emissions by 50,000 tonnes by 2013.

In keeping with the project's commitment to the principles of public participation, it was a natural decision to involve the community in plans to build the solar park to ensure it was a legacy both the project team and the community could be proud of.

The initial announcement, to install 100 kilowatts of solar PV panels at a pre-selected location with what looked to the community like a pre-determined ground mounted structure and shade for car-parking, was met with a surprising degree of resistance. It raised a number of issues which required a very sincere engagement campaign and a partnership with the community to work for a locally appropriate and supported outcome.

Following community feedback of "shade people not cars" the project adopted a more collaborative and empowering approach. At the third community forum, attendees elected a community reference group that worked with a talented and collaborative architect to produce a design that was both acceptable to all parties and surpassed project, technical and community requirements.

The Solar Skate Park was completed in 2011, and the end result is much more than just a large solar generation unit due to a committed team and the wholehearted support of the Magnetic Island community.

The Magnetic Island Solar Skate Park is now an exciting blend of publicly designed multi-use recreational facilities, a permanent public art exhibition illustrating important Magnetic Island values, a showcase of innovative renewable energy technologies incorporating thematic signage to support the sustainability message and a proud legacy demonstration place for the Townsville Queensland Solar City project.

8.12 – The 2010 Energy Use survey

In late 2010, the Townsville Queensland Solar City Project commissioned independent consultants d-sipher to conduct an evaluation study of the impact of the Solar City project on Magnetic Island amongst residents and businesses.

A robust survey method was utilised and the overall return rate of 26% for both residents and businesses, while lower than the 2007 Energy Use survey response rate of 39% is still an excellent rate of response for a direct mail survey. The response rate received for residents (27%) gives a good level of confidence in their data, while that for business (19%) still gives a reasonable degree of confidence in the results.

The study focussed on four main areas – community engagement effectiveness, the impact on behaviour change, the impact of the free energy assessment and hosting a solar city PV system with very positive results.

8.12.1 – Community engagement effectiveness

- The project has effectively engaged with the residential community with over 95% of respondents saying they would recommend participating to their friends
- There is a high overall awareness and familiarity with the project
- Residents have a high level of awareness around reducing energy use
- Business awareness is lower
- Over 90% of residents who attended the Trade Expo said it was a good way to access suppliers and gain information on energy efficient and renewable energy goods
- 70% of residents visited the Smart Lifestyle Centre, with over 80% happy with its purpose and their visit

Importantly, in 2010 56% of residents said they made changes 'for the good of the community', a reason not mentioned at all in the 2007 survey a key message used by the project to build community norms. This is one of the key messages used by the project to build community norms.

8.12.2 – Impact of behaviour change

Sixty three per cent of those who responded said it was the professional advice and assistance during the Solar City energy assessment that most influenced them to reduce and change the way they use electricity, while 56% felt that it was being part of a community that is doing something to reduce electricity use – a key project strategy implemented via community based social marketing thus heartening to receive this result.

While some residents feel that everything that can be done to reduce electricity use has been done, it was strongly felt the energy assessment – with specific reference to the professional advice and assistance from Solar City assessors – along with government rebates

"...in 2010 56% of residents said they made changes 'for the good of the community', a reason not mentioned at all in the 2007 survey, and a key message used by the project to build community norms."

were two of the keys to leverage positive change in residents and businesses energy use behaviours

Sixty four per cent of business respondents said the increased cost of electricity was the catalyst in their behavioural change while 61% did it for environmental reasons.

8.12.3 – Impact of the energy assessment

Both residents and businesses reported a high level of satisfaction with the energy assessments with more than 70% of residents implementing most of the recommendations provided by assessors.

Eighty four per cent of residents who had an IHD believed their In House Display Unit (IHD) helped them to monitor more carefully how much electricity they were using and 82% agreed that the vouchers provided as a result of the assessment provided them with the opportunity to make energy efficient changes to their house.

8.12.4 – Solar City PV systems and hosting model

- 82% of residents agreed or strongly agreed they were satisfied with their decision to host a PV system
- For those not hosting the most common barriers were no perceived financial benefit to the host, the roof is too shady (these people were interested in hosting), a need for more information, the dwelling / premise is rented

In summary, significant behaviour change can be achieved by getting firm commitment from participants. By using an integrated approach such as community based social marketing coupled with good thematic communication in the Energy Behaviour Change Framework, and sound principles of engagement and planning, the change can be locked in and significant savings made by all involved.

8.13 – University of Queensland peer review

Project progress has been regularly reviewed at a series of learning summits involving the whole team. During the review at a learning summit in November 2010, the team viewed and incorporated into future planning the salient points from the University of Queensland peer review of the Townsville Queensland Solar City project. This independent review was carried out in partnership with Ergon Energy's Innovation Manager with the following objectives:

- Review the progress of the Solar City project and present findings on successes and challenges
- How did the project evolve into an integrated set of operations?
- Outline some key aspects of innovation, technology management and community engagement
- The end result of the review should not be a technical report.

Dr John Steen and Dr Tim Kastelle, Technology and Innovation Management Centre, UQ Business School, University of Queensland reviewed the Solar City Project, and identified the following:

- The Townsville Queensland Solar City business model can be categorized as a 'customer solutions' business, underpinned by the co-creation of value between Ergon Energy and the customer. A customer solutions business model features four dimensions - communication, partnership, customer service and information management
- These reinforce each other to create value for the customer through the provision of a package of services. The value that is created is both tangible, in the form of reduced power bills and intangible through the sense of environmental sustainability.
- The TQSC project involved the consumer interacting as a 'business partner' with Ergon Energy through a common objective of managing demand and not the traditional customer relationship found in the electricity industry, where the focus is on centralised power generation and distribution. This new type of relationship goes beyond the goal of being 'customer driven'- an objective identified in the strategic plan.
- The TQSC model is adaptable to other instances where power consumption in regional communities will require the costly upgrade of transmission infrastructure. In the longer term, this may become the dominant business model for Ergon Energy.

TQSC demonstrates a different type of customer relationship that is closely related to a partnering model. By communicating with consumers through energy assessments and other educational initiatives, at the time of review (2010) Ergon Energy has been able to execute 212 PV hosting agreements. What is remarkable about this is that there is no direct financial incentive for the consumer to do this. The value that is being created for the consumer in this instance is a contribution to increase the production of renewable energy. For Ergon Energy, the hosting of the panels allows for the local production of power around the middle of the day.

The research described four dimensions; communication, partnership, customer service and information management as features of a customer solutions business model. They reinforce each other to create value for the customer through the provision of a package of services. The value that is created is both tangible, in the form of reduced power bills and intangible through the sense of environmental sustainability.

The research also created a generic 'energy solutions' strategy map that could be further developed for a business division that would be focussed on regional projects like TQSC.

Is the Magnetic Island 'Solution' replicable? Probably not in its exact form as the demand profile may be different in other communities and the CBSM messages need to be different. However, the approach used by the Solar City Project is replicable i.e. engaging the community, examining the challenges and putting together a package of integrated services that is a win-win for all stakeholders.

Learnings from this project have been incorporated in community engagement planning for a number of other Ergon Energy projects, including *powersavvy*, the Smart Grid, Smart City bid, and the project that has arisen from the good work done for that ultimately unsuccessful bid, Townsville – an Energy Sense Community (ESC). ESC is a program of works planned for Townsville that leverages a number of initiatives and manages them in a synergistic manner for ultimate benefits to both the customer and the company. It has a significant engagement element and has benefited from the Solar City learnings which were transferred during the planning process.

8.14 – Peer and industry recognition

The Townsville Queensland Solar City project has been recognised with a minimum of a State and a National award for each of the five years it has operated on Magnetic Island. While these have often been awarded for project community engagement, they reflect the commitment, team work and talent of the entire project team. Community engagement underpins each of the project and responsibilities and is inherent in all areas and thus unable to be separated. The project depends on it for success, and it is a big part of the way all team members operate.

For completion, following is the list of awards won by Ergon Energy Solar City team from 2008 – 2012 – a credit to the entire project team.

2012	
WINNER – Public Relations Institute of Australia – National Golden Target Award, Environmental Category	
WINNER – Public Relations Institute of Australia (Qld) Queensland State Award for Excellence, Environmental Category	
National Finalist – Banksia Awards, Education Award - Raising the Bar	
National Finalist – Clean Energy Council Industry Awards, the Business Community Engagement Award	
2011	
WINNER – International Association for Public Participation Project of the Year (Qld)	
National Finalist – International Association for Public Participation – Project of the Year for Australia and New Zealand	
COMMENDED – PRIA Queensland Community Relations Award for Excellence	
2010	
WINNER – (National) Australian Marketing Institute Inaugural Green Marketing Award for Excellence	
WINNER – (Queensland) Australian Marketing Institute Inaugural Green Marketing Award for Excellence	
WINNER – Public Relations Institute of Australia (PRIA) Environmental Award for Excellence - Queensland	
HIGHLY COMMENDED – Public Relations Institute of Australia (PRIA) Environmental Category - National Golden Target Awards	
2009	
HIGHLY COMMENDED – PRIA Queensland Community Relations Award for Excellence, Environment Category	
COMMENDED – PRIA National Golden Target Award, Environment Category	
2008	
WINNER – Queensland Tidy Towns Sustainability Category	
WINNER – Keep Australia Beautiful Sustainable Cities Community Action	

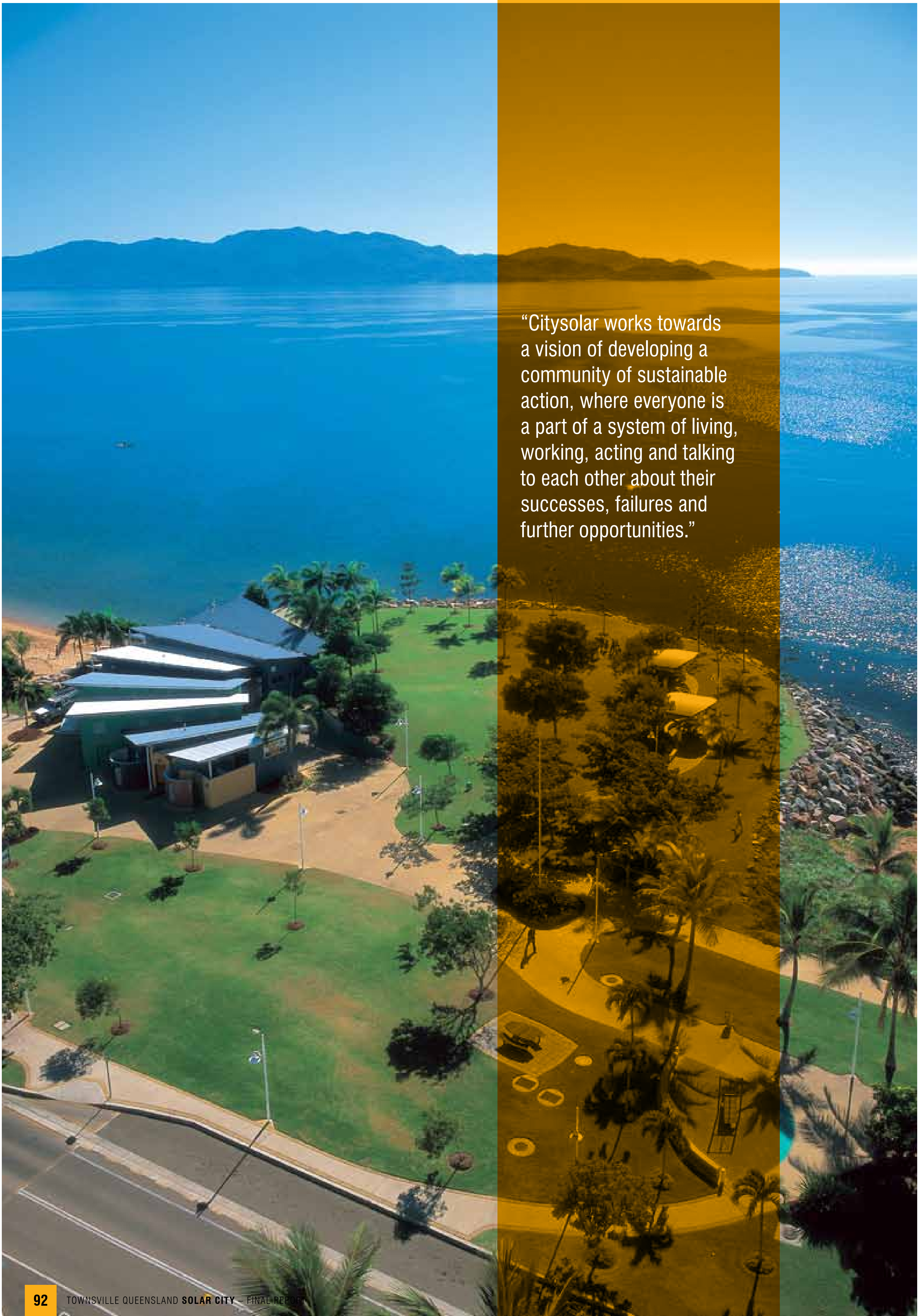
8.15 – Community Engagement supports all our work

The links between community engagement success and project results are very clear and have contributed significantly to surpassing project goals. Magnetic Islanders have the smallest bills in Townsville and in 2012 they are using less electricity than they were in 2005.

The success of engagement is practically demonstrated by 82% participation, leading to energy efficient behaviours becoming common across the island, surpassing our peak demand reduction target and energy conservation goals, hosting PVs in over 200 homes and businesses and reducing GHG emissions.

As well, the successful design, installation and adoption by the community of the 100kW Solar Skate Park. It includes local artwork, enhances existing facilities and creates a safe outdoor space for younger children and teens alike. The solar 'lid' extends hours of use, shading skaters and families from the hot midday sun and lighting up at night with spectacular LED lights.

In early 2012, the results of a survey conducted by James Cook University on behalf of the Queensland government were released. This survey found that around 40% of visitors to Magnetic Island were aware it was part of the Solar City program, and of those, two thirds visited the island with that information as an important reason for their visit, demonstrating the deep level of engagement with the project on the island and across the wider Townsville region.



"Citysolar works towards a vision of developing a community of sustainable action, where everyone is a part of a system of living, working, acting and talking to each other about their successes, failures and further opportunities."

09. TOWNSVILLE

SMART CITY, SOLAR CITY

9.1 – Townsville City Council – Citysolar

As a consortium partner in the Townsville Queensland Solar City project, the Townsville City Council conducts the community capacity building program through its Citysolar program. These Council programs underpin the work of the other consortium partners across the wider Townsville region, contributing to the overall success of the Solar City project.

The following section tells the story of the successes of the Citysolar Design System for Change in developing the Townsville community into a sustainable Solar City, Smart City.

city solar

09

Executive summary

The Townsville City Council Citysolar program is driving a vision for a tropical sustainable city and it is doing so with action. As an integral part of the Townsville Queensland Solar City project, Citysolar is synergising innovative and collaborative ways to building a smart, sustainable and resilient city for the future.

Citysolar works at a whole-of-community level in Townsville where the success of the program has been largely due to involving all industries, businesses, schools and residents. It works at local scale sustainability projects integrating across all systems (energy, water, waste, transportation, health and finance) which creates a framework for anyone and everyone to be a part of in ways that matter to them, shifting from local-scale sustainability to a transformative system that is replicable and transferrable to other cities in Australia and the world.

This cutting-edge program delivers a new framework for thinking and action that is designed to transform the way people think about and use energy.

Citysolar is building a city powered by the community

Through:

- Utilising all of our collective knowledge, visions, ideas and actions;
- Creating new inter-relating systems by integrating environment, economics and social dimensions
- Shifting the way people think and act about energy through continuous inquiry and small repeated actions in the direction we want for change;

The key objectives of the program are to:

- Communicate about sustainability in ways that matter to the community so that they are willing to foster sustainable change and adopt clean technology.
- Involve the community in sustainability initiatives and programs so that they come along on a journey of sustainable discovery and have buy in.
- Building the community's capacity to think and act for themselves, so that they take responsibility for their own futures and take action in the direction of a sustainable community.

The following document is a journey to uncover the hidden world of energy in Townsville through the actions that have been achieved by the Citysolar program for the 2011/12 financial year.

Citysolar Design System for Change

A Whole-of-Community Collaborative Framework for Action

The Townsville City Council (TCC) Citysolar program is a key **whole-of-community capacity building** component of the Townsville Queensland Solar Cities Project and has transformed the way the community of Townsville now thinks about and uses energy.

The program is designed to lead and drive innovation within the community and provide a framework for the community to respond to changes in their environment (economic, social and ecological) utilising a collaborative approach to integrate sustainability into their everyday lives.

Based on collective social learning, it was identified that there is a need in the community for new ways of thinking and action around sustainable energy use and a community program to support to achieve this.

In search of these new ways, Citysolar provides a *framework for action* where residents, businesses, schools, government and non-governmental organisations (NGOs) can act into and create their own preferred sustainable energy efficient and resilient future that is affordable, practical, implementable, socially acceptable and most of all meaningful to them.

This is achieved by:

- Communicating about sustainability in ways that matter to the community so that will be willing to foster sustainable change and adopt clean technology.
- Involving the community in sustainability initiatives and programs so that they come along on the journey of sustainable discovery and have buy in.
- Building the community's capacity to think and act for themselves, so that they take responsible for their own futures and take action in the direction of a sustainable community.

The Citysolar program works towards a vision of developing a community of sustainable action where they are part of a system of living, working, acting and talking to each other about their successes, failures and further opportunities. Their collective knowledge and individual actions will generate new interrelating systems that integrate environment, economics and social dimensions.

Systems thinking and networks

The Citysolar program applies systems thinking and network approaches through city-wide communications and feedback loops promoted through networks, businesses and environmental products and services. This approach fosters emergence and capacity building in trades and small to medium enterprises including ICT SME, sustainability SME and marketing services

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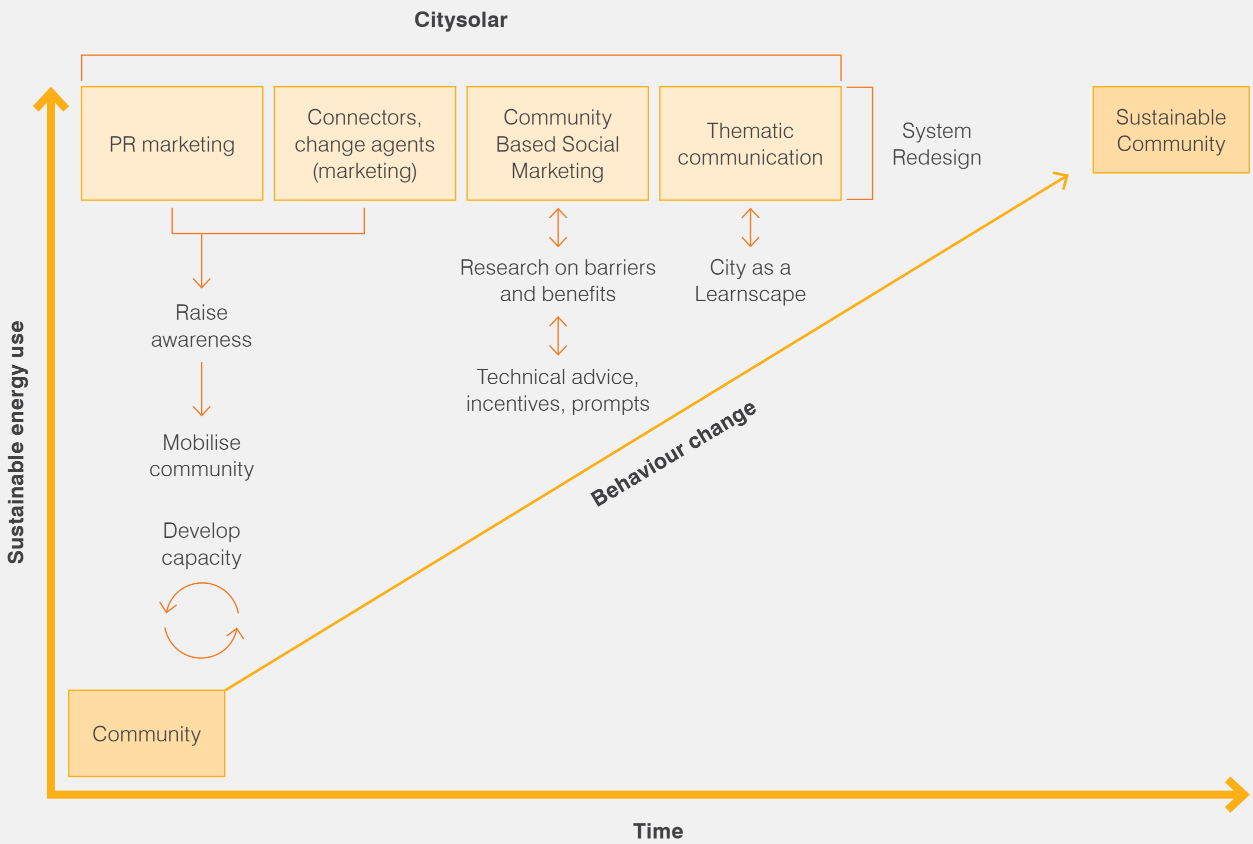

Figure 1 – The Citysolar Framework

The program works by uncovering the hidden world of energy (the hidden costs and underlying processes behind the challenges) and providing pathways (a framework for action) for the community to act for themselves in the direction of their preferred future (e.g. affordability). This is implemented through a whole-of-community Design System for Change approach, which is a framework for action delivered using the following proven methodologies;

- Collective Social Learning
- Community Based Social Marketing
- Thematic Communication
- Experiential Learning
- Systems Thinking and Network Approaches

Collective Social Learning

The program has adopted a Collective Social Learning (CSL) approach of Emeritus Professor Valerie Brown AO, which provides a neutral framework where knowledge, ideas, experiences and challenges can be shared and collaborated to enhance thought provoking processes to enable the community to design their own future of which they hold themselves responsibility for and can take action to create.

Collective Social Learning provides a framework for individuals to:

- Share their visions and world views (What Should Be?);
- Discuss the challenges and opportunities that exist in their everyday lives (What Is?);
- Generate new ideas based on the new shared learnings (What Could Be?);
- Take responsibility for their own future by taking action in a meaningful way (What Can Be?)

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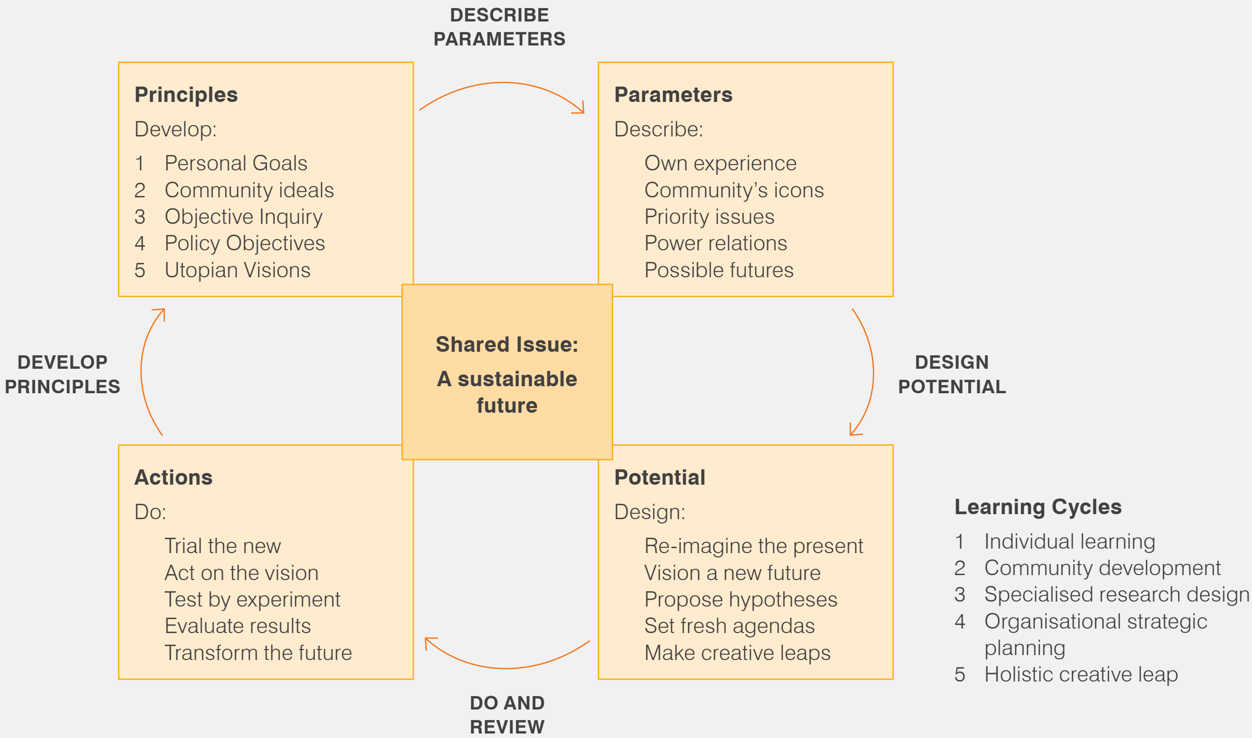

Figure 2 – Collective Social Learning Process

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Townsville Residential Energy Demand

In collaboration with TNEP, Citysolar has developed a Townsville Residential Energy Demand (TRED) Program based on the expanded CBSM methodology.

The program investigates methods of fostering sustainable behaviour related to residential energy demand by seeking to identify and investigate a number of options to encourage residents (specifically home owners) to reduce household energy demand that are suitable for application in Townsville.

The program is intended to provide valuable information and guidance to the council regarding effective methods to encourage and assist residents to reduce energy demand in the home. It is intended that encouraging residents to focus on reducing energy demand in the home can deliver reduction of direct energy costs and hence energy bills as well as a reduction in the consumption of fossil based electricity and the associated reduction in the generation of greenhouse gas emissions.

Prior to 2011/12, the program began with a comprehensive investigation into potential behaviours or actions that residents can undertake in their homes to reduce energy demand. The study, among the most comprehensive undertaken in the world, considered 241 such behaviours and investigated both the likelihood that residents would undertake the behaviour and the potential impact it would have on the energy demand of the home.

These results were peer reviewed by an expert panel to create the final database. From this a short list was created based on the anticipated likelihood and impact, as per the CBSM Methodology, and a range of potential benefits and barriers were identified and investigated.

Based on the findings, a workshop was held between TNEP and Citysolar to identify three behaviours to be further investigated.

The selected behaviours were:

1. Planting appropriate trees/shrubs to provide shading
2. Switching from an electric hot water storage system to a less energy consuming system
3. Painting the roof white, or a reflective colour

A series of focus groups and community surveys were then carried out to engage with Townsville residents to investigate perceptions around the benefits and barriers to each of the three behaviours. From this, the tools and strategies identified were mapped against the barriers and benefits to inform the design and delivery of a pilot program.

The 2011/12 year focussed on the implementation of a pilot program for the behaviour of painting the roof white, or a reflective colour. The program is called Cool Roofs Townsville.

As part of the Cool Roofs Townsville program, it was identified that an important tool in addressing the barriers and benefits was to develop a local Cool Roofs painters network which residents can interact with to increase the adoption of cool roofs.

IBM Smarter Cities Challenge

Townsville became one of just 24 cities world-wide to be awarded an IBM Smarter Cities Challenge.

From the 17 July – 5 August Citysolar hosted the IBM Smarter Cities Challenge: Townsville where 6 executives from IBM were integrated into the Citysolar Design System for Change.

The challenge was the result from a successful submission put forward to assist Townsville to better plan and act for a future smart, sustainable and energy efficient city through integrating smart technologies, data, social media/networks and behaviour change.

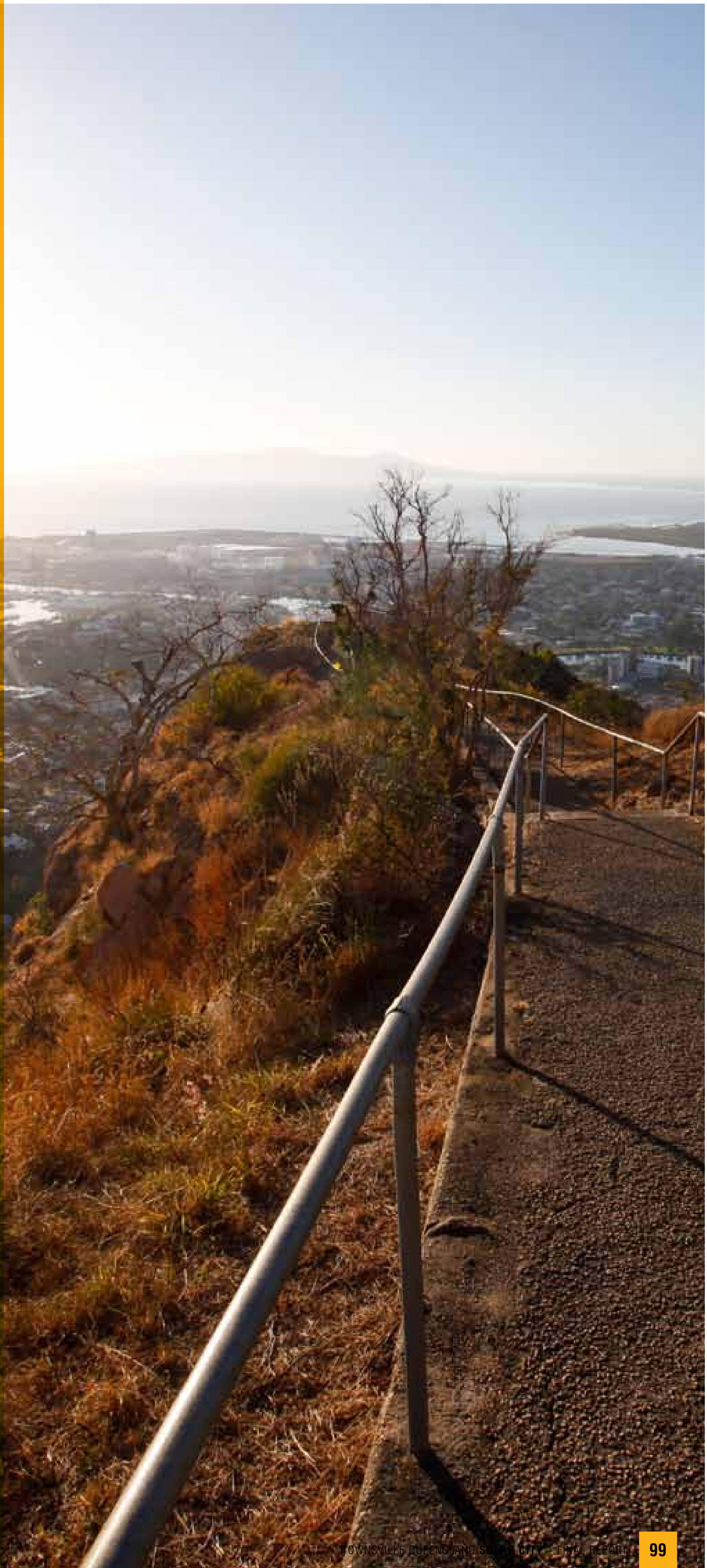
The challenge brought together over 250 stakeholders from across the community including sustainability practitioners, education sectors from primary schools to university, local businesses, NGOs, business/industry and government agencies and residents to create new pathways towards a future smart, sustainable and energy efficient city from the bottom up.

The process used to implement the challenge involved the IBM executives working the community and involving them in multiple linear (meetings and workshops) and non-linear (experiential learning and thought provocation) processes/activities to enrol them into living system of our learning city.

Smart Home and Lifestyle expo

The Smart Home and Lifestyle expo is a key event on the calendar for Townsville. It brings together all of the conversations, ideas and actions generated throughout the course of the year to a place and point in time so that the community can learn and generate their own ideas and actions to bring back to their everyday lives. The exhibitors include environmental products and services businesses and organisations that have participated and been involved in the Citysolar program through the year.

The Citysolar exhibit was transformed into an interactive flowing Collective Social Learning workshop where over 300 participants generated individual ideas and actions towards building a sustainable city that was relevant to them.



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Sustainable Townsville Network

Citysolar continues to build a framework for trustworthy and resilient Environmental Products and Services network to support the community in fostering sustainable change. This network acts both in competition and co-operation "Co-Opertition" which increases innovation and builds the market share for the businesses in the network.

Citysolar has been working collaboratively across the Townsville community with the following partners:

- Townsville Solar City Consortium
- Sustainable Townsville Ltd
- Environmental Products and Services
- Local Schools
- James Cook University (Schools of Business, Social Sciences, Engineering)
- JCU eResearch and ScienceMob
- IBM Smarter Cities
- ICMA (City of Dubuque, City of Mission)
- LGMA Pacific Fellows (PNG, Tuvalu, Fiji)
- TCC Internal Departments
- Australian Urban Research and Infrastructure Network (AURIN)
- Townsville Solar City Delegation

The development of knowledge network clusters (Figure 3) has provided a neutral environment where individuals, groups and organisations can think and work collaboratively to build their preferred future for our city.

Participants in the Townsville Solar City delegation to the 4th International Solar Cities Congress in Dezhou, China.

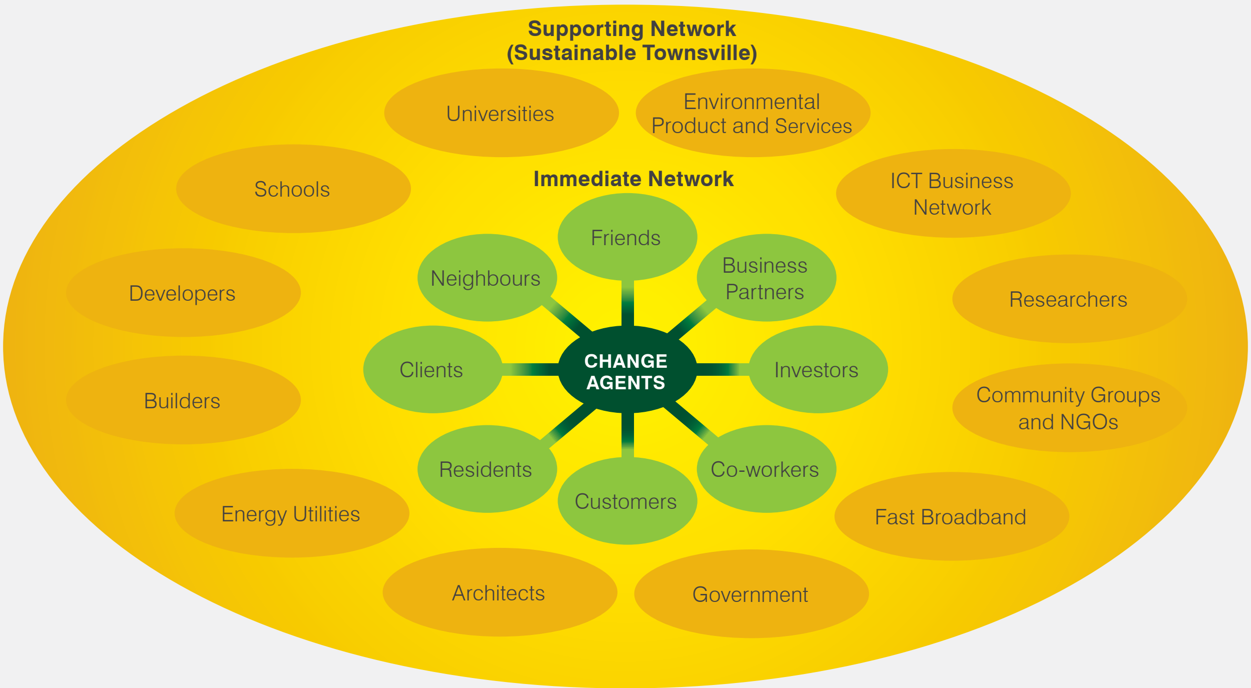
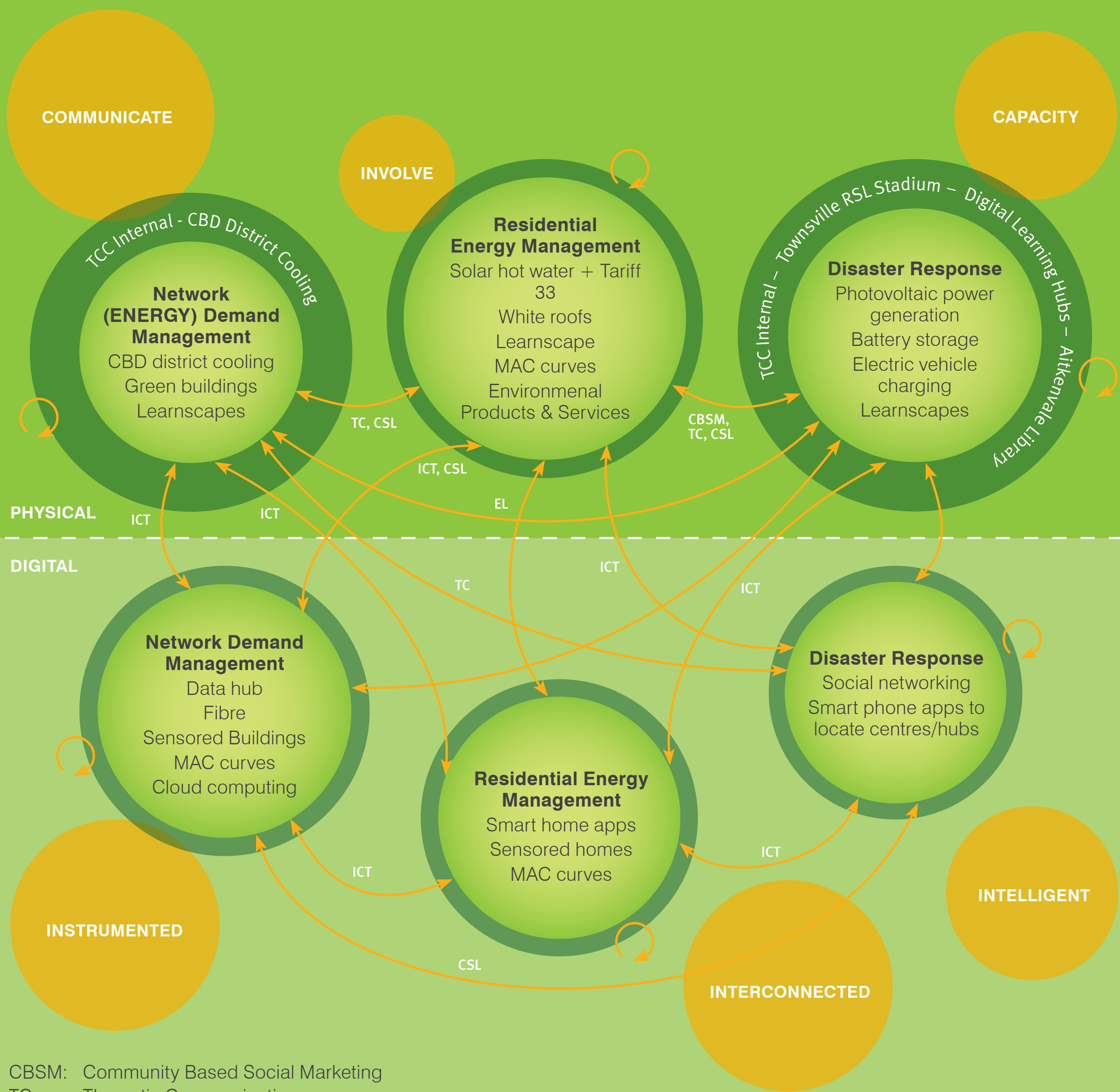


Figure 3 – Integrative Change Agent Diffusion Model

What's Ahead?

Citysolar is acting on the learnings from the IBM Smarter Cities Challenge. This provided a direction to act towards building a smart, sustainable and resilient city for the future.

Throughout the year, the outcomes of the collective social learning workshops, the findings from the CBSM research, the development in thematic communication, the increase in experiential learning through learnscape development and the growth of the sustainable network has uncovered pathways towards building Townsville as a Smart City Solar City with Citysolar underpinning the integration of physical and digital projects for the city (Figure 9: Townsville – A Smart City Solar City).



CBSM: Community Based Social Marketing
TC: Thematic Communication
CSL: Collective Social Learning
ICT: Information Communication Technology
EL: Experiential Learning

Figure 4 – Townsville – A Smart City Solar City

“...it’s not about the technology, it’s about how people use the technology that is important.”

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10. FINANCIAL TABLE

The Townsville Queensland Solar City is a $32 million project funded by the Australian Government through the Solar Cities Program, by the Queensland Government, and by the Consortium members.

This successful project has achieved its targets and delivered the outcomes on time and within the budget set in 2007. The expenditure and budget are set out below.

	FY 06/07	FY07/08	FY08/09	FY09/10	FY10/11	FY11/12	FY12/13	TOWNSVILLE QUEENSLAND SOLAR CITY TOTAL
PROJECT BUDGET								
Project	2,124,134	12,609,900	8,777,814	2,530,454	2,466,214	2,049,383	1,639,958	32,197,857
DCCEE funding	1,062,066	6,304,480	4,261,792	1,138,754	1,103,096	818,458	311,354	15,000,000
DME funding	2,000,000	1,000,000	1,000,000	1,000,000	-	-	-	5,000,000
Consortium contribution	(937,932)	5,305,420	3,516,022	391,700	1,363,118	1,230,925	1,328,604	12,197,857
Total funding budget	2,124,134	12,609,900	8,777,814	2,530,454	2,466,214	2,049,383	1,639,958	32,197,857
PROJECT ACTUAL								
Actuals cost incurred	212,338	8,591,406	3,724,861	6,178,713	4,244,579	5,503,034	1,928,209	30,383,139
DCCEE funding	1,000,000	3,341,756	1,867,132	4,778,446	2,107,360	1,237,273	293,029	14,624,995
DME funding	2,000,000	1,000,000	1,000,000	1,000,000	-	-	-	5,000,000
Consortium contribution	(2,787,662)	4,249,651	857,730	400,267	2,137,219	4,265,761	1,635,180	10,758,144
Total funding actual	**212,338**	**8,591,406**	**3,724,861**	**6,178,713**	**4,244,579**	**5,503,034**	**1,928,209**	**30,383,139**

“Our legacy has been to provide the springboard for the ongoing work by Ergon, Council and consortium members to make Townsville – and regional Queensland – more sustainable, and a leader in energy efficiency in the tropics.”

GLOSSARY

Community Based Social Marketing: Developed by Doug McKenzie-Mohr, this marketing approach is based upon research in the social sciences that demonstrates that behaviour change is most effectively achieved through initiatives delivered at the community level which focus on removing barriers to an activity while simultaneously enhancing the activities benefits.

Community engagement: The process by which organisations build ongoing, permanent relationships with the public to achieve benefits for the organisation and the community as a whole.

Compact Fluorescent Lamp/Light (CFL): a fluorescent lamp designed to replace an incandescent lamp. The lamps use a tube which is curved or folded to fit into the space of an incandescent bulb, and a compact electronic ballast in the base of the lamp.

Consortium: An association or combination of businesses, financial institutions or investors that have joined forces to engage in a joint venture.

Home Area Network (HAN): a residential local area network (LAN) for communication between digital devices deployed in the home.

Heat pump: a device that warms or cools a building by transferring heat from a relatively low-temperature reservoir to one at a higher temperature.

Iconic PV: Solar photovoltaic technology installed on well-known and highly visible public infrastructure to showcase renewable energy and sustainable living locally, nationally and internationally.

In-home display (IHD): A bench-top device that provides feedback on electrical or other energy use to encourage lower energy use; may also display the cost of energy used and estimates of greenhouse gas emissions.

Kilowatt (kW): 1,000 watts of electrical power.

Light Emitting Diodes or LED: is a semiconductor device that emits visible light when an electric current passes through it.

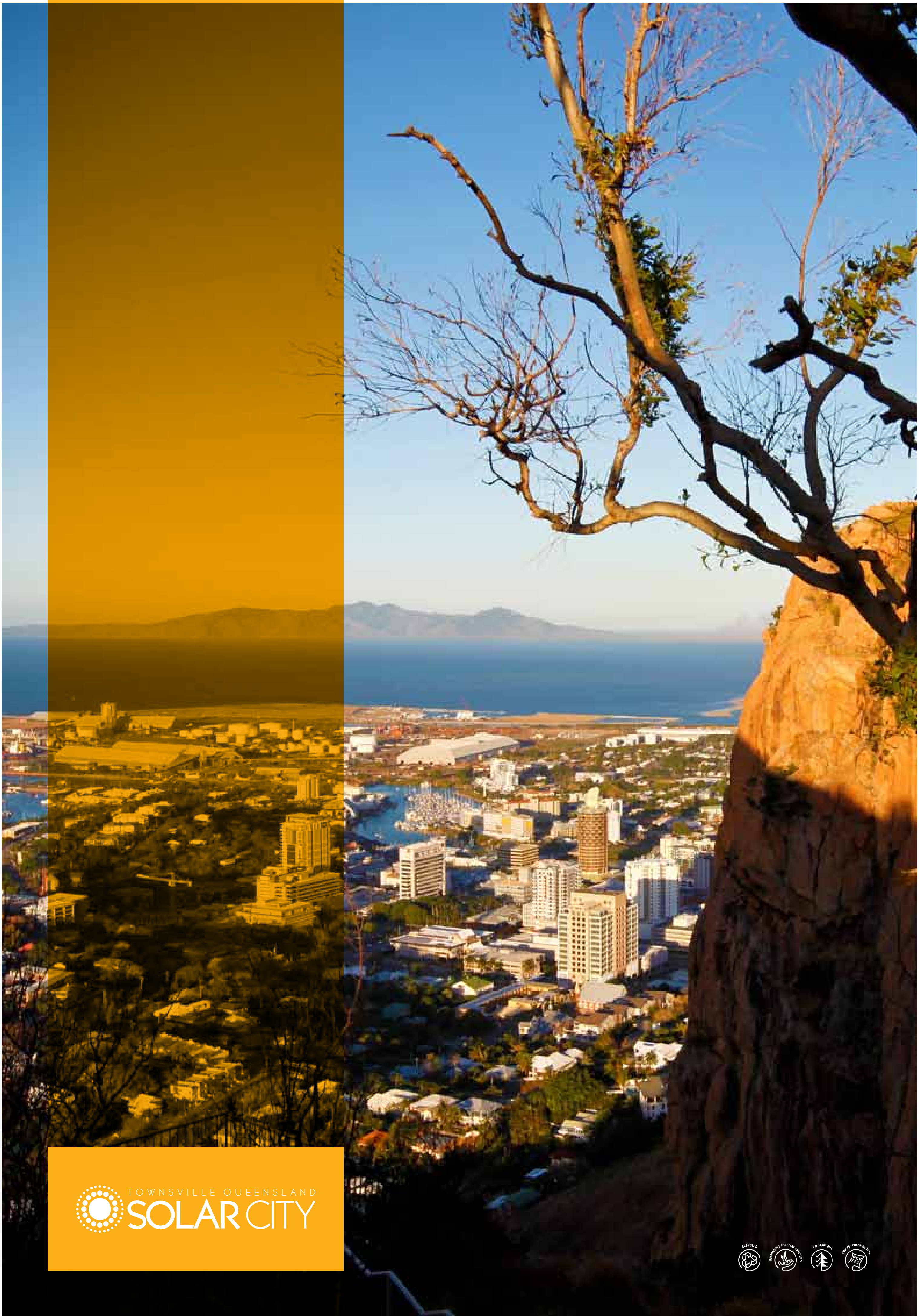
Peak demand: In terms of energy use, peak demand describes a period of strong consumer demand of electricity. On Magnetic Island this is the period between 6pm and 9pm daily when energy usage is at its highest. For an electric utility company, the actual point of peak demand is a single half hour or hourly period which represents the highest point of customer consumption of electricity.

Photovoltaic (PV): Technology that uses a device (usually a solar panel) to produce electric current when exposed to sunlight. Solar panels are frequently installed on roofs to take advantage of as much sun as possible.

Redflow battery: is a zinc–bromine flow battery which is a type of hybrid flow battery. A solution of zinc bromide is stored in two tanks. When the battery is charged or discharged the solutions (electrolytes) are pumped through a reactor stack and back into the tanks. One tank is used to store the electrolyte for the positive electrode reactions and the other for the negative.

Smart meter: A device that records electricity use and sends energy consumption information back to the electricity distributor via a telecommunications network; can record consumption information each half hour, enabling customers to see how their usage varies throughout the day.

Thematic communication: A communication approach adopted by the community engagement team, developed by Dr Sam Ham, and based on scientific theories and research. It is a way of thinking designed to inspire long term and sustainable behaviour change using messages that are themed, organised, relevant and entertaining to each specific audience.



TOWNSVILLE QUEENSLAND
SOLAR CITY