PUBLIC REPORT

Part 1 - Corporation Details

Period to which the report relates

Start Period 01/07/2012 End Period 30/06/2013

Controlling Corporation

Insert the name of the Controlling Corporation exactly as it is registered with the EEO Program.

The University of Queensland

Table 1.1 - Major Changes to Corporate Group Structure or Operations

Table 1.1 – Major Changes to Corporate Group Structure or Operations in the last 12 months
The University of Queensland has not experienced any major changes to the corporate group structure or operations during the 2012/13 financial year. As a result of a major flooding event in Brisbane in early 2011, The University of Queensland (UQ) sustained damage to some of its buildings and scientific greenhouses at the St Lucia campus. The State, represented by the then Department of Environment and Resource Management (DERM) and the Department of Employment, Economic Development and Innovation (DEEDI), granted UQ temporary access and use of the State-owned Long Pocket Science Site at Meiers Road, Indooroopilly from 22 March 2011. On 24 May 2013, UQ secured a long-term tenancy of the Long Pocket site, ensuring the University's continued occupancy. Ongoing occupation of the full Long Pocket site therefore means a net increase in the overall energy consumption of the University. In 2012/13, UQ acquired 1 Court Street, Ipswich on 30 April 2012 to house the Ipswich Clinical School, and the Goondiwindi Veterinary Centre was sold on 13 May 2013. There continued to be numerous building refurbishments/redevelopments throughout 2012/13 and three major buildings located on the St Lucia campus, Centre for Advanced Imaging, Advanced Engineering Building and the Global Change Institute, were completed and are now occupied. UQ has operational control over a total of 53 entities. Australia China BioEnergy Pty Ltd was the only newly formed or acquired entity which came under UQ operational control in 2012/13. Entities which ceased to be under UQ operational control in 2012/13 include ActiveTorque Pty Ltd, Bireme Pty Ltd, Dendrimed, PrimEd, and Vaxxas.

Declaration

Declaration of accuracy and compliance	
The information included in this report has been reviewed and noted by the board of directors and is to the best of my knowledge, correct and in accordance with the *Energy Efficiency Opportunities Act 2006* and *Energy Efficiency Opportunities Regulations 2006*. All opportunities have been assessed to a level of accuracy that is commensurate with the financial investment required for implementation.	**Professor Peter Høj** **President and Vice-Chancellor** **Date** 29/11/2013

Part 2 - Assessment Outcomes

It is compulsory to complete Tables 2.1 to 2.3 for each entity (subsidiary, business unit, key activity or site) that has been assessed.

Table 2.1 – Assessment Details

Name of entity	St Lucia Campus

A. Total corporate energy use in the last financial year	443,566	GJ
B. Total energy use covered by assessments	48,148	GJ
C. Total percentage of energy use assessed (B ÷ A) x 100	10.85	%

Description of the way in which the entity carried out its assessment

The main campus of The University of Queensland (UQ) is located on a large bend in the Brisbane River at St Lucia about 10km from the Brisbane CBD. The St Lucia Campus has over 33 major buildings with gross floor area (GFA) greater than 5000m^2 and over 60 smaller buildings. A wide range of teaching, research, recreational and cultural activities are conducted on this campus. Since its first year of the five year EEO cycle, namely 2010/11, the University has used a variety of methods to assess its energy use and to identify opportunities to improve energy efficiency. It has also made a number of investments to improve its capacity to record and analyse energy use, identify opportunities, make changes and monitor performance:

1. Formal level 1 and level 2 energy audits have been conducted by suitably qualified external consultants;
2. A technique has been established for lighting surveys and the development of retrofit reports;
3. Expert advice has been sought on how to improve the performance of specific equipment such as chillers;
4. University staff have conducted analysis and audits of specific buildings, or end uses, such as hot water heating;
5. Design guides have been developed and trialled for building management system improvements;
6. Energy metering has been expanded and a front end application that facilitates analysis is being rolled out;
7. Measures have been taken to increase staff and student engagement to increase the oversight of energy use; and
8. Innovative energy efficiency technologies have been reviewed and proposals developed to incorporate these into facilities.

The notes that follow provide chronological narrative outlining the main measures used at the St Lucia campus to assess energy use.

Building Audits and Lighting Retrofits

During 2010/11 the University commissioned an energy and comfort audit of the UQ Centre. The UQ Centre is the main graduation venue for the University. Students, their parents, relatives and friends, senior academic staff and dignitaries attend graduations and this provides an opportunity to showcase the University. For a number of years, however, parts of the UQ Centre have been uncomfortably hot at times during summer. Consultants recommended a multipronged strategy to reduce heat loads and improve comfort: improved lighting to reduce internal heat loads; window film for the eastern windows to block out solar heat gain; and better maintenance of the air conditioning systems to enhance energy efficiency and service delivery. This work was successfully completed in 2011/12.

Also during 2010/11, energy efficiency consultants conducted Level 1 energy audits on nine buildings at St Lucia and a Level 2 energy audit on one building, J D Story Building. The audits resulted in a large number of recommendations to improve energy use. Most of the recommendations covered lighting, but the level of detail provided did not enable immediate implementation; some further field work was needed, except in two cases, namely the Queensland Biosciences Precinct and the Queensland Brain Institute. A number of facility management personnel are exclusively assigned to these two buildings and these people had sufficient local knowledge to start the process of retrofitting new lighting straight away.

To help action the other audit results, a comprehensive lighting retrofit system was developed which involved lighting technology surveys, identifying specific retrofit opportunities and implementing the best options. A full scale trial retrofit was successfully conducted at the JD Story Building to prove the value of this system. This was followed in 2011/12 by light technology surveys and retrofitting of T8 fluorescent tubes with more efficient T5 tubes in 8 buildings at St Lucia: the Richards, Forgan Smith, Priestley, Hartley Teakle, Goddard and Steele Buildings, the Faculty of Sciences Building 69 and the Human Movement Studies Building. As well as changing fluorescent tubes, the light retrofit work included installation of passive infrared (PIR) and photoelectric (PE) sensors to turn off lights when not needed in toilets and meeting rooms.

During 2011/12 lighting technology surveys were also conducted in six major buildings (each with GFA greater than 5000 square metres): the Sir William McGregor, Mansergh Shaw, General Purpose South, Sir Llew Edwards, Hawken Engineering and Sir James Foots buildings. Finally during the 2012/13 year a further 14 major buildings (with a total GFA of just over 130,000 square metres) were surveyed to establish the existing lighting technologies and opportunities for energy efficient retrofits. The results of these surveys were reviewed as part of the building audits conducted in the 2012/13 year.

Towards the end of the 2011/12 year, request for tender (RFT) documents were prepared for Level 2 energy audits of 12 major buildings on the St Lucia Campus and associated reviews of the metering and building management systems (BMS) in these buildings. The buildings covered by the request for tender were Building 69, General Purpose North 3, Hawken Engineering, Sir James Foots, Sir William MacGregor, Goddard, Mansergh Shaw, General Purpose South, Chamberlain, Sir Llew Edwards, Hartley Teakle and Forgan Smith Buildings. Audits of these buildings were conducted in 2012/13. In addition to identifying a range of energy efficiency opportunities, the audits recommended improvements to metering and the BMS in the target buildings. Implementing the energy efficiency opportunities arising from these audits has been scheduled for the 2013/14 year.

During the 2012/13 year, RFT documents were also prepared for audits of a further 14 major buildings at the St Lucia campus. A contract was awarded for the audits with the work scheduled for completion in the first half of 2013/14 and implementation in the second half of the financial year. Figure 1 shows a map of the St Lucia campus showing the buildings already audited and those planned for audit during to the end of 2013. Buildings shown in purple are colleges on University land and residences over which the University does not have direct control. Of the 33 major buildings at the St Lucia campus and under the direct control of the University, 22 buildings were audited by the end of 2012/13.

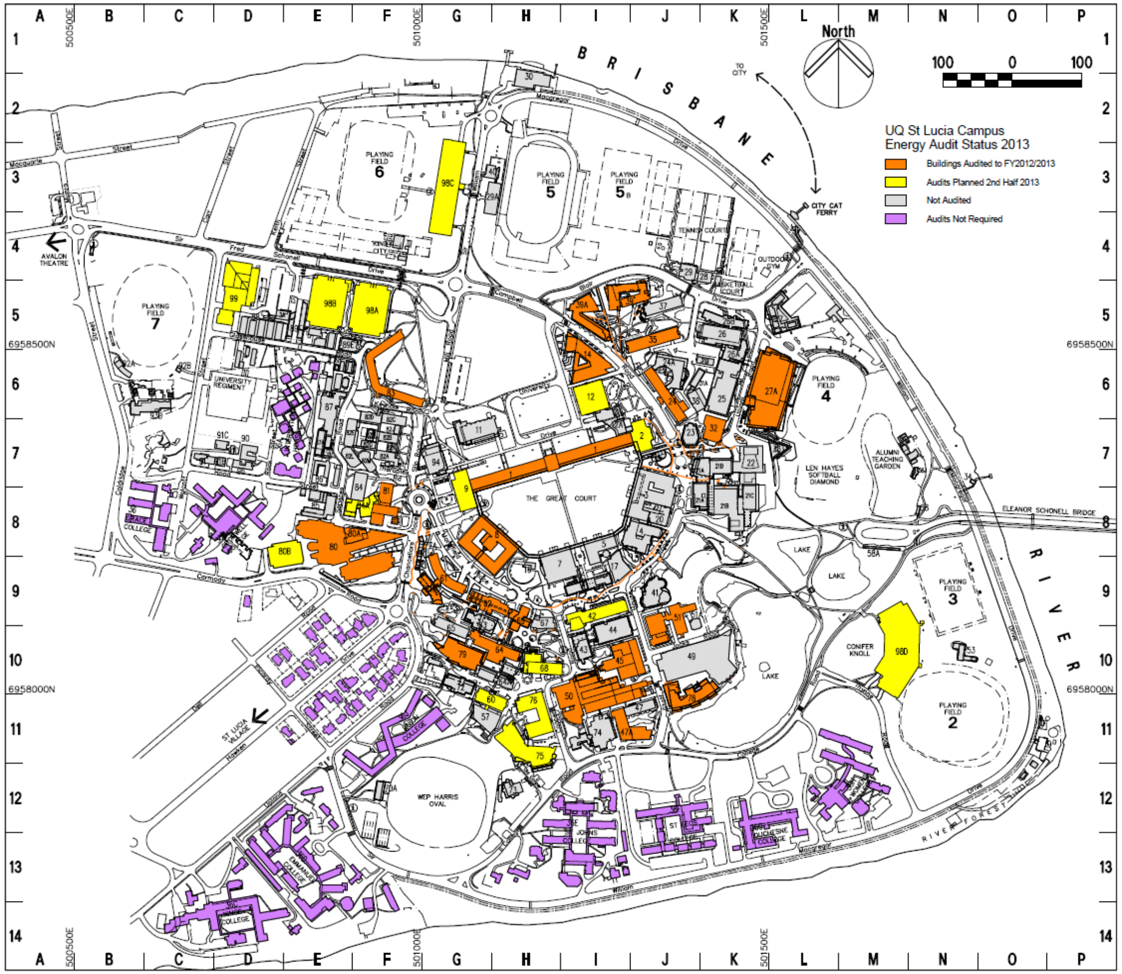

Figure 1: St Lucia Campus - Building Audit Status 2012/13

Air Conditioning – Chilled Water Production

Air conditioning at St Lucia is provided using chilled water produced in central chiller stations. St Lucia has 12 chiller stations serving multiple-building precincts and two standalone installations – chillers that serve just a single building. Presently the largest chilled water precinct, the Central Precinct, has 12 buildings served by a single chiller station (please refer to Figure 2 below). Understanding the production, distribution and use of chilled water at St Lucia, is essential to identifying efficiency opportunities.

Towards the end of the 2010/11financial year, temporary metering was installed to monitor the performance of selected chillers in three of the largest chiller stations. The results indicated that there was room to improve the performance of the chillers. A project was developed to install permanent electrical and chilled water metering on all the chillers in these three large stations (eight chillers in total) and the work was completed in 2011/12. The meters were then integrated into a software front end. Metering data confirmed the need for improvement and the University explored options for installing optimisation packages on the chiller stations. Optimisation packages control the chillers, pumps and cooling towers and other necessary ancillary equipment so the need for chilled water is satisfied at all times and in a way that, while consistent with the operating limitations of the plant and equipment, gives the most energy efficient outcome. Such packages can typically reduce energy use by 15-20%. During 2012/13 proposals were sought for trial installations of optimisation packages for two of the three chiller stations, namely the Central Chiller Station and the Commerce Hill Chiller Station. A decision was taken to proceed and the installations are planned for the first half of the 2013/14 year.

Toward the end of 2012/13 a project was developed to upgrade the Computer Sciences Precinct Chiller Station, including the stations' cooling towers. This precinct serves seven buildings, including the Chancellery and the other two main administrative buildings, the JD Storey and Prentice Buildings. It also provides chilled water to cool part of the University's main data centre. A decision was taken early in the project that achieving an energy efficient outcome would be a major objective. It was also decided that options for greater use of the chiller station chilled water in the data centre would be explored. Currently the bulk of cooling at the Data Centre via air cooled DX (direct expansion) units rather than the more efficient water cooled chillers typically used in chiller stations.

One of problems of the past has been the need to operate chillers with poor low load characteristics at low load. The new chillers for the Computer Sciences Chiller Station will be highly efficient across their full load range. Under certain circumstances, which can be difficult to forecast, loads can be lower than the chiller turndown for the smallest chillers. To cover the possibility, the chiller station has been designed from the outset with a footprint for an efficient low load chiller should one be needed in future. A chiller station optimisation package has been specified for the upgrade to ensure that all the plant – chillers pumps and cooling towers - operate as efficiently as possible.

One of the lessons from metering of the three chiller stations mentioned above, was that in addition to measuring electric inputs, metering chilled water thermal energy flows across the chilled water network can be an invaluable diagnostic tool. As part of the University's CAPEX (new building) program, chilled water meters were also installed in the chillers serving the new Centre for Advanced Imaging Building during 2011/12. In 2012/13 thermal meters were installed on the chillers serving the Human Movement Studies precinct. Thermal meters were also installed on the chilled water supplies to three buildings; the Chancellery, the Learning Innovation Building and the Chamberlain Building.

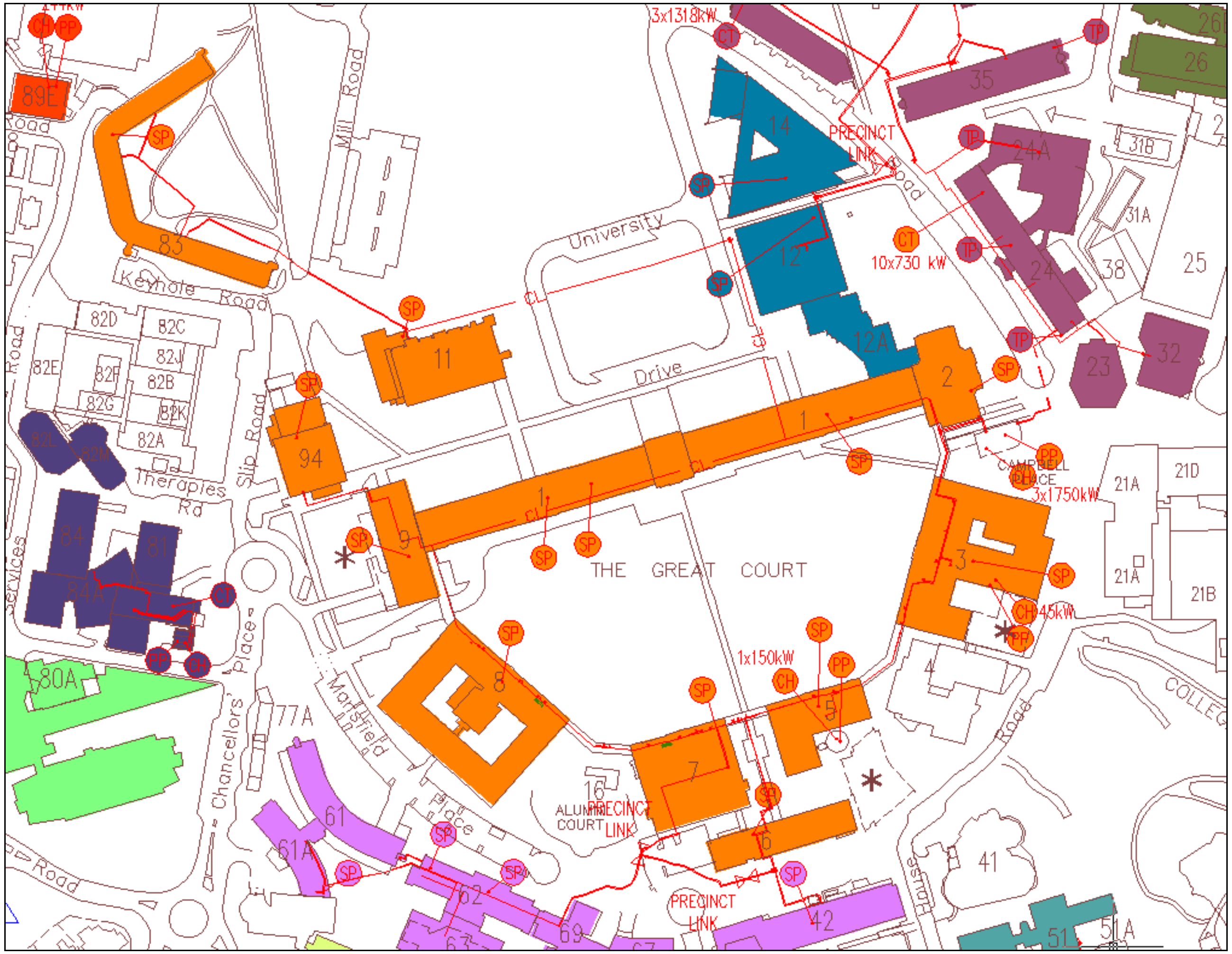

Figure 2: Central Chiller Precinct at St Lucia (orange fill)
Note : the Learning Innovation Building is now also on this precinct
[PP & SP = Primary & Secondary Pumps; CT = Cooling Towers; CH = Chillers]

Metering and Analysing Energy Use

The electricity consumption of the St Lucia campus is determined by metering two high voltage feeds from the Energex network. High voltage power is then distributed around the campus and transformed in over 30 sub stations to low voltage electricity for use by plant and equipment, such as chillers, as well as building light and power circuits, data centres and other end uses. A system of sub-metering is needed to determine how much electricity is used by individual buildings and end uses.

A major review of electrical metering at St Lucia was conducted during 2011/12. Existing meters were identified and their location and other attributes were entered into an asset management database. Single line diagrams (SLDs) were prepared showing the location of all meters in the electrical reticulation system. An example of a single line diagram is shown in Figure 3 below. These diagrams enable the system to be visualised and help when identifying gaps in the metering network.

Gaps are determined by reference to strategic objectives. The first priority was to be able to readily measure how much electricity is being consumed by each of the 35 major buildings at St Lucia (GFA greater than 5000 square meters). The second priority was to be able to measure the electricity input to the production of chilled water; the electricity consumption of the chillers, pumps and cooling towers at each chiller station. The third priority was to be able to measure the chilled water demand of each building - in thermodynamic terms this equates to the amount of heat removed from each building by the air conditioning system. Based on this data it is possible to reliably estimate the total amount of energy each building uses – the sum of its direct electricity consumption and the electricity embodied in the chilled water the building uses for air conditioning and other cooling uses (if gas use is significant then this also needs to be brought into the equation).

Knowing how much energy each building uses is important for a variety of purposes. In terms of the EEO reporting, it enables a picture to be built up of the total amount of energy use assessed (by building audits for example) each year. It also enables buildings to be benchmarked and compared. Identifying underperforming buildings helps assign priorities for when auditing energy use and looking for efficiency opportunities.

During 2011/12 the existing meter system was reviewed. Block diagrams were built up to visualise the metering system and help with the development of the metering formulae needed to arrive at total building electricity consumption. The block diagram for the Queensland Biosciences Precinct (QBP) is shown in Figure 4 as an example. To simply determine the electricity consumption of this single building a considerable number of meters were needed to be installed and then integrated. The total building energy use is determined by applying virtual meter (VM) formulae to the data collected from each meter – data is added and subtracted as necessary. This approach is typical of the situation found at the St Lucia campus.

During 2012/13 virtually all of the gaps relating to direct building electricity and chiller station electricity use were filled by installing additional meters. Also during 2011/12 a user friendly front end software package was purchased. This package enables electricity consumption reports, dashboards and various real time energy flow diagrams to be created. This package was initially applied to the metering on the Central Chiller station and, as mentioned above, this helped to confirm that there was an opportunity to improve the operation of this chiller station.

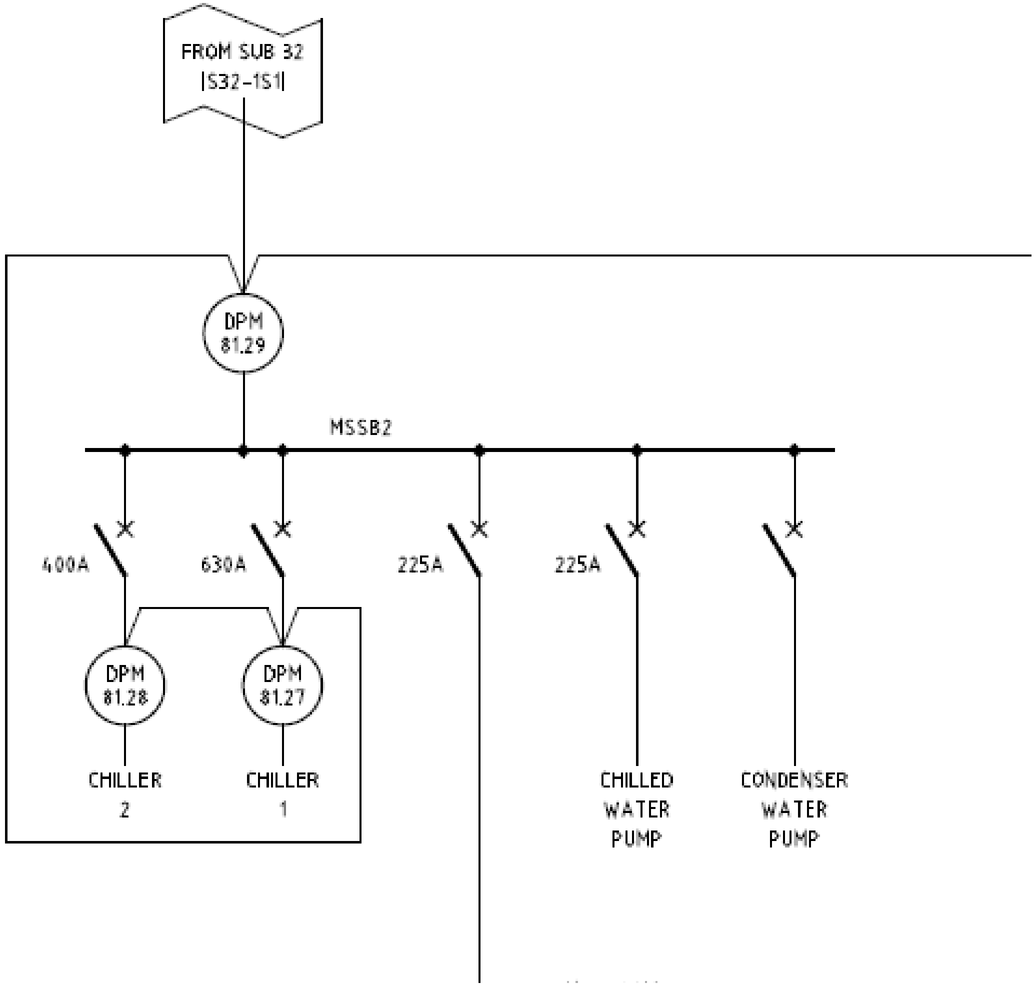

Figure 3: Extract from a typical meter SLD.
It show that two chillers are directly metered and that, with the addition of one meter, the consumption of the two pumps can be deduced.

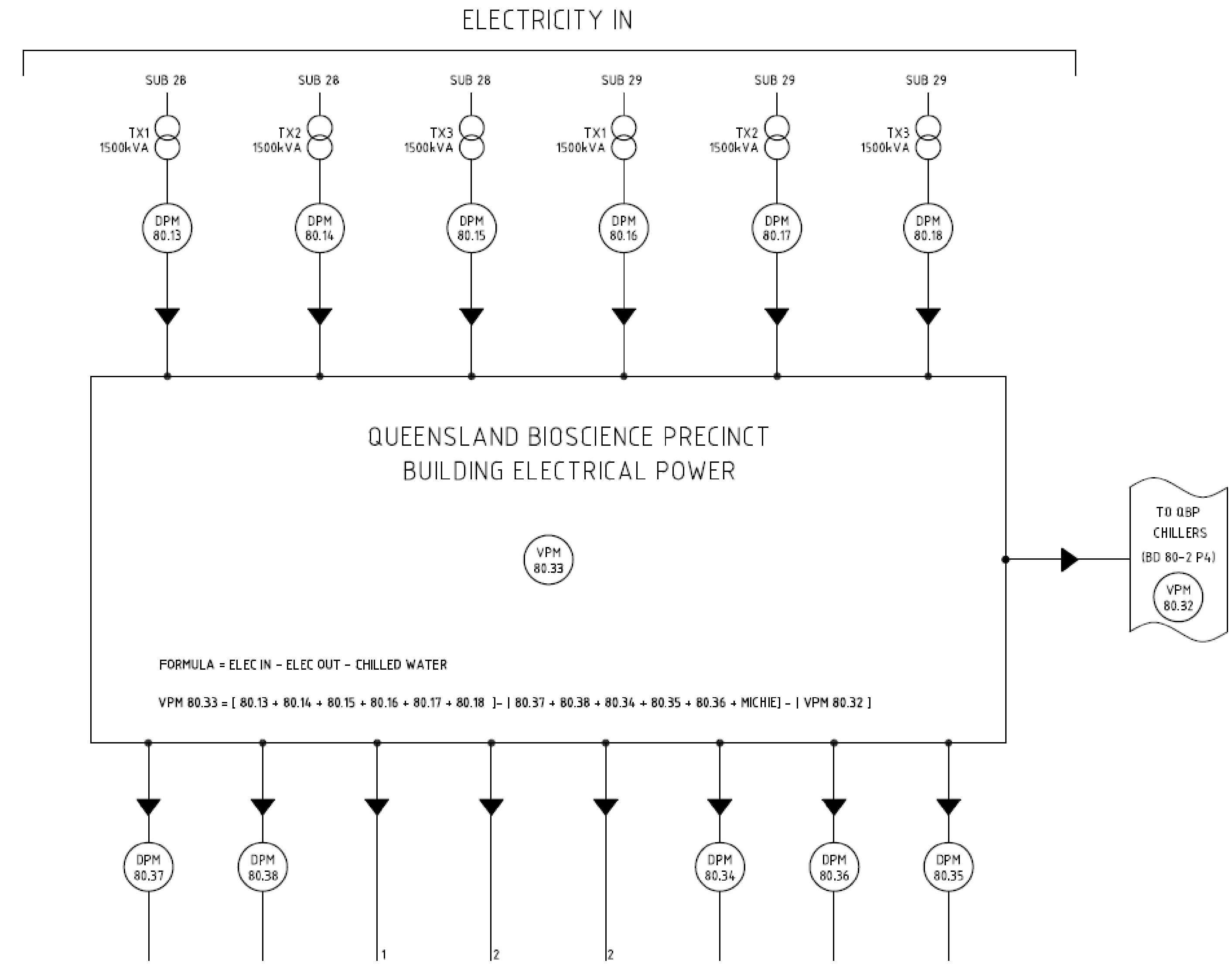

Figure 4: Building Block Diagram – QBP Example
Enables Metering Gaps to be Identified and Formulae Developed

During 2012/13 the front end package was applied to the meters in the new Global Change Institute (GCI) and the Advanced Engineering Buildings. An example of the dashboard created for the GCI Building is reproduced in Figure 5. This dashboard covers grid supply to the building as well as photovoltaic production (there is 140kW of PV on the GCI roof and adjacent roofs feeding the building) and the flow into and out of the buildings energy storage battery. Other graphics are available showing the consumption of key building sub-loads: light and power; mechanical services (pumps and motors); the lift; and the building's chiller. Plans have been developed to extend the coverage of this and similar software packages to other buildings across the campus during 2013/14.

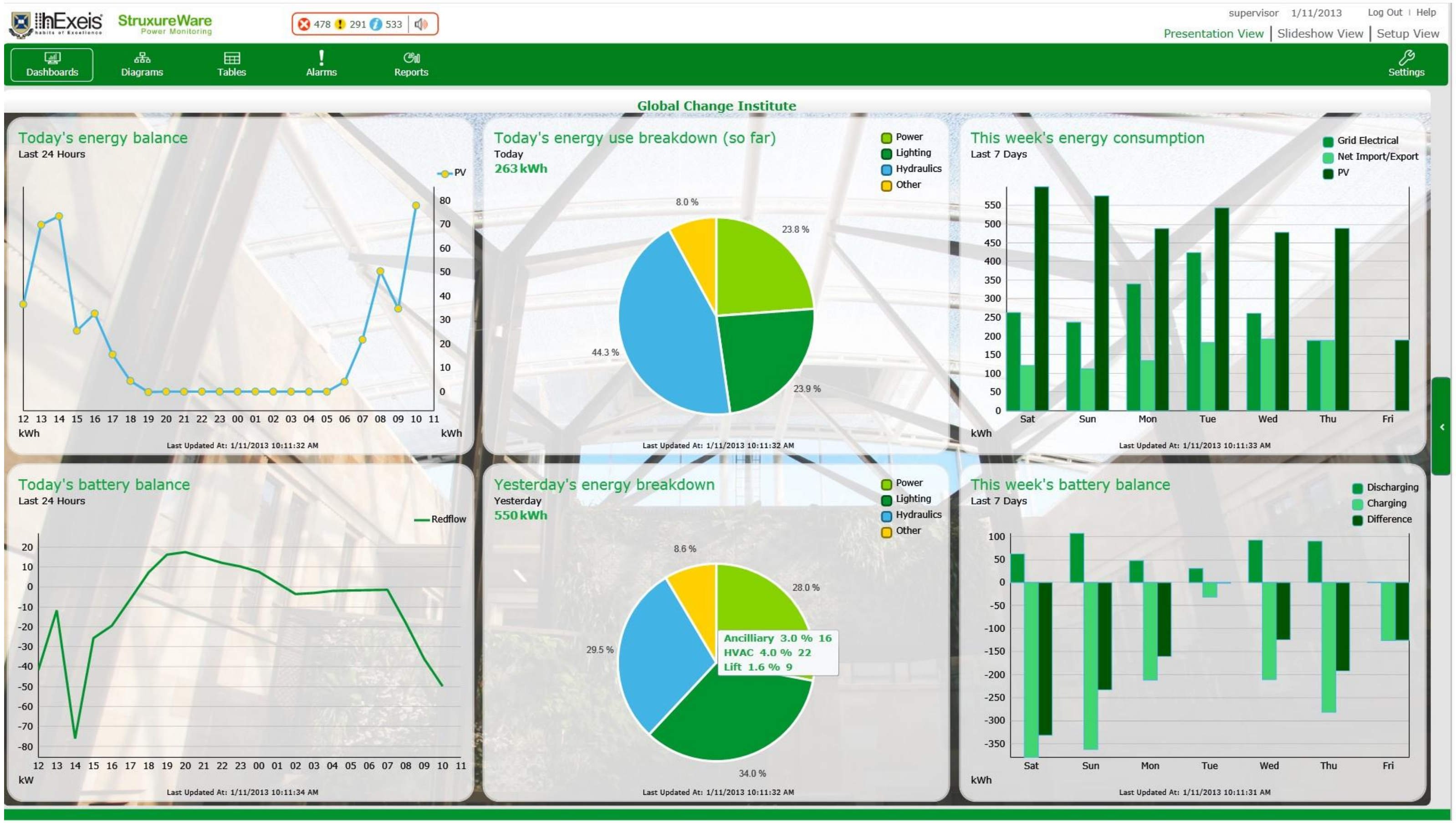

Figure 5: Global Change Institute Building Energy Dashboard

Building Management Systems

The chilled water produced by chiller stations is used in air handling plant to cool offices, teaching spaces, laboratories, animal facilities, server rooms and data centres at the St Lucia Campus. The Johnson Controls Metasys system provides the building management system (BMS) to control this extensive air conditioning system. A BMS system with good user friendly graphical interface can be used to detect opportunities and assist with the implementation of energy efficiency projects. The type of opportunities that can be detected range from correcting miss-scheduled plant (which means a service is provided when not needed), to excessively low temperature set-points and clashes between heating and cooling the same space. A common and very energy efficient project is to slightly raise set-points where appropriate (usually office spaces). This measure often reveals weaknesses in the current air conditioning systems, such as the poorly ventilated spots or work stations hotter than average (due to proximity to equipment like photo copiers or north facing windows). A good BMS system facilitates troubleshooting of such issues so that tailored solutions can be created rather than simply switching the whole floor or building back to the earlier state and missing out on the energy saving opportunities.

During 2012/13 the aspects of the BMS were reviewed during the audit of 12 buildings. University staff extended this review to a gap analysis across the campus. This led to a rethink of the existing BMS graphics and the development of a new graphic design guide that creates a single port of call (home page) for each floor of each building. The plant and equipment that serve the floors are immediately obvious and the operating temperatures in each room are visible. Design guides that deal with related matters, such as a consistent plant and equipment naming and numbering convention were also developed.

One or two clicks away from the home page the viewer can find all relevant information on the scheduling for the floor, the operation of plant and equipment and data trends or logs.

The graphical design guide was trialled on one floor of the Prentice Building (one of the resulting interactive user views is shown in Figure 6). The user views that resulted from implementing the design guide were found to be very effective at identifying opportunities and troubleshooting air conditioning problems. As soon as implemented, the graphical interface provided benefits: a significant scheduling error was found; outside air fans were discovered to be running 24/7 rather than being synchronised with air handling units; after hours calls for air conditioning were logged and found to result in the whole floor being serviced rather than just the occupied zone; and clashes between heating and cooling were noted.

These problems were progressively resolved during 2012/13. The after-hours issue was addressed by installing additional after hours buttons and making control adjustments so that, as far as possible, an air conditioning service is only directed to the zone that made the after-hours call. This after hours system is now being monitored and if the results match expectations then the system will be rolled out across the campus. Meanwhile plans have been developed to trial the design guide on a complete building during the first half of 2013/14 and then progressively implement the system in the second half of that financial year.

During 2013/14 the University's policies regarding appropriate temperature set-points for offices and teaching spaces will be reviewed. If a decision is taken to raise these slightly then the new BMS graphic interface will be invaluable when implementing and monitoring the change.

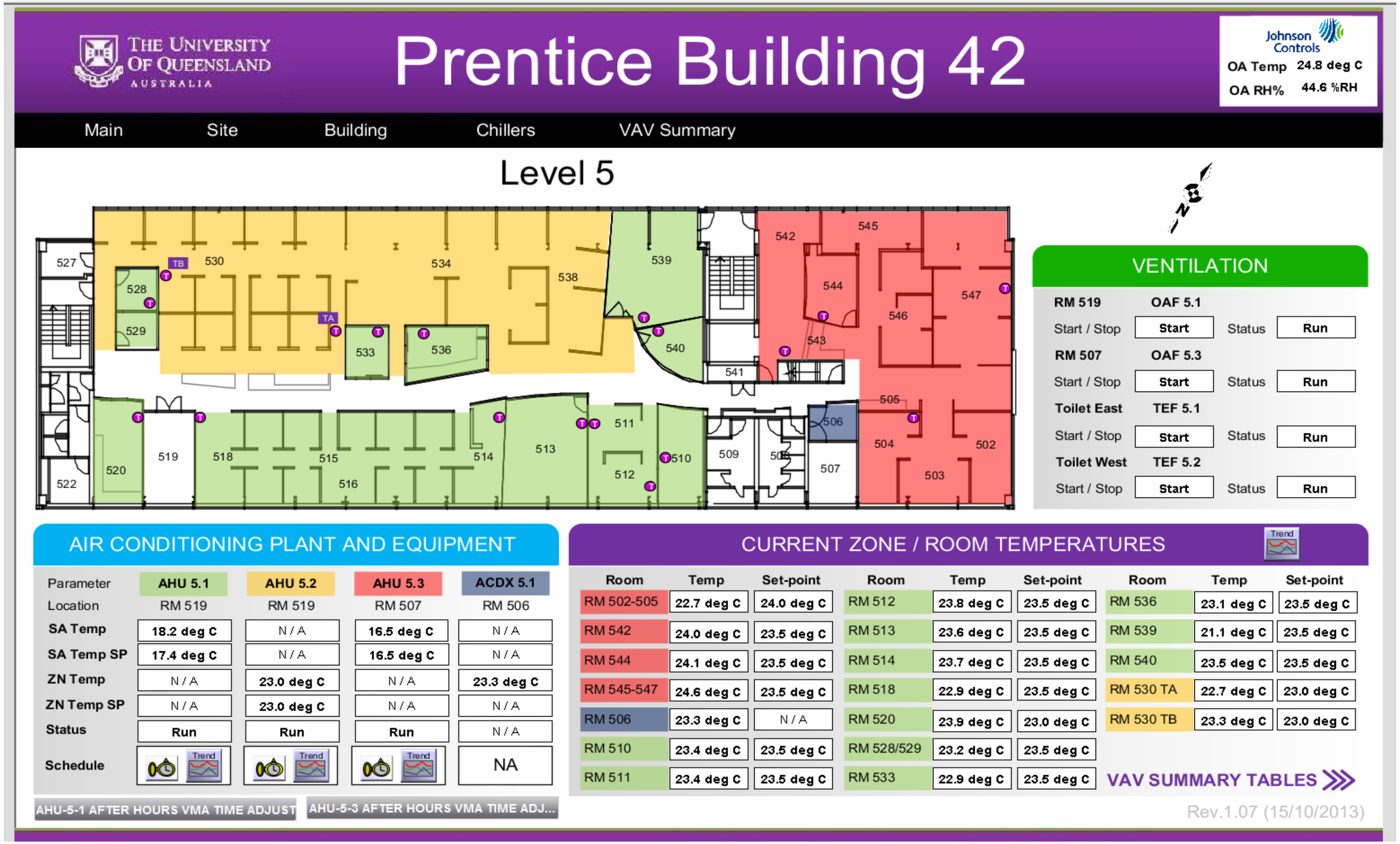

Figure 6: BMS Floor Plan Graphic Interface

Student and Staff Engagement

The University employs a limited number of students directly in energy management. The improvements to the BMS systems and the metering and monitoring systems outlined above have enabled students to identify energy efficiency opportunities. Less training is needed to get results from the new user friendly interfaces and time is spent more productively looking for opportunities for improvement and troubleshooting. The University is also committed more generally to the St Lucia campus being develop as a living laboratory – putting in place systems so that students and staff can make use of the buildings and infrastructure as teaching, learning and research resources. This is reflected in the design philosophy of the new Advanced Engineering Building and the Global Change Institute Building (both with occupancy scheduled for August 2013).

Having various forms of metering and monitoring available creates the potential for greater engagement of students and staff in energy management issues. Having more eyes on the system, so to speak, increases the chances that delinquent equipment behaviour, incorrect scheduling and so on, will be promptly picked up and rectified. Most of the established meter front end software packages do not, however, have provision for web clients. In order for people to have visibility of the metering system, a special application usually has to be loaded onto their desktop computers. To overcome this limitation the University is developing a web based system that interfaces with standard meter front end software. The idea is that eventually people will be able to click a shortcut on their desktop and be able to review the energy meter and BMS information for their building (and other buildings).

During 2012/13 a prototype touchscreen application was developed for the Prentice Building as a platform for staff and student engagement. The touchscreen application had a slideshow which could be controlled by the user. Some of the slideshow pages allowed for further interaction and query. The idea was to not only have foyer based touchscreens but also to have all the information for a building available via the web. At the time the prototype was developed, energy information for the Prentice Building was limited to the photovoltaic production from the roof top array rendered via the University's interactive live PV display, http://www.uq.edu.au/solarenergy/. Figure 7 shows the screen in use.

During 2012/13, the capacity to show a real time power diagram for buildings was developed. A power diagram was integrated into the touchscreen application developed to satisfy a Green Star requirement for the Advanced Engineering Building (Figure 8 below). The touchscreen application is available as a web URL, namely, http://uq.rise.ws/aeb/. The website is best viewed using Mozilla Firefox as the browser. There are plans to augment this application in 2013/14 with an energy dashboard and to extend the level of user interaction across more energy sub-metering and BMS parameters.

The 5 Star Green Star Advanced Engineering Building (AEB) is a mixed mode building which means at times it will operate in an open mode with cross ventilation rather than normal air conditioning. As well as providing information on energy use, the touchscreen application also provides information aimed to improve the building occupants' understanding of the AEB design philosophy and how they can work with this energy efficient building and make it function better. A similar touchscreen application will be developed for the Global Change Institute Building in 2013/14. The prototype Prentice Building touchscreen application will be brought up to the same standard as the AEB display and a broader strategy for roll out of touchscreens across other buildings will be prepared in the first half of 2013/14.

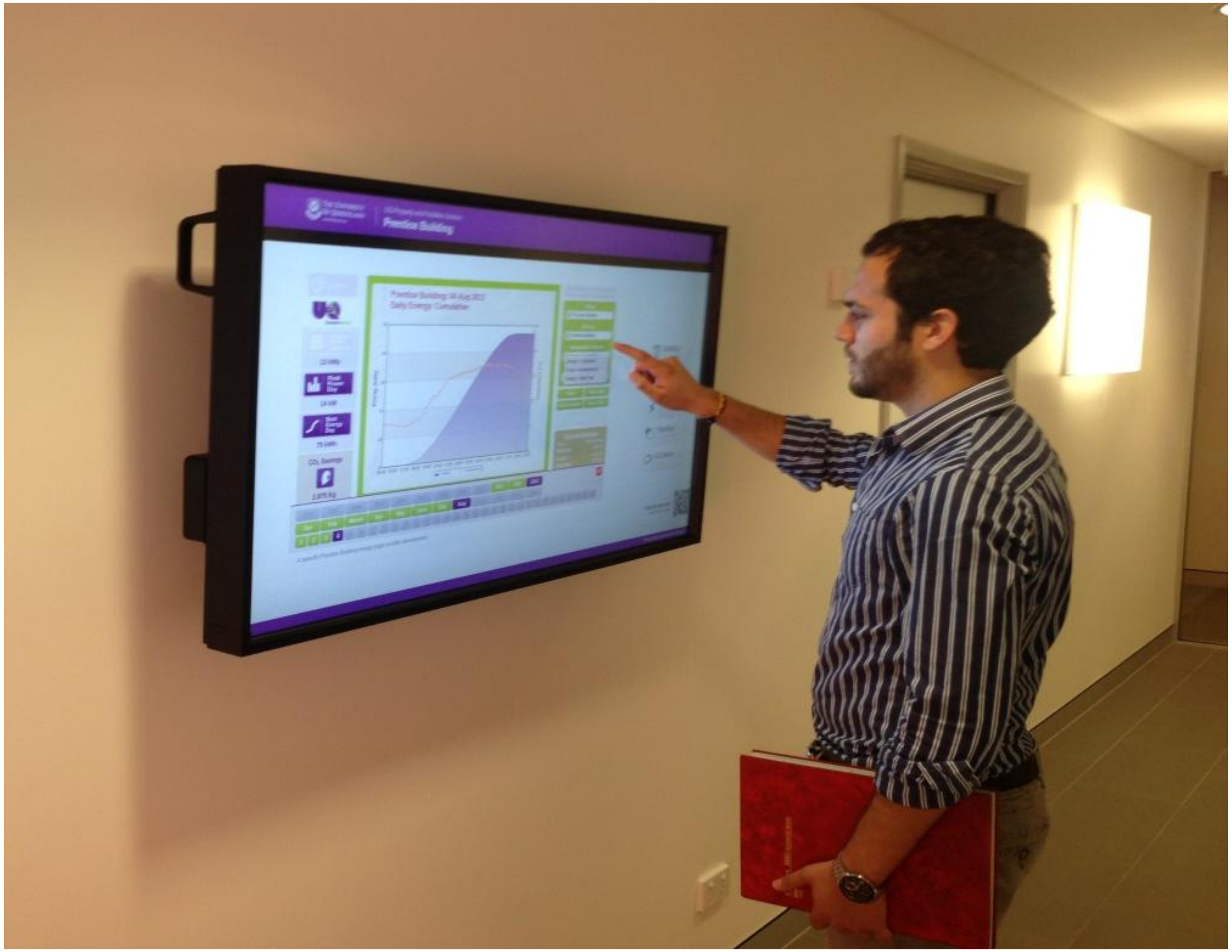

Figure 7: Prototype Touchscreen Display – Showing UQ Solar Live PV Display
http://www.uq.edu.au/solarenergy/

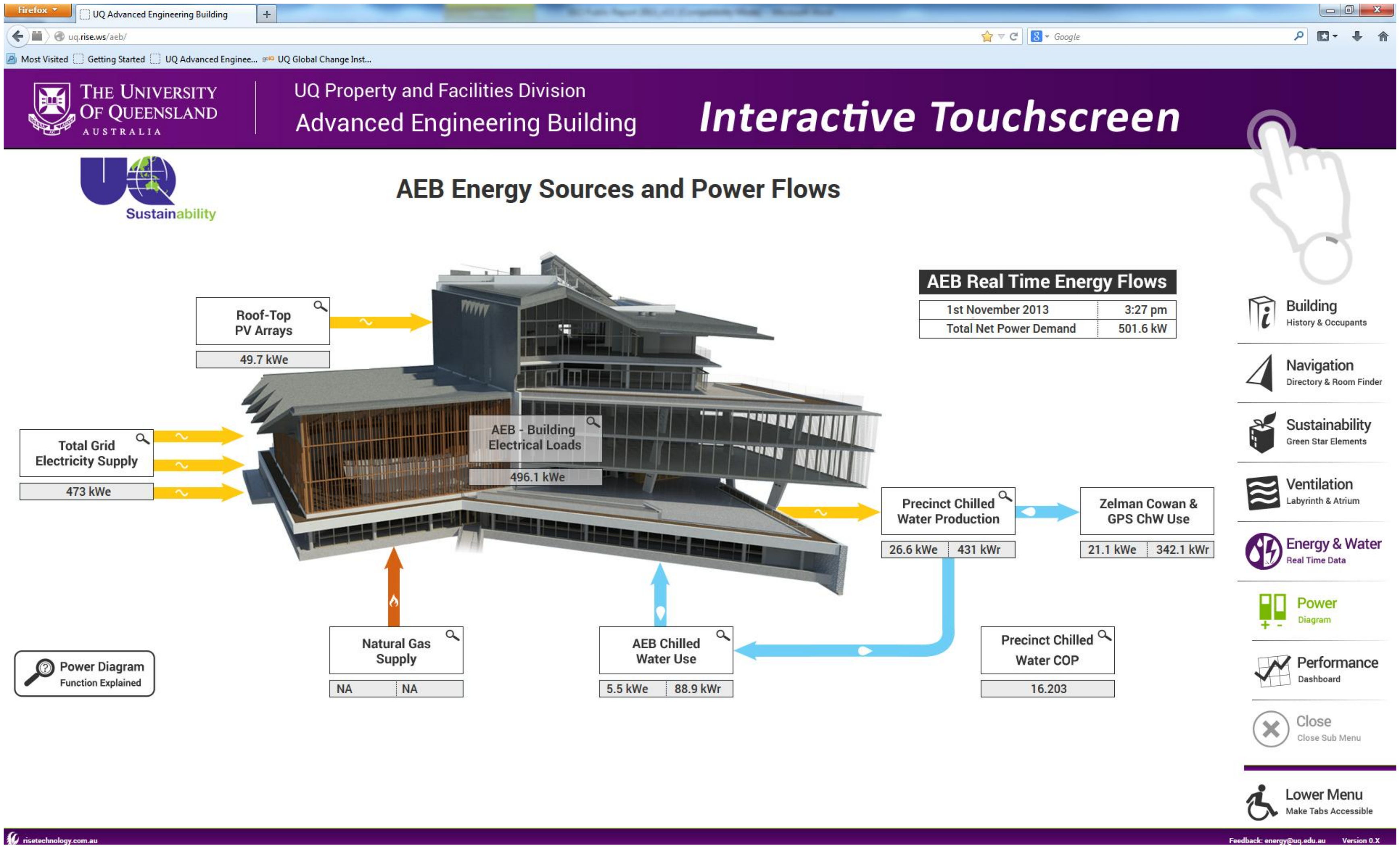

Figure 8: Real Time Energy Power Diagram – Example

From AEB Touchscreen http://uq.rise.ws/aeb/

(optimised for Mozilla Firebox)

Name of entity	Gatton Campus

A. Total corporate energy use in the last financial year	60,897	GJ
B. Total energy use covered by assessments	0	GJ
C. Total percentage of energy use assessed (B ÷ A) x 100	0	%

Description of the way in which the entity carried out its assessment

The UQ Gatton Campus is located adjacent to the Warrego highway at Gatton approximately 90km west of Brisbane. The main activities at Gatton are teaching and research associated with veterinary and agricultural science disciplines, food production and environmental management. Gatton has residential colleges to house students and accommodation for visiting staff. It also has administration, teaching and research buildings, a veterinary hospital and farm facilities such as a dairy, calf rearing sheds, piggery units and equine facilities.

During 2010/11, consultants conducted a Level 1 energy audit of the Centre for Advanced Animal Science (CAAS), a complex of buildings at Gatton. CAAS is a joint venture between the Queensland Department of Primary Industries and The University of Queensland. The CAAS complex comprises 24 buildings ranging from containment laboratories through to animal sheds. CAAS is a relatively new complex and possibly as a consequence, no energy efficiency opportunities with paybacks of less than 4 years were identified by the audits.

Two of the audit report‘s recommendations concerned hot water heating. Recommendations were made to replace electric resistance storage heaters with heat pumps or to augment the systems with solar collectors. Retrofitting the relatively new existing equipment at CAAS was not considered cost effective, but the University thought that retrofitting hot water plant close to end of life would be viable. As a consequence during 2011/12 the University reviewed how water is heated at Gatton and noted other opportunities for improvement, such as converting the electric hot water heaters at the Halls of Residence to solar electric and heat pump water heating. Using heat recovery from refrigeration to heat water was another opportunity noted.

A detailed survey was undertaken of the hot water systems at the Halls of Residence. The Halls can accommodate around 450 people and provide hot water for showers and clothes washing. They have some LPG water heating systems but most of hot water demand is met via electric storage heaters. The total installed capacity is just over 180kW. During 2012/13 a hydraulic consultant was engaged to document retrofit proposal for the Halls of Residence hot water systems. This work is planned for 2013/14.

The expansion of the dairy herd at Gatton revealed shortcomings in the system used to supply hot water for washing down and equipment flushing. Electric resistance heating was used to provide this water. Like most dairies the one at Gatton had a large refrigeration unit to cool the milk holding vat. During 2011/12 a project was developed to use the waste heat from the refrigeration unit to preheat the water needed for washing and flushing. The key elements of the project are a super heater and 450 litre tank that recover heat from the refrigerant that would normally just be transferred to the atmosphere via a radiator and a fan. This project was completed during 2011/12. It is expected to save approximately 15,000 kWh in electricity per year or about $1,500 in running costs.

An electrical meter documentation exercise, similar to that carried out at the St Lucia campus, was completed at Gatton during 2011/12. Meter locations and other attributes were entered into an asset management database and single line diagrams showing the campus electrical reticulation and meter positions were drawn up. This work will assist with the identification of energy efficiency opportunities in future years.

During 2011/12 the University investigated an opportunity at Gatton to treat piggery and other waste streams via anaerobic digestion to produce methane and to use this to produce heat and power. Solar thermal and photovoltaic power opportunities were also investigated at Gatton during 2011/12. This was followed by an investigation into the potential storage of surplus PV as chilled water for later use in air conditioning. The use of other renewable energy sources at Gatton, such as biomass fuels, was also examined. The possibility of integrating various renewable energy sources with energy efficiency and load management initiatives to create a clean energy campus was explored. This resulted in a report on the measures that might be needed to make the Gatton Campus more self-sufficient based on clean energy sources.

Energy management efforts at Gatton during 2012/13 also went into supporting the development of a project involving the installation of a 3.27MW PV pilot project at Gatton, part of the Commonwealth Government's Solar Flagships program. The pilot project required reconfiguration of the existing high voltage (HV) grid connection and changes to the Gatton campus internal HV network. Additional metering needed to be scoped to monitor energy flows. The brief for an energy efficient solar research building was developed.

The pilot project includes battery storage of energy. Outside the scope of the pilot project, consideration is being given (as mentioned above) to storing surplus PV electricity as chilled water for later use. The PV pilot project will greatly reduce the grid demand of the Gatton campus. The storage of energy in batteries and possibly as chilled water will reduce the need to export power during time of PV surplus. Taken together these factors mean that the pilot project will reduce energy losses on the transmission grid.

Name of entity	Ipswich Campus

A. Total corporate energy use in the last financial year	17,850	GJ
B. Total energy use covered by assessments	0	GJ
C. Total percentage of energy use assessed (B ÷ A) x 100	0	%

Description of the way in which the entity carried out its assessment

The UQ Ipswich Campus is located at Ipswich, approximately 40km west of Brisbane. The campus was established in 1999 on the site of an historic mental health facility. The campus consists of a mix of heritage buildings and relatively modern facilities. At Ipswich the University provides teaching, research and clinical activity in the Health Sciences, but also offers programs in the Arts and Education.

During 2010/11 two energy related initiatives took place at Ipswich. The production and distribution of chilled water was reviewed by consultants in the context of developing a chilled water master plan. The local electricity distribution company, Energex, requested that the University also explore the potential for peak load reduction in the course of developing the master plan. Subsequently, a chilled water thermal energy storage (TES) proposal was developed for the Ipswich Campus. The TES project had the potential to save energy as well as shift load to off-peak periods. The cost to the University of a TES system turned out to be very high and a decision was taken not to proceed with the project. Experience with this project has, however, encouraged the University to explore a similar concept at its Gatton Campus where a number of factors may make TES more viable.

During 2011/12 the University conducted a detailed light technology survey of all the interior lighting at the Ipswich campus (20 buildings). The type, number and location of all fittings and lamps were recorded in an Access database. This information was then assessed to identify energy efficiency retrofit opportunities based on replacing lamps, de-lamping and installation of sensor controls, etc. The retrofit projects are planned for 2013/14.

Outdoor lighting was also reviewed at Ipswich. There are over 200 pole mounted outdoor lights at Ipswich each containing a 70W sodium lamp. Trials were conducted where the sodium lamp was replaced with a 24W compact fluorescent lamp. Light levels remained satisfactory so this retrofit is now being rolled out.

An electrical meter documentation exercise, similar to that carried out at the St Lucia campus, was completed at the Ipswich campus during 2011/12. Meter locations and other attributes were entered into an asset management database and single line diagrams showing the campus electrical reticulation and meter positions were drawn up. This work will assist with the identification of energy efficiency opportunities in future years.

Name of entity	Moreton Bay Research Station

A. Total corporate energy use in the last financial year	1,144	GJ
B. Total energy use covered by assessments	0	GJ
C. Total percentage of energy use assessed (B ÷ A) x 100	0	%

Description of the way in which the entity carried out its assessment

UQ's Moreton Bay Research Station (MBRS) is located at Dunwich on North Stradbroke Island which is on the eastern side of Moreton Bay and about 45km east of Brisbane. The MBRS is used to conduct marine research, to provide teaching facilities for University and secondary school students and is also used as a conference venue.

In view of the high cost of electricity supplied to the MBRS, consultants were engaged to examine the feasibility of using renewable energy sources, namely solar hot water heating and PV to supply some of the Station's needs. During 2010/11, the University also engaged with consultants and the local electricity distribution company, Energex, to study peak load reduction opportunities at the MBRS. These studies improved our knowledge of the MBRS load profile and energy distribution across end uses and also indicated some general opportunities for energy efficiency improvements.

One general opportunity related to lighting retrofits. Subsequently the University conducted a detailed survey of the lighting at the MBRS and drew up a scope of work for improvements, which mainly consisted of replacing T8 fluorescent tubes withT5 tubes and the use of voltage controllers. This work was completed in 2012/13.

Other lighting retrofits completed at MBRS during 2012/13 included the replacement of 50W halogen dichroic lamps and fluorescent PLC lamps with energy efficient low wattage LEDs. This work was made possible in part due to over-lamping (excessively high light levels) with the existing fittings. This issue was picked up during lux surveys.

Another opportunity related to water heating. The hot water system at MBRS is based on electric resistance storage cylinders and a pumped circulation loop. The existing shower heads were replaced with super low flow heads which lowered hot water use by almost 15%. The circulation pump was placed on a timer and this has reduced heat losses from the long pipe network. The pipe insulation was also improved. Finally a solar collector and storage tanks were installed.

Reflective window film was installed on north facing windows at the MBRS during 2012/13. Prior to this action the potential for solar heat gain through these windows was substantial and would have been adding to the air conditioning load.

The renewable energy feasibility study mentioned above has led to a 40kW PV installation on the roof of the MBRS, completed in November 2011. While this does not qualify as an opportunity in terms of EEO legislation, the panels themselves create a secondary efficiency gain; they provide significant shade to the research station roofs thus reducing solar heat gain and load on air conditioning equipment. It is difficult to quantify this benefit at present but it is being considered as a subject of research at the University.

The renewable energy feasibility and load reduction studies also revealed that energy management at the MBRS would be improved by the installation of sub-meters and a power quality meter. This work was completed during 2011/12 and is now assisting with the identification of further energy efficiency opportunities at the MBRS.

Name of entity	Heron Island Research Station

A. Total corporate energy use in the last financial year	1,967	GJ
B. Total energy use covered by assessments	0	GJ
C. Total percentage of energy use assessed (B ÷ A) x 100	0	%

Description of the way in which the entity carried out its assessment

Heron Island is located 72km NE of Gladstone, off the central Queensland coast. The island has the Delaware North Heron Island Resort, a Queensland Parks and Wildlife Service Ranger Station and the University's Heron Island Research Station (HIRS).

During 2010/11 Wide Bay Water Corporation managed a Commonwealth Government Green Precincts Project which was designed to improve energy efficiency, reduce water use and reduce the carbon footprint of activities on this World Heritage Site. Wide Bay Water Corporation arranged a comprehensive audit by external consultants of energy and water use at the HIRS. Subsequently Wide Bay Water Corporation worked with UQ to action many of the audit recommendations. The University funded around two thirds of the cost of implementation and the balance came from the Green Precincts program.

One of the key Green Precincts projects, a 54kW photovoltaic installation, does not qualify itself as an EEO project, but the presence of solar panels on the roofs of the research Station is thought to reduce solar heat load and thus reduce electricity used for air conditioning.

Super low flow shower heads were installed resulting in energy savings of around 15% from the need to heat less hot water. Water on the island comes from the Resort's desalination plant, so such water efficiency measures reduce the diesel consumption of the Resorts generators. This saving has not been attributed to UQ in this EEO report.

The key projects that saved energy at the HIRS were: installing a variable speed (VS) drive; improved control on the HIRS seawater pump that supplies water to the teaching and research aquariums; placing timers on the air conditioning equipment so that it switches off when people are not present; improving the controls on food cold-rooms and freezers; and making improvements to lighting. These were all completed in 2010/11.

During 2011/12 an opportunity was identified to replace an existing compressor on the island with a more energy efficient model. The compressor in question was used to provide air to an ongoing climate change experiment. This experiment runs 24 hours a day, every day, so the compressor's duty cycle is high and the potential energy saving from a more efficient model is considerable. A new highly energy efficient compressor was installed during 2012/13.

During 2012/13 there were problems from time to time with the reliability of electricity supply at the HIRS. As a consequence a decision has been taken to explore ways to make the station more self-sufficient using renewable energy. The first step though is to explore ways to make the station more energy efficient and to look at the scope for load shifting to get a better match between the timing of loads and energy supplies (such as PV generation).

During 2011/12 a complete inventory was created of all the plant equipment and lighting at the Research Station. The type of equipment, its location and rated load were noted in a database. This information will be reviewed during 2013/14 as a part of the investigation to make the station more energy efficient and self-sufficient.

Name of entity	Long Pocket

A. Total corporate energy use in the last financial year	3,478	GJ
B. Total energy use covered by assessments	104	GJ
C. Total percentage of energy use assessed (B ÷ A) x 100	2.98	%

Description of the way in which the entity carried out its assessment

The Queensland State Government made facilities at its Long Pocket site available to the University after the January 2011 Brisbane River flood. The site is near Indooroopilly and about ten minutes by shuttle bus from the main campus at St Lucia. Prior to its use by UQ, the site was used by State Government land, natural resource and environmental agencies (DERM and DEEDI). Only part of the site was occupied by UQ in 2011/12 with the rest lying largely vacant. During 2012/13 the long term future of the site was reviewed by the University and the State Government, with UQ securing a 99 year lease over the full site from May 2013.

Walk through audits in late 2010/11 and 2011/12, in advance of UQ occupying certain buildings, indicated that opportunities existed for the lighting to be improved by retrofitting more efficient lamps or installing occupancy sensors. These opportunities were implemented during 2011/12. Now that the long term future of the site is known, the University will expand the lighting surveys, audit other energy services such as the air conditioning systems and review the existing metering systems.

Name of entity	Indooroopilly Mine

A. Total corporate energy use in the last financial year	3,675	GJ
B. Total energy use covered by assessments	0	GJ
C. Total percentage of energy use assessed (B ÷ A) x 100	0	%

Description of the way in which the entity carried out its assessment

The University of Queensland Experimental Mine is located at Indooroopilly, a suburb of Brisbane. It is situated on a moderately steep slope bordering Witton Creek some 200m from the Brisbane River. The site has a mining history dating back to 1918 when silver/lead mineralisation was discovered. It now has a number of surface office, teaching and maintenance buildings as well as subsurface mine features.

The UQ School of Mechanical and Mining Engineering operate out of the site. The Julius Kruttschnitt Minerals Research Centre (JKMRC), now part of the UQ Sustainable Minerals Institute (SMI), also shares surface infrastructure at the site.

During 2011/12 the University surveyed the lighting in the seven surface buildings at the Mine site. Information on fitting and lamp locations, type, number and control were recorded in an Access database. This has revealed a number of retrofit opportunities. These surveys will be reviewed and where appropriate developed into scopes of work for implementation during 2013/14.

Table 2.2 - Energy efficiency opportunities identified in the assessment

St Lucia

Status of opportunities identified		Total Number of opportunities	Total estimated energy savings per annum (GJ)
Business Response	Implemented	30	812
	Implementation Commenced	0	0
	To be Implemented	23	520
	Under Investigation	43	7,898
	Not to be Implemented	1	9
Outcomes of assessment	Total Identified	97	9,238

Please note that Corporate Groups **are not required** to report opportunities with a payback greater than 4 years. Reporting this data is voluntary.

Gatton

Status of opportunities identified		Total Number of opportunities	Total estimated energy savings per annum (GJ)
Business Response	Implemented	1	54
	Implementation Commenced	0	0
	To be Implemented	0	0
	Under Investigation	0	0
	Not to be Implemented	0	0
Outcomes of assessment	Total Identified	1	54

Please note that Corporate Groups **are not required** to report opportunities with a payback greater than 4 years. Reporting this data is voluntary.

Ipswich

Status of opportunities identified		Total Number of opportunities	Total estimated energy savings per annum (GJ)
Business Response	Implemented	0	0
	Implementation Commenced	0	0
	To be Implemented	1	145
	Under Investigation	0	0
	Not to be Implemented	0	0
Outcomes of assessment	Total Identified	1	145

Please note that Corporate Groups **are not required** to report opportunities with a payback greater than 4 years. Reporting this data is voluntary.

Moreton Bay Research Station

Status of opportunities identified		Total Number of opportunities	Total estimated energy savings per annum (GJ)
Business Response	Implemented	4	43
	Implementation Commenced	0	0
	To be Implemented	0	0
	Under Investigation	0	0
	Not to be Implemented	0	0
Outcomes of assessment	Total Identified	4	43

Please note that Corporate Groups **are not required** to report opportunities with a payback greater than 4 years. Reporting this data is voluntary.

Heron Island Research Station

Status of opportunities identified		Total Number of opportunities	Total estimated energy savings per annum (GJ)
Business Response	Implemented	2	203
	Implementation Commenced	0	0
	To be Implemented	0	0
	Under Investigation	0	0
	Not to be Implemented	0	0
Outcomes of assessment	Total Identified	2	203

Please note that Corporate Groups **are not required** to report opportunities with a payback greater than 4 years. Reporting this data is voluntary.

Long Pocket

Status of opportunities identified		Total Number of opportunities	Total estimated energy savings per annum (GJ)
Business Response	Implemented	5	186
	Implementation Commenced	0	0
	To be Implemented	0	0
	Under Investigation	0	0
	Not to be Implemented	0	0
Outcomes of assessment	Total Identified	5	186

Please note that Corporate Groups **are not required** to report opportunities with a payback greater than 4 years. Reporting this data is voluntary.

Indooroopilly Mine

Status of opportunities identified		Total Number of opportunities	Total estimated energy savings per annum (GJ)
Business Response	Implemented	0	0
	Implementation Commenced	0	0
	To be Implemented	0	0
	Under Investigation	0	0
	Not to be Implemented	0	0
Outcomes of assessment	Total Identified	0	0

Please note that Corporate Groups **are not required** to report opportunities with a payback greater than 4 years. Reporting this data is voluntary.

Table 2.3 - Details of significant opportunities identified in the assessment

It is compulsory to report at least 1 example of a significant opportunity for improving the energy efficiency for the controlling corporation that has been identified in assessments. If a corporation has structured assessments to relate to business units or key activities they should report one significant opportunity for each of those entities to which the assessment applies.

Description of Opportunity No 1	Type of information to be covered
Chiller Optimisation Package The installation of permanent electrical and thermal meters on the chillers in the Central Chiller Station on St Lucia campus has enabled chiller performance to be monitored. Low coefficients of performance were observed especially at low load. There is room to improve the operation of the chillers, cooling towers and associated pumps. Presently condenser water flow, cooling tower staging and chiller load are not closely matched, for example. The chilled water set-point is also fixed rather than allowed to float slightly with the load. It is possible to operate a chiller station and its cooling towers in a closely matched manner to optimise service delivery and energy efficiency. Sub-optimal performance was also observed with the plant and equipment serving the St Lucia Commerce Hill Chiller precinct. A combination of the right equipment and suitable control strategies is needed to achieve optimal performance. Often variable speed drives need to be retrofitted to pumps and fans and a custom controller installed. This type of retrofit can typically yield energy savings of up to 25%. Chiller manufacturers, for example have developed custom optimisation packages. These packages control the chillers, pumps and cooling towers and other necessary ancillary equipment so the load, at all times, is satisfied in way that, while consistent with the operating limitations of the plant and equipment, gives the most energy efficient outcome. A typical package will consist of a PLC like controller, additional sensors needed on plant and equipment; sensor and control wires/cabling to facilitate inputs and outputs from sensors and controlled equipment; one or more data ports; and other balance of system hardware. The optimisation program usually comes with a front end application, complete with a graphics package that enables the performance of the package to be monitored and adjusted from desktop computers and a plant room touchscreen. The relationship between the BMS and the optimisation package can vary but typically the package controls all necessary plant and equipment, creates and stores logs and provides visibility of data and	Equipment Type Business Response Energy saved (GJ) Greenhouse gas abated (CO2-e) $s saved Payback period

operating parameters and can generate reports; the BMS may also provide visibility of data points and operating parameters, but does not control plant and equipment. During 2012/13 the University decided to install two optimisation packages; one each for the plant and equipment serving the Central Chiller Precinct and the Commerce Hill Chiller precincts. Only minor plant retrofits are needed for the Commerce Hill precinct – two new variable speed drives are needed. More retrofit work is needed to install a suitable package on the Central Chiller Precinct: • Installation of Three (3) 45kW Variable Speed Drives for Condenser Water Pumps • Installation of Ten (10) 5.5kW Variable Speed Drives for Cooling Tower Fans • Installation of differential pressure transducers and temperature sensors as required • Installation of Chiller Optimisation unit to control: a) Three (3) Centrifugal Chillers b) Three (3) Existing Chilled Water Pump Variable Speed Drives c) Three (3) Newly supplied/Installed Condenser Water Pump Variable Speed Drives d) Ten (10) Newly supplied/Installed Cooling Tower Fan Motor Variable Speed Drives e) Primary Chilled Water Bypass Valves • Provision of a software package to provide system visibility and control via desktop and HMI • Installation of a HMI in the plant room to provide local visibility and control. Retrofitting optimisation packages can typically yield energy savings of up to 25%. Contract negotiations for the two retrofits were completed during 2012/13 The total cost of the two packages will be approximately $180,000 and the average payback is expected to be less than 4 years. The work is planned for the first half of 2013/14. These retrofits are being treated as trials and if they are successful then the University will develop plans to install optimisation packages on other chiller stations and cooling towers.	

Description of Opportunity No 2 – Voluntary	Type of information to be covered
Moreton Bay Research Station UQ's Moreton Bay Research Station (MBRS) is located at Dunwich on North Stradbroke Island which is on the eastern side of Moreton Bay and about 45km east of Brisbane. The MBRS is used to conduct marine research, to provide teaching facilities for University and secondary school students and is also used as a conference venue. From a strategic point of view it is tempting for the University to focus on its largest campuses since they consume the bulk of the large overall energy demand. It is important however, that all students and staff be engaged in the task of improving energy use wherever they are. The MBRS also has a special role to play due to its involvement with the wider community as a conference venue and host for secondary school student visits. The MBRS already showcases renewable energy through having rooftop PV array and solar hot water heating system. During 2013 a lighting retrofit program was carried out. This involved swapping the existing T8 fluorescent tubes for more efficient T5 tubes. After allowing for changes in ballast losses as well as the lower lamp wattage, the retrofit reduced consumption by around 10W per tube. This type of retrofit is not obvious to the untrained eye; the other retrofits done at MBRS used LED downlights and create more of a talking point and educational opportunity. Inefficient dichroic halogen downlights were replaced with LEDs. A number of PLC downlights were also replaced with lower wattage LEDs. These retrofits were possible because there was a degree of over-lamping at the Station and this was picked up during lux level surveys. Finally reflective solar film was applied to a number of north facing windows. This reduced glare and improved occupant comfort but also significantly reduced solar heat gain. This in turn reduced the load on the air conditioning system. In all, the lighting retrofit project and installation of window film saved over 6000 kWh per annum.	Business Response Energy saved (GJ) Greenhouse gas abated (CO2-e) $s saved Payback period

Please note that the "Description of the Opportunity" above should include information on the specific nature and type of opportunity as well as information on the type of equipment and/or process involved.