Liverpool city council
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Liverpool City Council Energy Management Plan

August 2012

Liverpool City Council Energy Management Plan

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Executive summary

Since 2006 energy savings actions at Liverpool City Council facilities have been guided by the Liverpool City Council Energy Savings Action Plan. This plan has now run full-term, with all action either completed or requiring review. As such a new plan is needed to guide energy actions.

Liverpool City Council's Energy Management Plan provides a list of practical energy saving measures for key energy using facilities, with a detailed list of potential energy savings that can be achieved at these sites. The 2012 Energy Management Plan aims to:

- Set the strategic direction for Council's energy use
- Provide Council with a unified approach to energy conservation and management
- Identify key actions to achieve energy savings
- Allocate responsibility for energy conservation actions to be undertaken in relation to Council's operations
- Identify resources required to implement energy saving programs.

Energy use at Council facilities for the 2011-12 financial year (combined natural gas and electricity) was approximately 7,971 megawatt hours (MWh), at a cost of over $1,213,000. Resultant greenhouse gas emissions were at least 8,368 tonnes of Carbon Dioxide Equivalent (CO2-e).

Council's top energy using facilities consumed approximately 6,118MWh of energy or approximately 31% of Council's total energy use. During the 2011-12 financial year these top 14 energy using facilities accounted for over 78% of facilities electricity use. Focusing on 14 key energy using facilities enables Council to maximise the impact of energy management and retrofit actions.

The current review of Council's energy plans began with audits of key energy use sites, creating a list of 128 recommendations for reducing energy consumption. In total, proposed actions have the potential to reduce facilities energy consumption by approximately 32%. That is 2,051 MWh of electricity and approximately 5,466 gigajoules (GJ) of gas. This is equivalent to an annual reduction of approximately 2,604 tonnes of Carbon Dioxide (CO2-e).

Within the list of actions for energy efficiency, core measures, to be implemented in the short-term, have the potential to reduce electricity consumption by 1,756,060kWh, at a cost of approximately $1,626,000 and total financial savings of at least $348,900 per year (a payback of 4.7years). The Energy Management Plan focuses on these key measures or actions at in order to reduce energy use in the most cost effective manner.

The 2012 Liverpool City Council Energy Management Plan is informed by the list of audit recommendations as well as the NSW Office of Environment and Heritage – *Local council guide for Energy Management Plans*. The result of energy actions will be reported annually via Council's management report.

Signoff of the Plan

The Liverpool City Council Energy Management Plan provides a progressive approach to improving resource management. On behalf of Council I am pleased to endorse the Liverpool City Council Energy Management Plan for the next four years.

Farooq Portelli
General Manager

1. Introduction

1.1 Introduction to Liverpool City Council

The Liverpool Local Government Area covers approximately 305 square kilometres and includes 45 suburbs, from Greendale in the west to Holsworthy in the east. The Liverpool Local Government Area still consists of semi-rural areas but also has an expanding and vibrant City Centre where major commercial and retail opportunities exist. Liverpool City's current population is over 185,480 and is expected to reach 228,770 by 2021. Council's 605 full time staff currently maintain a large number of assets, including:

- Over 791km of sealed (and illuminated) roads
- Over 500km of walking paths and cycle ways
- 501 parks (including flood lit ovals)
- 5 Libraries
- 3 Aquatic / leisure centres
- More than 40 community centres

With both energy costs and population density expected to rise dramatically in the next ten years, resource management will be a key factor in the growth and development of Liverpool.

Liverpool City Council is committed to reducing the environmental impact of its facilities and activities through conserving resources and leading by example. Energy is embodied all the goods and services used by Council. Any attempt to reduce Council's environmental impact necessarily includes addressing energy use.

2011-12, organisation wide electricity consumption data showed an approximately 3% decrease compared to the previous financial year. The Energy Management Plan aims to continue this trend, identifying energy savings in a practical, effective and flexible way, detailing organisational and facility based actions to reduce energy use.

Planet Footprint

Since 2009 Liverpool City Council has used the services of a utilities data collection/aggregation service. Utility data for all facilities was collected and sorted on Council's behalf (by Planet Footprint), to assist Council monitor key energy using facilities (and track energy use generally). This aggregated energy data service facilitates the evaluation of energy management actions.

1.2 Limitations and Variations

While informed by State Government guidelines the 2012 Liverpool City Council Energy Management Plan (EMP) is unique in scope in the following ways. Firstly, the EMP focuses exclusively on energy used at Council facilities. That is the plan excludes energy use through street lighting and consumption of fuel in Council vehicles and equipment.

Vehicle fleet and street lighting energy use are addressed elsewhere by Council. For example internal policy requires that street lights installed are the most efficient available at the time and at end of life are replaced with the most efficient technology available. Meanwhile Council's Motor Vehicle Fleet Management Policy addresses the use of bio-fuels (bio-diesel) and fuels with Ethanol additives (E10). For more information on efficient fuel use see Councils plan at: www.liverpool.nsw.gov.au

The first step in the planning process is collection of energy data from existing sources. This allows Council to develop an understanding of energy use and prioritise key sites. For the organisation as a whole Council uses the services of the data aggregation service mentioned. Meanwhile, for individual facilities Council relies on receiving bills directly from service providers.

Prioritisation of key sites is an important first step in creating relevant and applicable energy efficiency plans. Focusing on key energy using facilities enables Council to direct limited resources to where they will be of most benefit. These facilities account for over 78% of Council's total consumption of energy. As such the EMP focuses on energy saving at the list of key energy using facilities listed in section 1.3.

Unfortunately, several factors have affected the ability of Council to obtain consistent billing data for all facilities. A change in energy provider is only one reason for inconsistent data, and data collection by key energy using facilities must be improved.

Available utility data for key energy using facilities was collected, on Council's behalf, then analysed by an energy auditor to assist Council monitor key energy use. Once again, limited data (lack of smart meters at some sites) meant that for most sites peak electrical demand savings could not be determined and for some sites seasonality could not be determined. Most significant is the lack of natural gas data for Michael Wenden Aquatic Leisure Centre. Whitlam Leisure Centre used 18,250GJ of natural gas in 2011-12. That is Whitlam Leisure Centre data shows significant use of natural gas at a similar facility. The under-reporting of gas use for Michael Wenden Aquatic Leisure Centre is expected to lead to dramatic under estimation of total energy demand. All of this of course means the energy usage reported for the organisation will slightly underestimate actual consumption.

Throughout this report Energy Density is defined as the total annual energy consumption for the site (electricity + gas) divided by the total area of all buildings at the site. This provides a useful method of benchmarking energy use between facilities of comparable function. Note that in some cases buildings considered to be storage sheds have not been included in the total area figure. The audit reports included in Section 7 of this document provide details of audit methodology and site inventories.

Finally, in discussing key sites electricity (and occasionally energy) usage is reported in kilowatt hours (kWh) not megawatt hours (MWh). This is because at the larger MWh scale energy data for smaller facilities is imprecise. Natural gas figures are usually presented as gigajoules (GJ) used.

1.3 Key Energy Using Facilities

Since the 2006 Liverpool City Council has undergone massive change and growth. The single greatest impact on operations has been the destruction (by fire) of Council's administration centre, at Hoxton Park Road and the establishment of a new administration centre at 33 Moore Street, Liverpool.

Current key energy using sites include aquatic centres, ovals and administration centres. Each was audited by energy experts to provide a list of practical energy saving measures, with a detailed list of potential energy savings that can be achieved at key sites. This energy management plan details actions for:

- Carnes Hill Reserve
- Casula Community Centre
- Casula Library
- Casula Powerhouse Art Centre
- Casula Pre-school
- Council Administration Building
- Chipping Norton Recreation Centre
- Hammondville Park
- Liverpool City Library complex
- Liverpool Regional Museum
- Michael Wenden Aquatic Leisure Centre
- Northumberland Street Carpark
- Rose Street Depot
- Whitlam Leisure Centre

Focusing on key energy using facilities, or sites where Council's electricity use is concentrated, enables retrofit actions to attain maximum benefit (return on investment), achieving both significant energy reductions and doing so in the shortest period of time.

Auditing these sites enables Council to maximise the impact of energy management and retrofit actions. As part of the audit process Council also reviewed small sites, such as the Liverpool Regional Museum, which have a disproportionately hight energy given the scale of the site. The list of key energy-using sites will change as facilities improve their energy management. Table 1, below details the current list of key sites.

Note: Two centers, Holsworthy Swim Centre and Green Valley Library Council have, in the past been included as key energy use sites. However, as part of this EMP, development of energy actions is relying on the results and recommendations of the audits from similar sites. That is, while Holsworthy Swim Centre and Green Valley Library were not audited, the results and recommendations of the audits of similar sites are informing energy management at both at both these facilities.

Table 1: Description of key audit sites

Site Name	Site Address	Site Description
Carnes Hill Reserve	Greenway Drive, West Hoxton	Also referred to as Greenway Park, this site is comprised of an oval with flood lighting, a carpark, playground equipment, three barbeques and three free standing brick buildings. The buildings house a kiosk (with store room), change rooms/showers and a public toilet block. The park also contains Cricket, AFL and Softball are played at this location. Greenway park is home to the Southern District Shires Cricket Club, South West Tigers Junior Australian Rules Football Club and the Wildcats Softball Club.
Casula Community Centre	39 Ingham Drive, Casula	This centre is part of a complex of three single story brick buildings on site (including library and pre-school. The Community Centre shares an awning with the pre-school but is otherwise a stand-alone building. The centre is comprised of a hall, kitchen facilities, tables and chairs. Hall capacity = 100.
Casula Library	39 Ingham Drive, Casula	The library is a single story brick building; part of a complex of three buildings on site. Opening house are9.30am-5pm on Monday, Wednesday, Friday, 9.30am-8pm on Tuesday and Thursday and 9.30am-12 noon on Saturdays.
Casula Powerhouse Art Centre	Casula Road, Casula	Casula Powerhouse is a regional arts centre that provides facilities for theatre performances, exhibitions, functions and education programs.

Casula Pre-school	39 Ingham Drive, Casula	Casula Pre-School is a single story brick building, in a complex of three, Council owned buildings. The recently refurbished pre-school (was a childcare centre) provides educational care for children aged 3 – 5 years. The centre operates Monday through Friday, 8.30am – 4.30pm.
Council Administration Building	33 Moore Street, Liverpool	The building is a seven storey office complex with ground floor retail and a three storey basement carpark. Tenants include Liverpool City Council, the NSW Police service, other NSW State Government agencies and private organisations.
Chipping Norton Recreation Centre	Angle Park, Homestead Avenue, Chipping Norton	Also referred to as The Lakes Boatshed, the lower level of this centre is home to a local boating club (fridges, work area and boat storage). The upper floor is made up of an office, kitchen facilities, tables and chairs and a hall with capacity for 100 seated guests.
Hammondville Park	Heathcote Road, Hammondville	The site has five sporting fields for soccer, rugby, cricket and baseball. The site also has five netball courts, five amenities blocks, a grandstand and car park areas. The sporting fields border Moorebank Sports Club and Harris Creek Reserve.
Liverpool City Library complex (incl. carpark)	170 George Street, Liverpool	The car park building has six levels with open air parking on level 5 and provides approximately 666 parking spaces. The library building is located adjacent to the car park level 1. The library has three levels with a small café on the ground floor of the library.
Liverpool Regional Museum	Cnr Hume Highway and Congressional Drive, Liverpool	The Liverpool Regional Museum was established in 1989 with the aim of preserving and promoting Liverpool's history and cultural heritage. The single story brick building is made up off offices, amenities, a research room and large open plan gallery space with exhibit lighting.
Michael Wenden Aquatic Leisure Centre,	62 Cabramatta Avenue, Miller	The aquatic leisure centre is owned by Liverpool City Council and operated by Belgravia on Council's behalf. The aquatic leisure centre consists of three swimming pools, which include a 50m outdoor heated pool, an indoor heated programs pool and a children's splash pool. The aquatic leisure centre also contains a fitness centre, two indoor fitness (indoor soccer) courts, childminding area and kiosk.
Northumberland Street Carpark	Northumberland Street, Liverpool	This 440 space, 3 level carpark is composed entirely of aging reinforced concrete, with artificial lighting on all levels. The site recently installed parking meters to become a Pay-and-Display carpark.

Rose Street Depot	99 and 101 Rose Street, Liverpool	The depot consists of a reception building, trades workshop, training facilities, operations centre and mechanical workshop, which has a vehicle wash facility. A total of 185 staff are employed at the depot, of this, approximately 30 staff work full time at the depot per day. The remainder of staff work on council maintenance and operations projects throughout the local community.
Whitlam Leisure Centre	Hoxton Park Road, Liverpool	The leisure centre is owned and operated by Liverpool City Council and operated by Belgravia on Council's behalf. The leisure centre contains an aquatic centre, stadium, fitness centre and function facilities. The aquatic centre consists of a 50m outdoor heated pool, an indoor 25m heated pool, an indoor leisure pool, spa and sauna. The stadium and function facilities have seating capacities of up to 3,000 people and 3,200 guests respectively.

1.4 History of Energy Savings

In 1998 Liverpool City Council committed to reducing greenhouse gas emissions when it joined the Cities for Climate Protection (CCP) program. In 2003, the Greenhouse Reduction Actions in Liverpool (GRAIL) was developed and adopted by Council (as part of achieving Milestone Three of the CCP program). Most recently, in 2006 Liverpool City Council produced the Energy Savings Action Plan (ESAP) to guide energy conservation actions.

The ESAP was prepared through a cross-council working group, with full implementation of the four-year plan aimed to save 1,306 Megawatt hours (MWh) of energy (approximately 2% of total consumption at the time) and 1,286 tonnes of carbon dioxide equivalent (CO2e) greenhouse gas emissions each year from Council's activities. The Energy Savings Action Plan has now run full-term.

With the cost of energy increasing rapidly, monitoring and reducing Council's energy consumption is becoming increasingly important. Liverpool City Council's Energy Management Plan (EMP) addressed this need by identifying energy savings in a practical, effective and flexible way; as well as detailing organisational and facility based actions to reduce energy use.

The EMP replaces the ESAP and has been informed by the plans and protocols that preceded it, reflecting Council's continuing commitment to saving energy. The EMP is also informed by the Office of Environment and Heritage *Local council guide for Energy Management Plans*.

Creation of the EMP began with energy audits of key Council managed facilities. Combined these sites account for over 78% of the electricity used by Council (excluding street lighting). Section 3 of this report details these key energy use facilities. The list of priority actions in Section 6 are derived from the auditors recommendations for these sites.

The 2012 Energy Management Plan aims to:

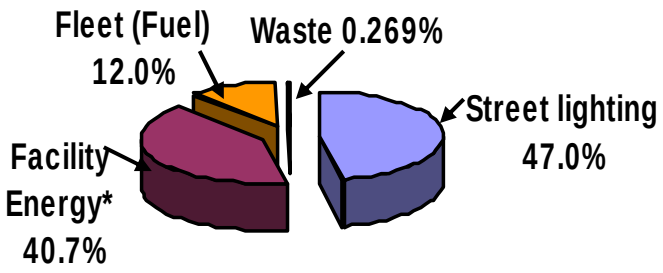
- Set the strategic direction for Council's energy use
- Provide Council with a unified approach to energy conservation and management

- Identify key actions to achieve energy savings
- Allocate responsibility for energy conservation actions to be undertaken in relation to Council's operations
- Identify resources required to implement energy saving programs.

Council's largest energy use has been the provision of essential street lighting (see section 1.1). Fortunately addressing energy use through street lighting is a straightforward process. Council policy dictates that once a street light reaches end of life it must be replaced with the most efficient bulb available (determined as cost over lifespan of the unit). While a slow process, retrofitting has resulted in Council trailing both L.E.D. and solar powered street lighting. Solar powered lighting is currently being used in several reserves and 'passive play' parks.

Figure 1, below illustrates organisation wide energy consumption. Energy use for facilities (the focus of this EMP) was 40.7% in 2011-12. This is up from 27.3% the previous year and is largely matched by a fall in the contribution made by street lighting, falling from 58.2% last financial year to 47% in 2011-12. In part the increase in energy use by facilities can be attributed to a new and expanding Council Administration Centre. Major redevelopment/retrofitting of the site is expected to begin in 2014 and is currently in the planning phase.

Figure 1: Emissions by source for the 2011-12 financial year



*Facility Energy is comprised of electricity and gas supply to buildings, water infrastructure and other facilities

1.5 Corporate Strategic Planning

Liverpool City Council has prepared a 10 year Community Strategic Plan for the City, *Growing Liverpool 2021*. The community strategic plan set directions for "social, environmental, economic sustainability and civic leadership for the future". The plan and includes a:

- 10-year community strategic plan for the City
- 4-year Delivery Program – describing the direction Council is taking in relation to key performance areas such as energy, during the council term.
- 1-year Operational Plan – describing the specific actions that Council will implement during the year. These are complex energy actions, made up of several stages or sub-actions.
- Resourcing Strategy – describing how Council will manage its assets, finances and human resources
- 10 year long term financial plan
- 10 year asset management plan
- 4 year workforce management plan

These documents will inform the community what Council will do to deliver its responsibilities under the Community Strategic Plan. The Delivery Program reflects the Council's priorities for Liverpool and does not necessarily address all the strategies in *Growing Liverpool 2021*. A key issue for Council in deciding on priorities for its term in office is what financial resources are available for the delivery of services.

The Operational Plan describes Council's environmental actions in broad terms. The individual steps that make up Operational Plan energy actions are described in the Business/Work Plans for the specific team in Council conducting the no-ground activity.

1.6 Integration of Energy Management Plans

Liverpool City Council's Integrated Environmental Sustainability Action Plan (IESAP) provides the mechanism for better integration of Council's broad range of sustainability-based strategies (and related actions) with Council's corporate processes. This includes integration of the energy management plans and related documentation.

The Liverpool City Council IESAP lists corporate environmental sustainability objectives and indicators. Specifically these are:

- Key Performance Area: Energy
- Objective: Reduce Council's energy use (electricity, gas and fuel consumption)
- Environmental Sustainability Indicator: Monitor trend in corporate energy consumption (electricity, gas and fuel consumption will be reported)

In the area of energy management these are interim objectives and indicators. A comprehensive energy management review is required before Council can commit to a four-year energy conservation objective, and begin to monitor success in achieving the objective.

Staff from relevant sections of Council will oversee the development and implementation of energy savings actions, to align with the Community Strategic Plan and Council's Delivery Program.

2. Historical Energy Use at Liverpool

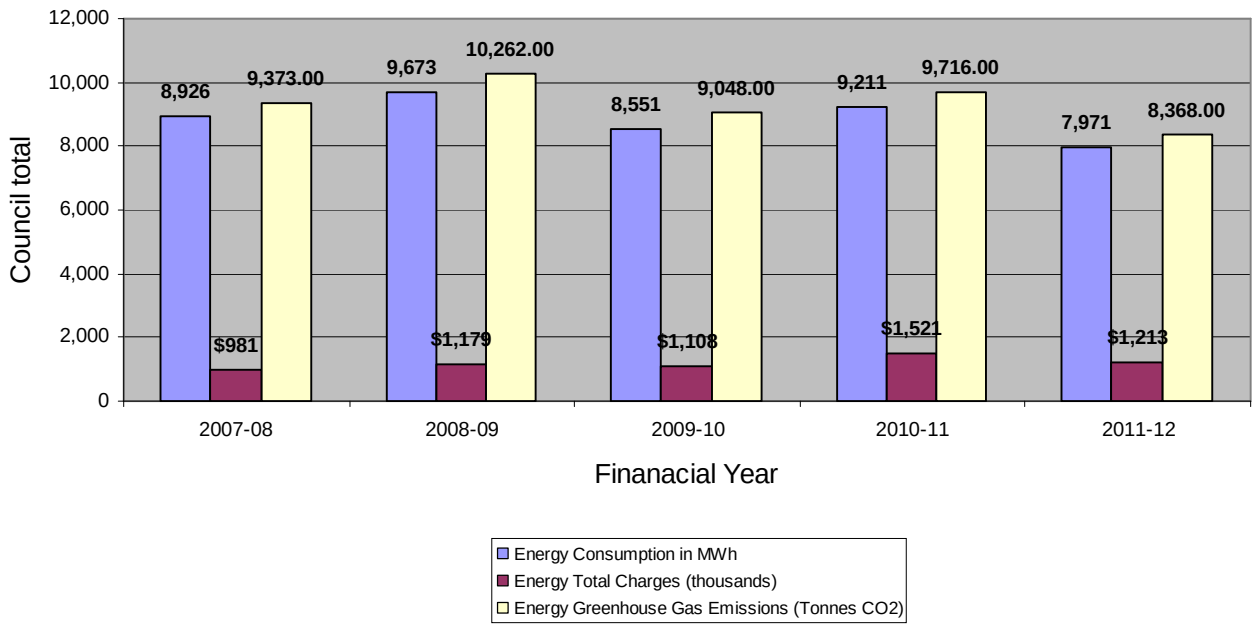
2.1 Historical Usage

During the 2005-06 financial year Council consumed approximately 14,685GJ of gas (equivalent to 1047 tonnes CO2e), and consumed 15,012MWh of electricity (equivalent to 14,787 tonnes of CO2e). Thus total energy use for the 'whole of council' was reported in 2006 as 19,091MWh.

This figure of 19,091MWh was used as the *baseline energy use* figure for Council's now superseded Energy Savings Action Plan.

As discussed in section 1, new facilities and residential redevelopment of green space has seen Liverpool City Council grow dramatically in the last five years. Figure 2, below, illustrates energy use across Council for the last five years, including the associated cost and greenhouse gas emissions.

Figure 2: Council energy use for 2007-08 to 2011-12



The above graph shows a decline in energy use during 2009-10, as Council came to the end of the term of the 2006 Energy Savings Action Plan. August 2010 saw the destruction (by fire) of Council's administration building. The rise in energy use in that year is linked to the fractured nature of Council activities at that time. Finally the 2011-12 financial year data shows a marked decrease in energy consumption compared to previous years. This is due to several factors, from retrofitting of Council libraries to increased awareness of energy issues (behavioural changes) as a result of rising energy prices.

Current energy use for the organisation as a whole, and the sites that make up Council's current suit of key energy using facilities are discussed in detail in section 3 of this report.

2.2 Historically High Use Sites

The list of sites described in the 2006 Energy Savings Action Plan as using a significant amount of energy included eight facilities that are, once again, in 2012 key energy use facilities. The table below includes the energy use of the facilities in 2005-06. This figure is the baseline against which the facility is assessed in 2011-12.

Table 2: Summary of Energy Consumption at Key Facilities in 2005-06

Site name	Baseline energy per annum	Greenhouse emissions pa tonnes CO_2e	Baseline energy use key performance indicator	Baseline summer peak electrical use (kVa)	Baseline winter peak electrical use (kVa)
Casula Community Centre	Electricity – 20,000 kWh Natural gas – 5 GJ TOTAL – 21,111 kWh	20	0.17 GJ/m^2	NA*	NA*
Casula Library	Electricity – 216,944 kWh TOTAL – 216,944 kWh	214	3.26 GJ/person/day	NA*	NA*
Casula Powerhouse Regional Arts Centre	Electricity – 85,000 kWh TOTAL – 85,000 kWh	84	0.06 GJ/m^2	45.13	43
Liverpool Central Library complex	Electricity – 1,191,000 kWh Natural gas – 292 GJ TOTAL – 1,271,944 kWh	1,194	4.35 GJ/person/day 0.8GJ/m^2	402	261
Michael Wenden Aquatic Leisure Centre	Electricity – 670,000 kWh Natural gas – 1,564GJ TOTAL – 1,104,722 kWh	772	7.03 GJ/person/day	237	240
Northumberland Street Carpark	Electricity – 194,722 kWh TOTAL – 194,722 kWh	192	0.19 GJ/m^2	39	37
Rose Street Depot	Electricity – 11,667 kWh TOTAL – 11,667 kWh	11	0.28 GJ/person/day 0.01 GJ/ m^2	NA*	NA*
Whitlam Leisure Centre	Electricity – 1,261,000 kWh Natural gas – 12,353GJ TOTAL – 4,691,944 kWh	2,122	7.13 GJ/person/day	444	261

*These sites do not contain a smart meter and therefore do not have kVa data available.

For sites not reviewed in 2005-06 the baseline year used to compare all future savings against, is the latest year for which 12 months of usage data exist.

The baselines/energy density for all key sites is listed in Table 4 of Section 3 of this report. The most critical of these sites is Council's new administration building, which makes up over 15% of total Council energy use.

Council has estimated 'base building' energy consumption of the Council Administration Building by using the data available. Energy usage data from all tenants has not been available. Based on this limited data:

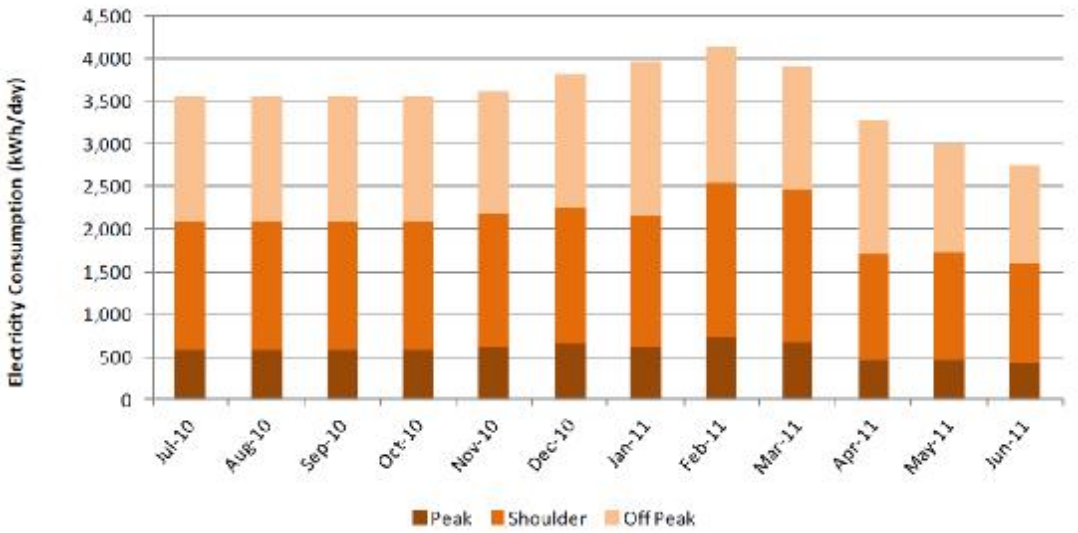
- Estimated Base Building electricity usage is 1,223,025kWh
- Estimated Base Building natural gas usage is 1,074.46 GJ

- Energy density as a function of space is 187 kWh /m2 pa (total rated floor area, TFA = 8,121 m2)
- Energy density as a function of occupancy is 3,498 kWh /person pa (435 employees in building)

Benchmarks for office buildings indicate 272 kWh/m2 pa represents the average energy density for "Whole Building Office's in Australia", as published in the Australian Building Codes Board (ABCB) Class 5 benchmarking (Edition 2.0) handbook. This handbook uses the same benchmarking principles as NABERS.

The following diagrams illustrate the historical energy use data that informed the energy audits for current key sites.

Figure 3: Historical Energy Use at Council Administration Building



Note: The current administration building has been Council property for 12 months only. July 2010 to October 2010 consumption is estimated due to unavailable data

Figure 4: Historical Energy Use at Carnes Hill Reserve

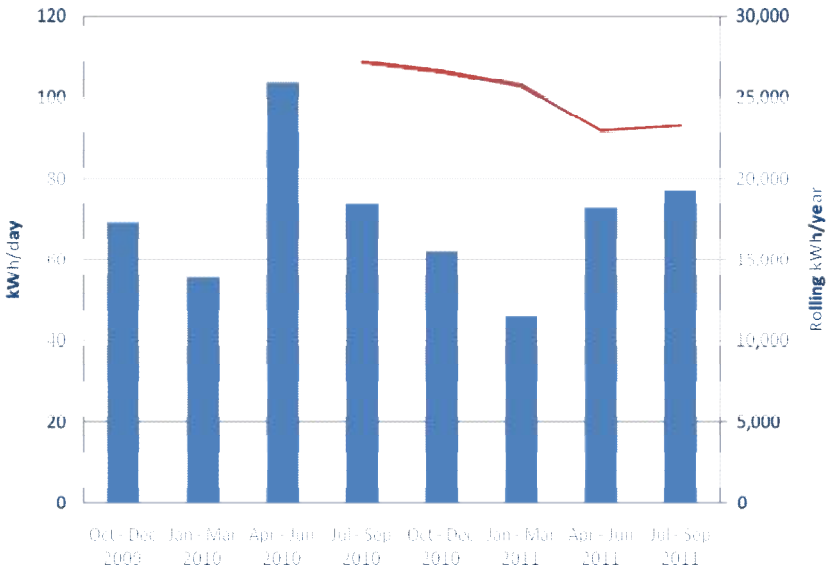


Figure 5: Historical Energy Use at Casula Community Centre

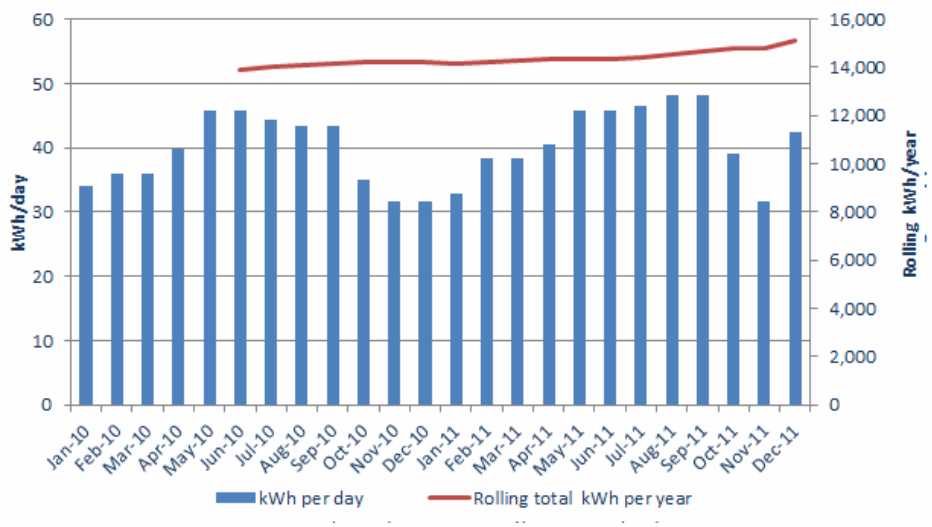


Figure 6: Historical Energy Use at Casula Library

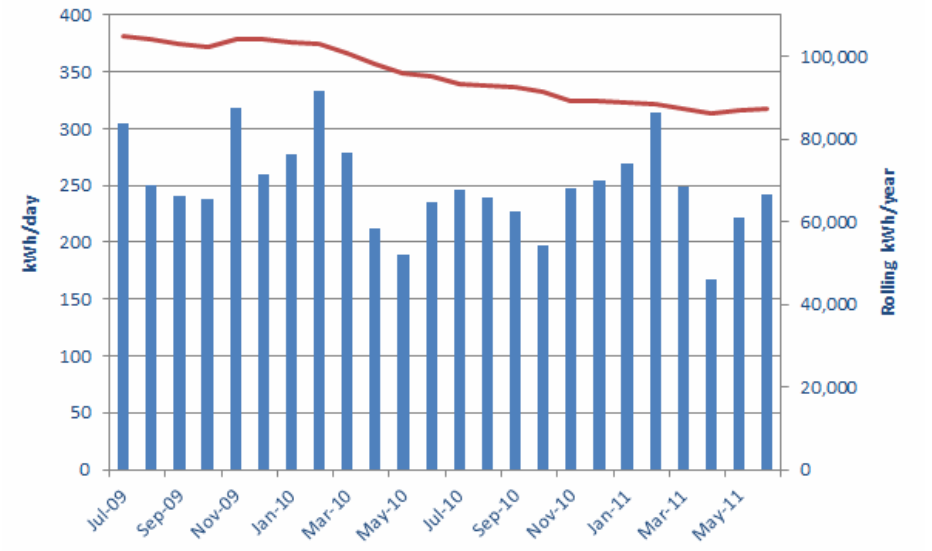


Figure 7: Historical Energy Use at Casula Pre-School

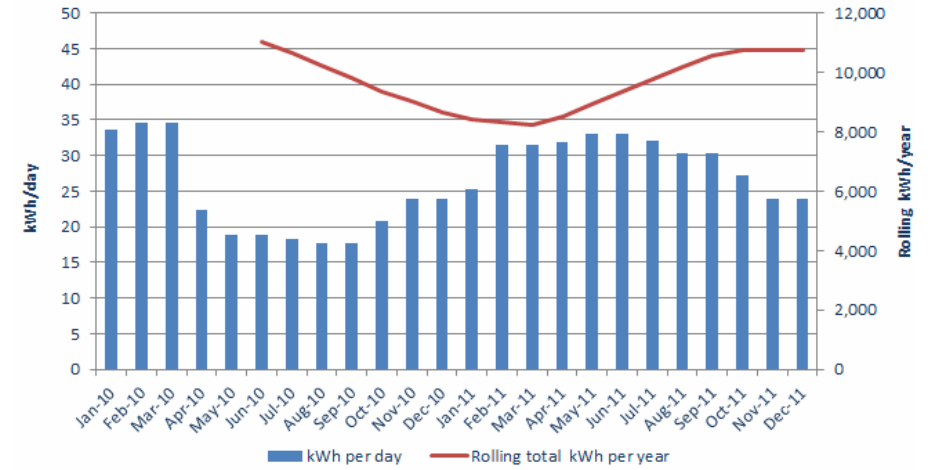


Figure 8: Historical Energy Use at Chipping Norton Recreation Centre

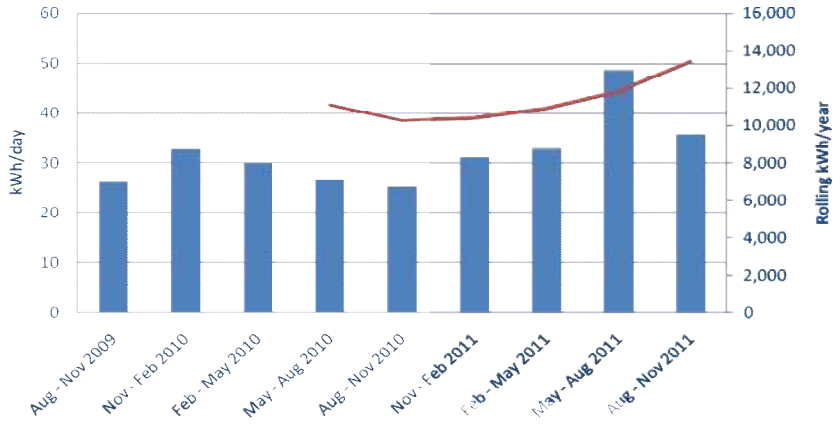


Figure 9: Historical Energy Use at Casula Powerhouse Art Centre

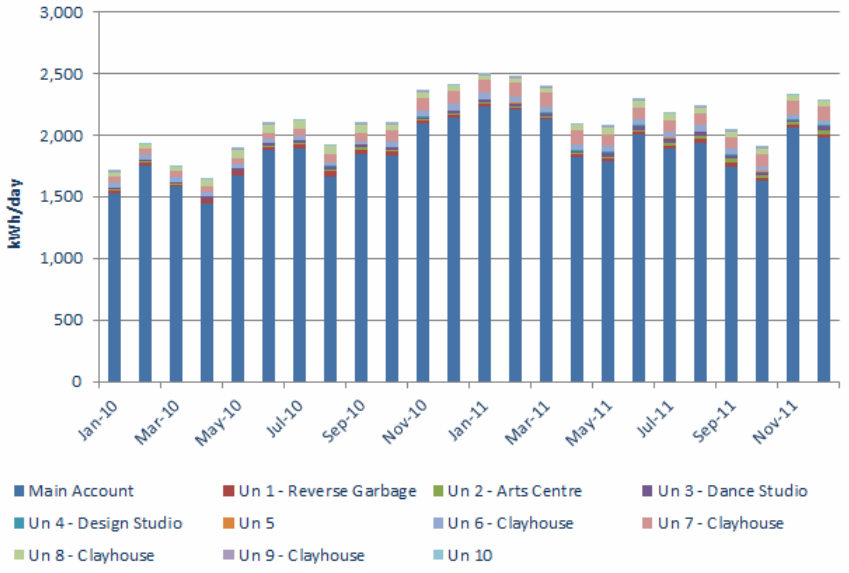


Figure 10: Historical Energy Use at Liverpool City Library Complex

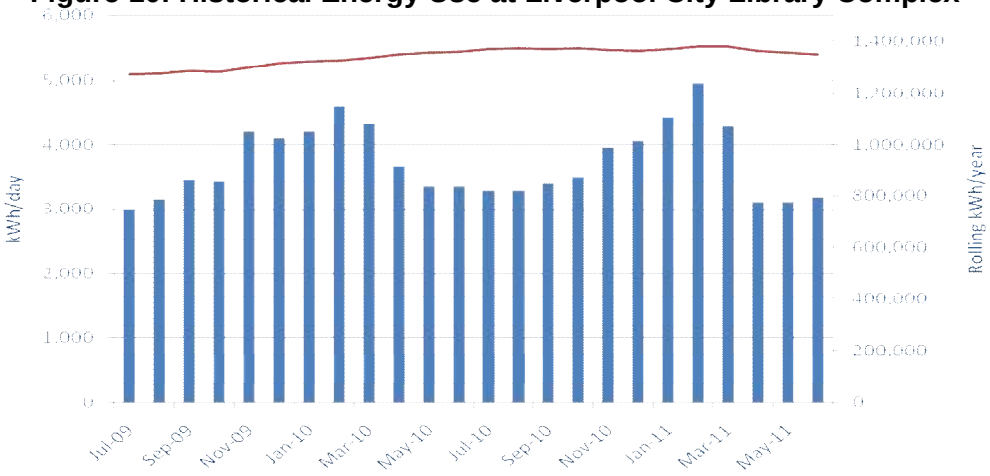


Figure 11: Historical Energy Use at Liverpool Regional Museum

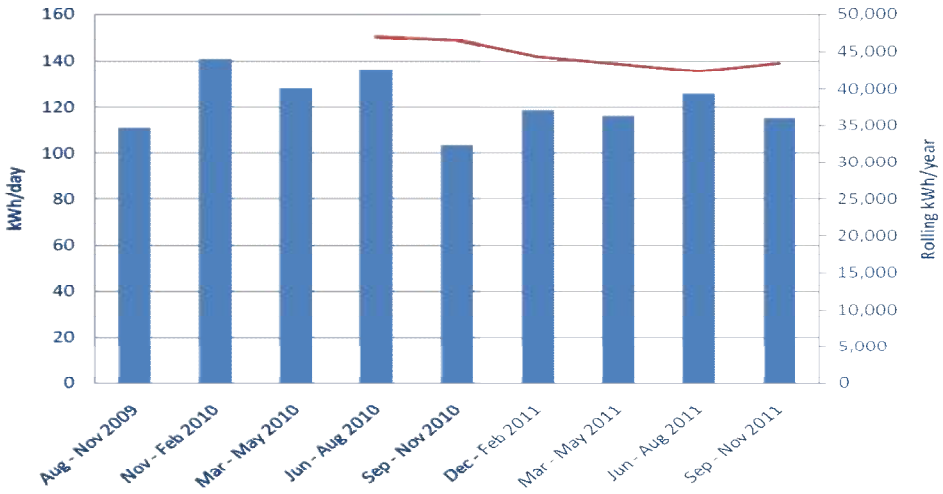


Figure 12: Historical Energy Use at Michael Wenden Aquatic Leisure Centre

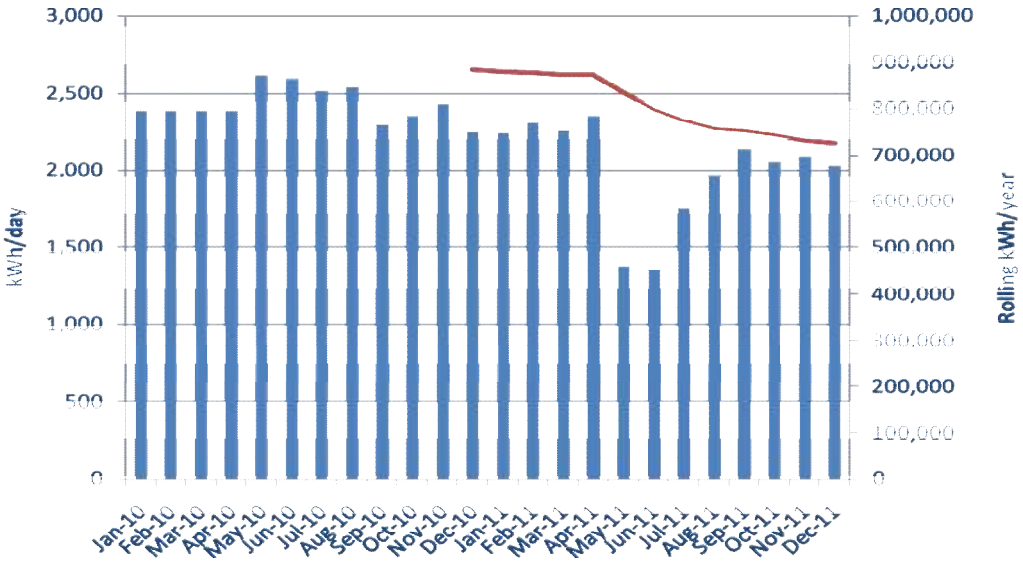


Figure 13: Historical Energy Use at Northumberland Street Carpark

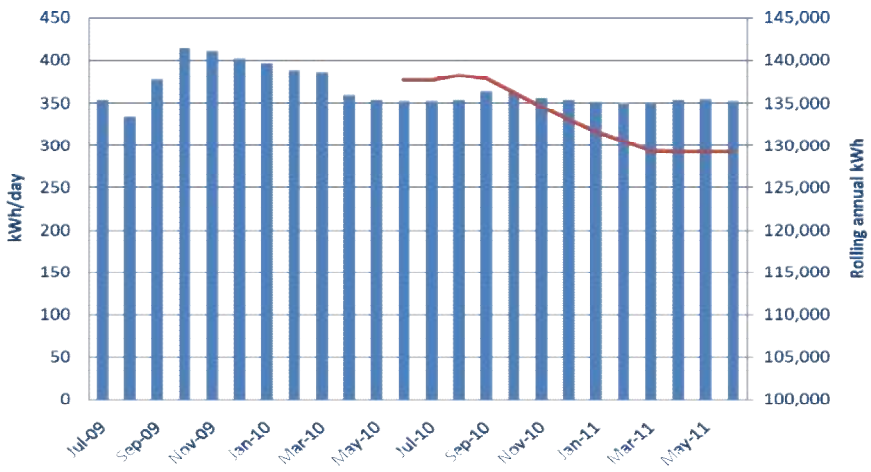


Figure 14: Historical Energy Use at Rose Street Depot

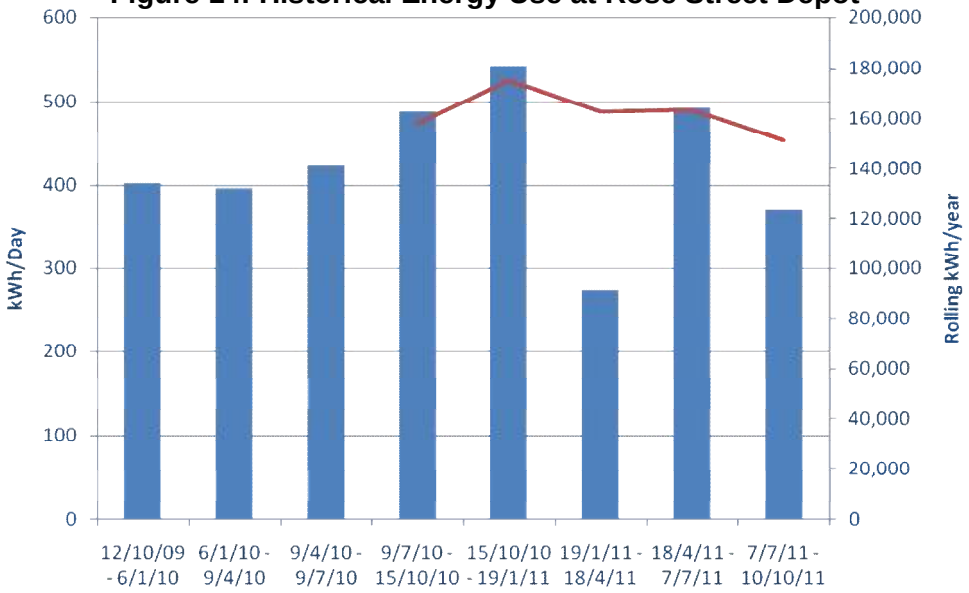
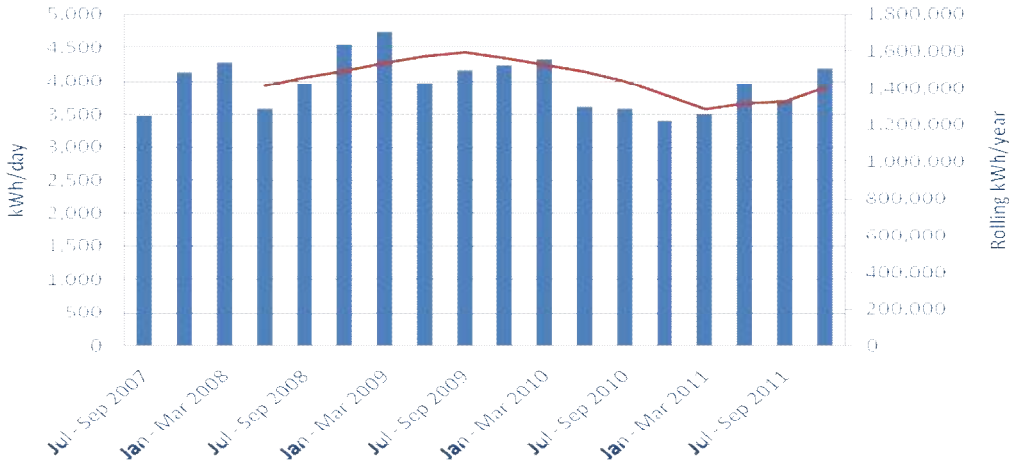


Figure 15: Historical Energy Use at Whitlam Leisure Centre



3. Current Energy Use

3.1 Defining Baseline Energy and Energy Density

Baseline energy use can be defined in terms of energy use per person or energy use per area. It is often reported as a facility's Energy Density. That is Energy Density is the amount of energy stored in a given system or region of space per unit volume.

The figure is reported in kWh/m2 or energy per hour of person usage, depending on what the business activity indicator (BAI) is appropriate for the site. For example the BAI for a sports oval may be quare meters, while the BAI for an office may be the number of staff. Thus KPI will be usage per square metre (m2) or per person. Total annual energy consumption for each facility (electricity + gas) has, in this report, been divided by the total area for parkland/carparks or persons for buildings, to provide baseline energy density figures for each key energy use facility.

Baseline energy use is a key indicator of a facility's performance as the measure accurately defines the potential to generate energy savings by analysing performance and equipment settings. Verifying baseline energy use and post-occupancy conditions validates that energy-consuming systems are operated in conformity with the design-basis documents.

This section of the EMP includes baseline energy for 14 key sites and for the organisation as a whole. The figure for key sites are drawn from the energy densities provided in the audit reports. Cumulative data for Liverpool City Council has been (since 2007-08) been provided by Planet Footprint.

3.2 Liverpool City Council Energy Consumption

As a 'release council' (responsible for the re-development of green space) the last five years have seen Liverpool City Council grow to include new suburbs and new communities; facilities have been expanded and roads built. Council itself has restructured and moved to a new administration building. As mentioned, Council's new administration centre accounts for the largest portion of energy used by Council facilities over the 2011-12 financial year. This is expected to rise as more staff are transferred from temporary facilities to the new building at Moore Street.

For these reasons the previous 'whole of council' baseline used in the 2006 Energy Savings Action Plan, is an inappropriate measure for inclusion in this energy management plan. Given the changes Council has undergone, the 2011-12 financial year is proposed as the new baseline year for future energy use comparisons.

Organisation wide energy consumption for facilities and services over the 2011-2012 financial year was approximately 7,971MWh, at a cost of over $1,213,000. Resultant greenhouse gas emissions are at least 8,368 tonnes of Carbon Dioxide Equivalent (CO2-e). Total consumption, including fuel and street lighting was approximately 19,585 MWh; equivalent to the energy use of approximately 1088 standard houses.

Energy data from 1 July 2007 to 30 June 2012 indicates an average consumption baseline of approximately 2,7292GJ or 7,581MWh hours.

The NSW Independent Pricing and Regulatory Tribunal have warned councils to expect an energy price rise of at least 15%. With this in mind Liverpool City Council's energy bill for 2012-2013, including excluding fuels and street lighting is expected to be at least $1,394,950.

The following table provides a detailed account of Council's energy consumption, at the organisation-wide scale, including street lighting and fuel purchased for equipment (excludes fuel for staff vehicles).

Table 3: Current Energy Use of Liverpool City Council

Description	All Council buildings/facilities and street lighting
Baseline Start Date	01-July-2011
Baseline End Date	30-June-2012
A: Total electricity purchased by Council in MWh	7,572.14 MWh
B: Green power purchased by council*	2.65% / 925.7MWh
C: Total electricity generated via local renewable sources	less than 1% for street lighting
D: Total electricity used by Council	7,972 MWh
E: Proportion of renewable energy used as % of total energy use by Council	approx 3%
F: Total natural gas purchased by Council in GJ	692.2 GJ
G: Total other energy that is purchased for stationary equipment on site (eg fuel)	approx 30,842 GJ
H: Total energy used by Council in GJ	70,501 GJ
Total Greenhouse gas emissions in tCO2-e [1.07(A-B) + (0.06553 x F) + (0.0748 x G)]	8,999 tCO2-e
Portion of total energy used for facilities	40.7%
Total energy used by key energy using facilities in GJ/MWh	28,694 GJ or 7,971 MWh

*Note: 10% of street lighting for the period of July to December 2011

Organisation wide electricity consumption has decreased by approximately 3% from the previous financial year. The general reduction in energy use highlights Council's proactive approach to the energy management. The challenge remains to ensure that processes are put in place to ensure that Council can consistently meet reduction targets for each key facility. It should be noted that reduction targets are a result of the audit process and are detailed in section 7 of this report.

Fire damage to Council's previous administration centre

As discussed, this Energy Management Plan focuses on actions at key sites. The following table lists energy use for key Council facilities.

Table 4: Current Energy Use for Key Sites

Site Name	Carnes Hill Reserve	Casula Community Centre	Casula Library	Casula Powerhouse Art Centre	Casula Pre-school	Council Administration Building	Chipping Norton Recreation Centre
Energy meter NMI numbers	4310336284 4310336295	43103261034	4310012394	4310291849 4310291850 4310291851 4310291852 4310291853 4310953406 4310953407 4310953408 4310953409 4310929634 NEEE004663	4.31E+10	NEEE001964 (tenants have their own meters)	4310327561
Gas meter DPI numbers	52408298516	5240653583	NA	NA	5.241E+09	52400282303	NA
Audit data start date	Oct-10	Jan-11	Jul-10	Jan-11	Jan-11	Jul-10	Nov-10
Audit data end date	Sep-11	Dec-11	Jun-11	Dec-11	Dec-11	Jun-11	Dec-11
A: Total electricity purchased on site in kWh	20,900	15,144	87,840	813,900	10,748	1,297,907	13,450
B: Greenpower purchased on site in kWh	0	0	0	0	0	0	0
C: Total Natural Gas purchased by the site in GJ	3.23	0.87	0		0.624	1,074	0
D: Other energy purchased for stationary equipment	0	0	0	0	0	0	0
Total (purchased) energy used on site in GJ	78.47	55.87	316.00	2,930.00	39.62	5,746.00	48.42
Total (purchased) energy used on site in kWh	21,797.00	15,144.87	87,840.00	813,900.00	10,748.62	1,596,240.00	13,450.00
Site greenhouse gas emissions in t CO2-e [1.07x (A-B) + (0.06553 x C) + (D x 0.0748)]	22.57	16	94	871	12	1,459	14.39
Site Energy Density	83.6 kWh/m2	41.1 kWh/m2	136.8 kWh/m2	261.5 kWh/m2	41.1 kWhm2	3,556 kWh/day or 187kWh/m2 or 3498kWh/person	106 kWh/m2

Table 4 continued

Site Name	Hammondville Park	Liverpool City Library complex	Liverpool Regional Museum	Michael Wenden Aquatic Leisure Centre	Northumberland Street Carpark	Rose Street Depot	Whitlam Leisure Centre	Totals
Energy meter NMI numbers	84N040463 84N066143 82N064145 81N186538 69N083295 9010867 2402310 1493663 1493623 1493620	NEEE002291	43100123809	NEEE0014977	NEEE002293	43100101179 43100282405 43103127458 43103127440	NEEE0005638	
Gas meter DPI numbers	NA	52405953856	NA	52408210661	NA	NA	52406060706	
Audit data start date	NA	Jul-10 (Gas Oct-10)	15-Nov-10	Oct-10	Jul-10	Oct-10	Jan-11	
Audit data end date	NA	Jun-11 (Gas Sep-11)	17-Nov-11	Sep-11	Jun-11	Sep-11	Dec-11	
A: Total electricity purchased on site in kWh	51,000	1,351,000	43,000	727,000	129,000	153,000	1,404,000	3,858,000
B: Greenpower purchased on site in kWh	0	0	0	0	0	0	0	
C: Total Natural Gas purchased (in GJ)	0	113	0	data unavailable	0	0	18,250	18,363.00
D: Other energy purchased for stationary equipment	0	0	0	data unavailable	0	0	0	
Total (purchased) energy used on site in GJ	184.00	4,977.00	155.00	data unavailable	464.00	551.00	23,304.00	29,635.00
Total (purchased) energy used on site in kWh	51,000.00	1,382,389.00	43,000.00	data unavailable	129,000.00	153,000.00	6,473,333.00	8,231,722.00
Site greenhouse gas emissions in t CO2-e [1.07x (A-B) + (0.06553 x C) + (D x 0.0748)]	55	1,453	46	at least 778	138	164	2,698	4,553.50
Site Energy Density	83.6 kWh/m2	185.3 kWh/m^2	67.2 kWh/m2	563.6 kWh/m2	34.9 kWh/m2 (378 kWh/car)	153 kWh/m^2 (office area only)	667 kWh/m^2	

4. Energy Management Review

Liverpool City Council completed an Energy Management Review on 21 September 2006. Representatives from Corporate Management, Assets and Infrastructure, Services, Recreation and Open Space and Sustainable Environment and Health provided input into the Energy Management Review process. The One-2-Five Diagnostics system was used for the review, with the results included in the 2006 ESAP.

With the ESAP run full term an energy management review is required, to incorporate the information reviewed by the site audits into the way Council manages all facilities. This review is planned for the 2012-2013 financial year, with the results of the review informing the EMP through the annual update of the actions in Table 6.

5. Site Assessments

The first step in understanding energy use at key sites is conducting an audit of energy using fixtures/equipment. The audit reports in Section 7 (Appendix) includes tables listing the energy fixtures at each site

These tables are exhaustive and reflect the NSW Government *Local council guide for Energy Management Plans*. In order to clarify key areas of energy use, the diagrams below provide a breakdown of the energy use of each component at each site. Details of the specific equipment at each site (e.g. type of lights, number etc) can be found in the complete audit report included in Section 7.

Figure 16: Breakdown of electricity consumption (in kWh) for key sites during the 2011-12 financial year

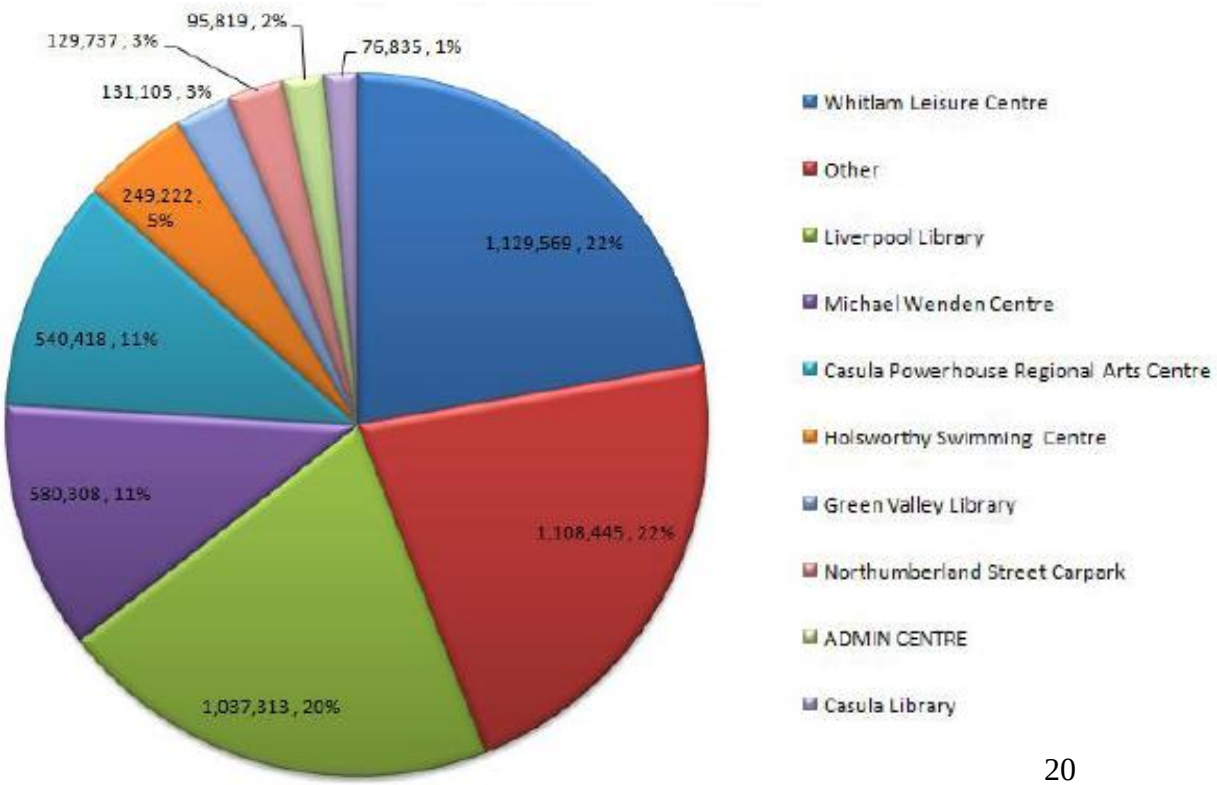
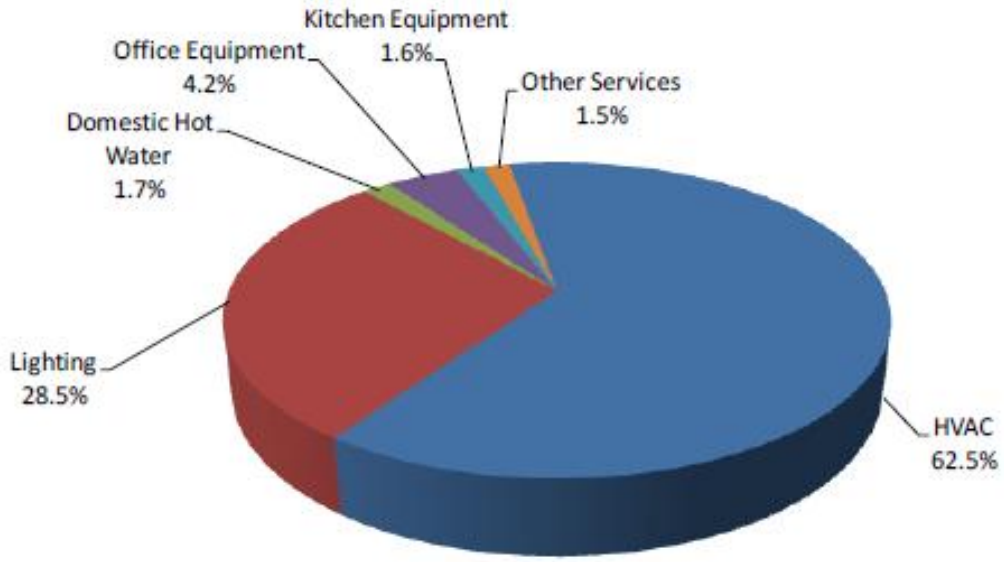


Figure 17: Electrical end use breakdown by area for Council Administration Building – 33 Moore Street, Liverpool



This is Council's largest point source for energy use. As HVAC is the largest source of energy in the building it is safe to say that the HVAC system at 33 Moore Street is Council's single largest energy consumer.

Figure 18: Electrical end use breakdown for Carnes Hill Reserve

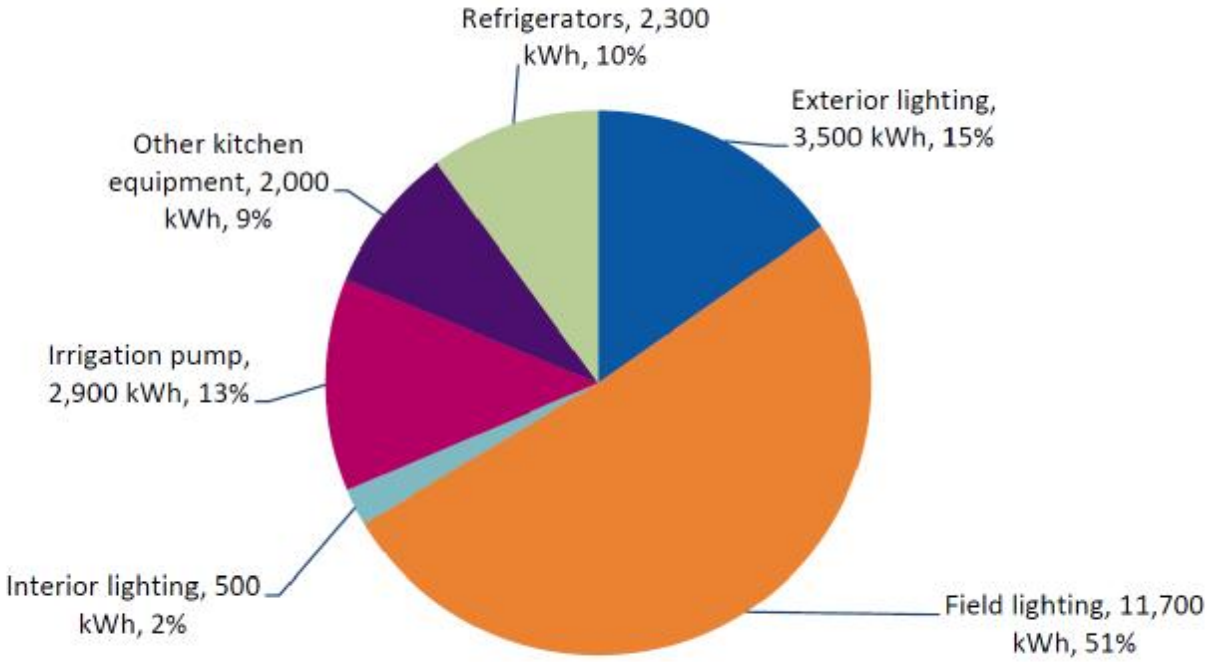


Figure 19: Electrical end use breakdown for Casula Community Centre

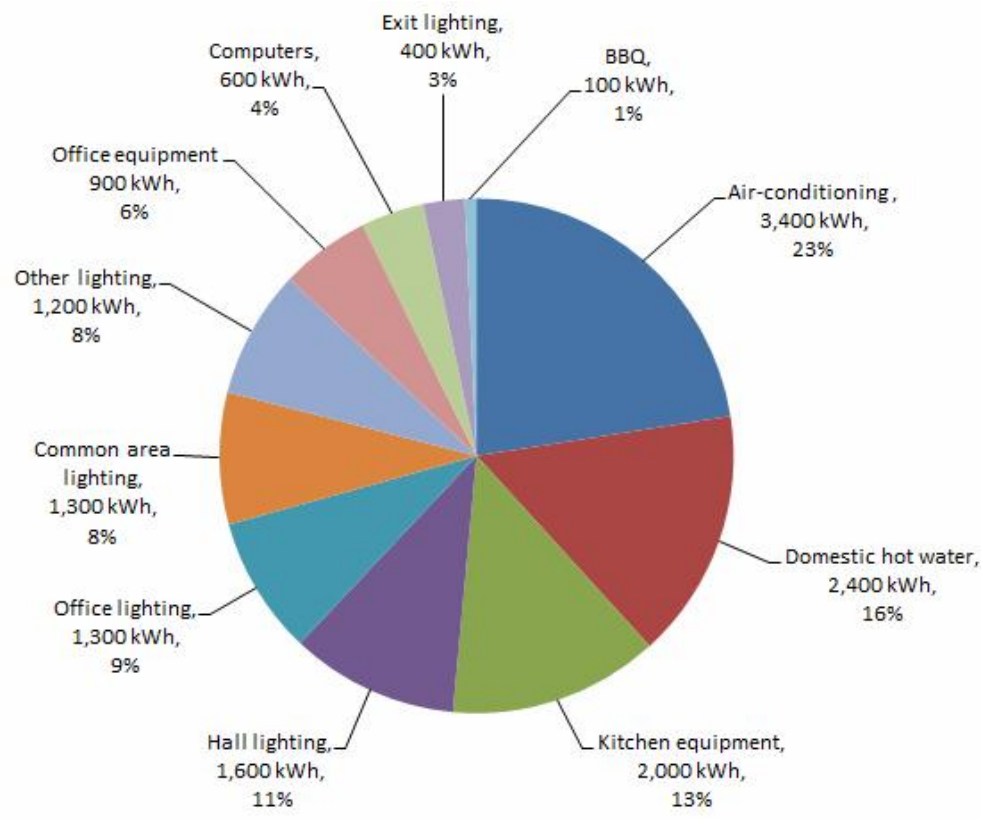


Figure 20: Electrical end use breakdown for Casula Library

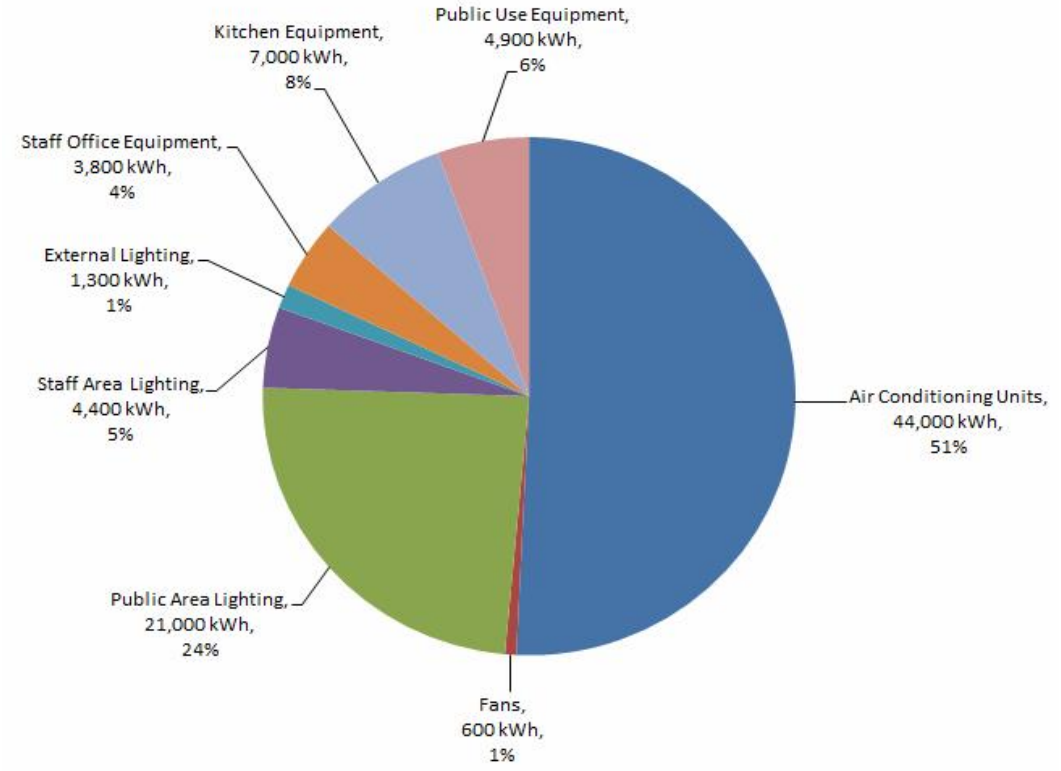


Figure 21: Electrical end use breakdown for Casula Powerhouse Arts Centre

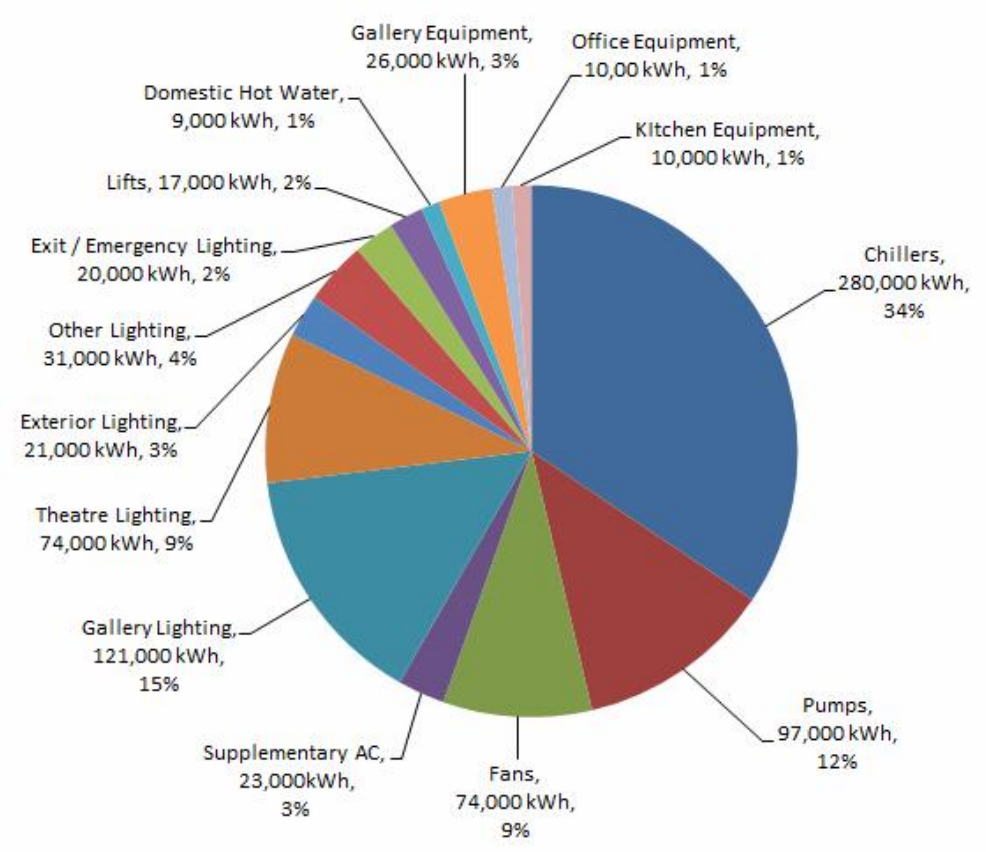


Figure 22: Electrical end use breakdown for Casula Pre-school

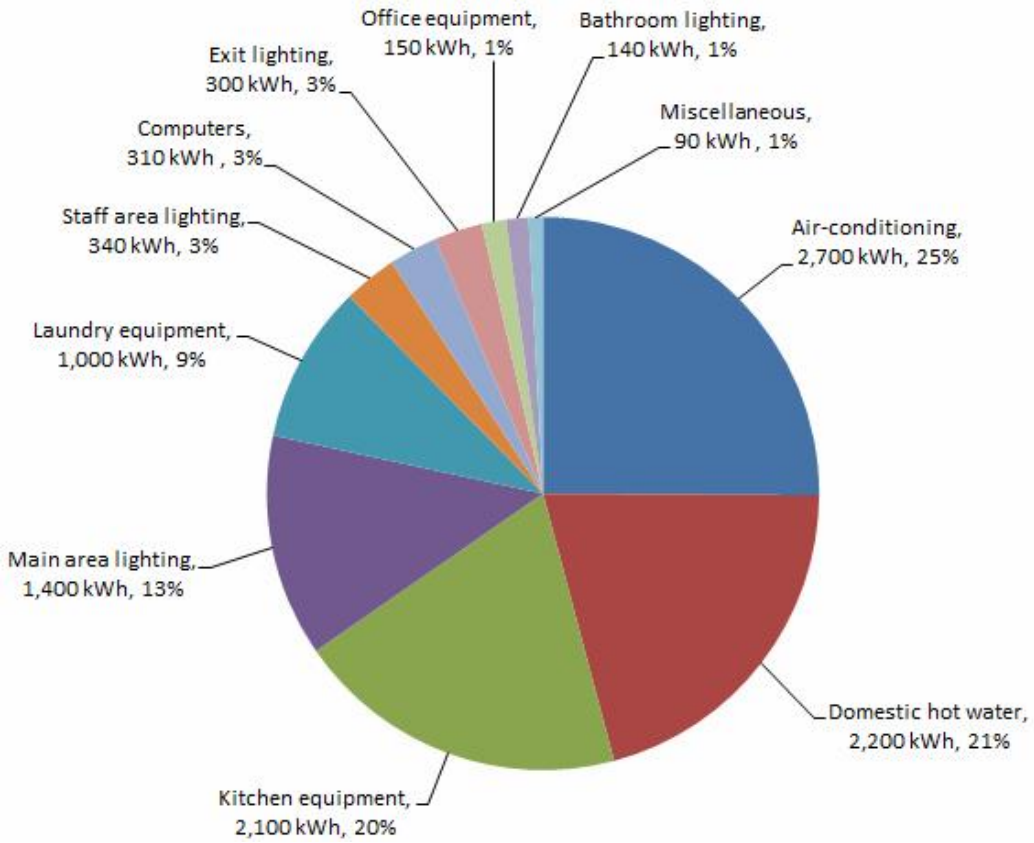


Figure 23: Electrical end use breakdown for Chipping Norton Recreation Centre

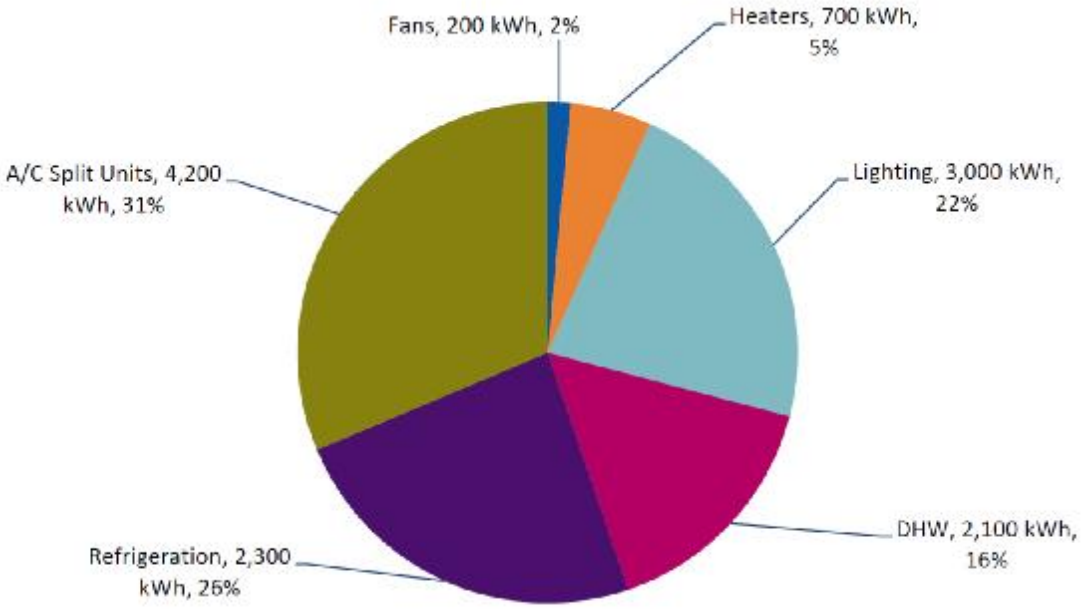


Figure 24: Electrical end use breakdown for Hammondville Park

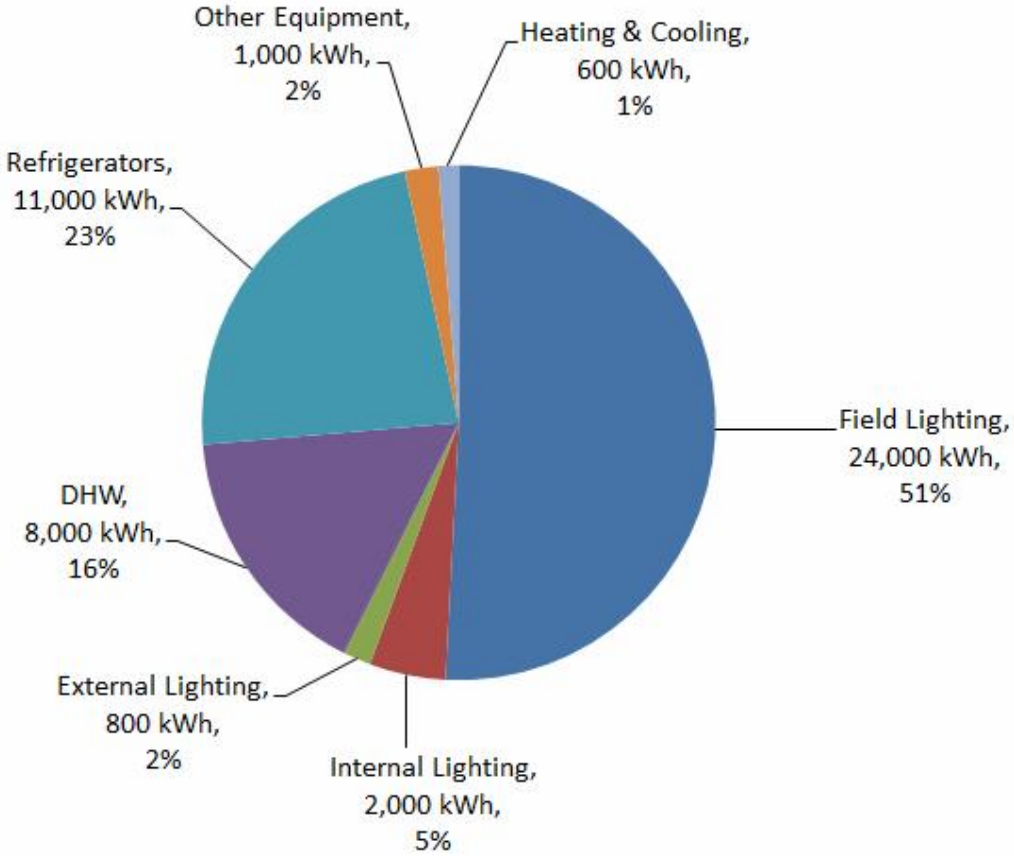


Figure 25: Electrical end use breakdown by area for Liverpool Library Complex

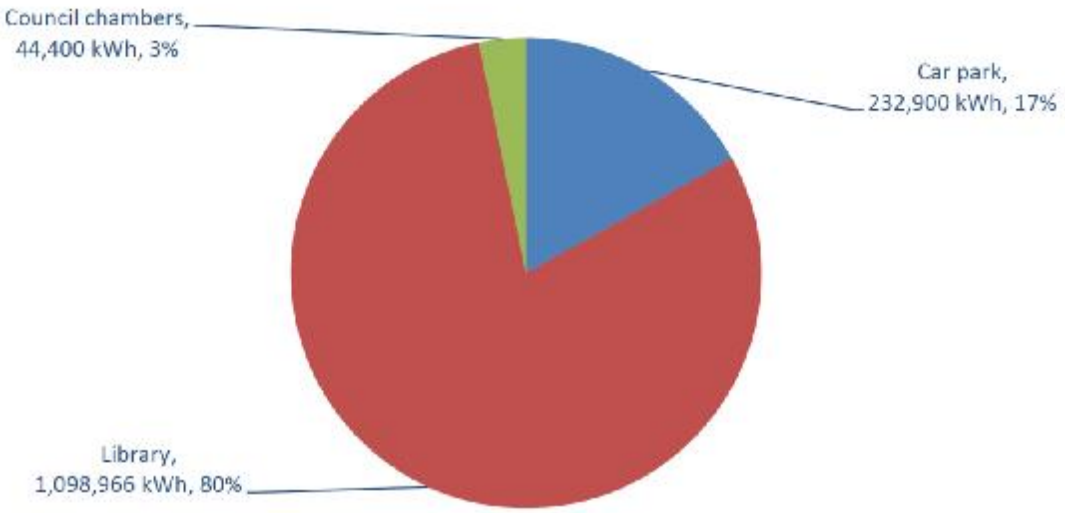


Figure 26: Electrical end use breakdown for Liverpool Library Complex

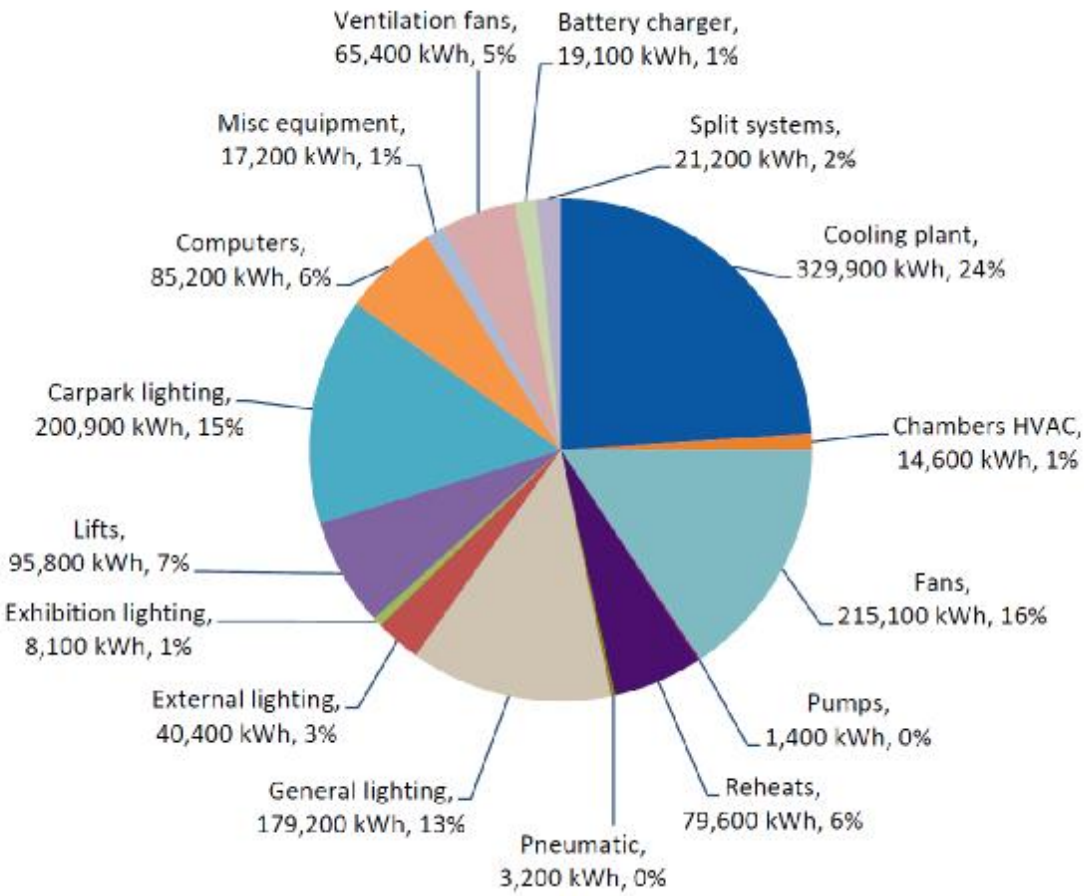


Figure 27: Gas end use breakdown for Liverpool Library Complex

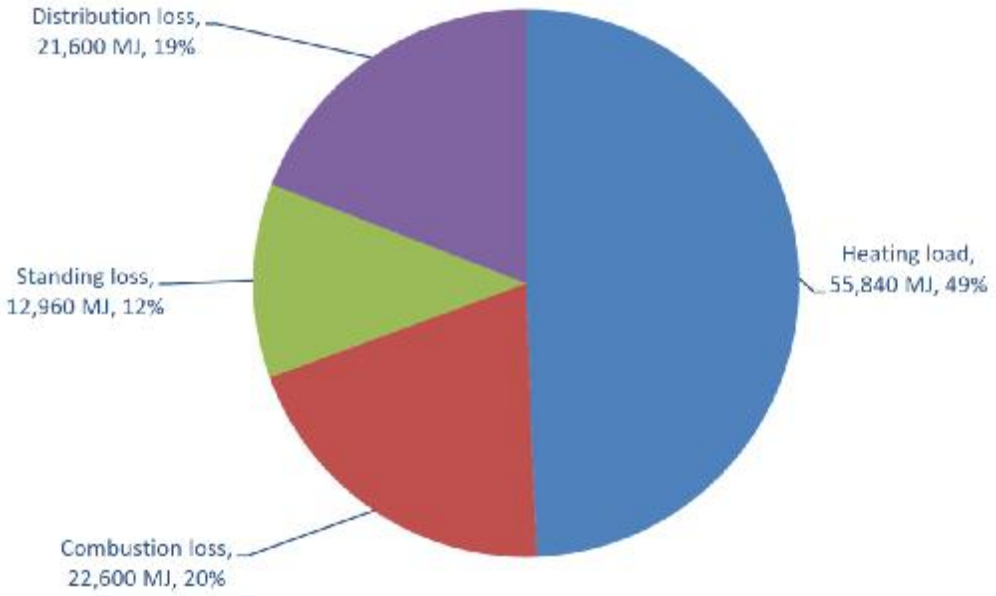


Figure 28: Electrical end use breakdown by area for Liverpool City Museum

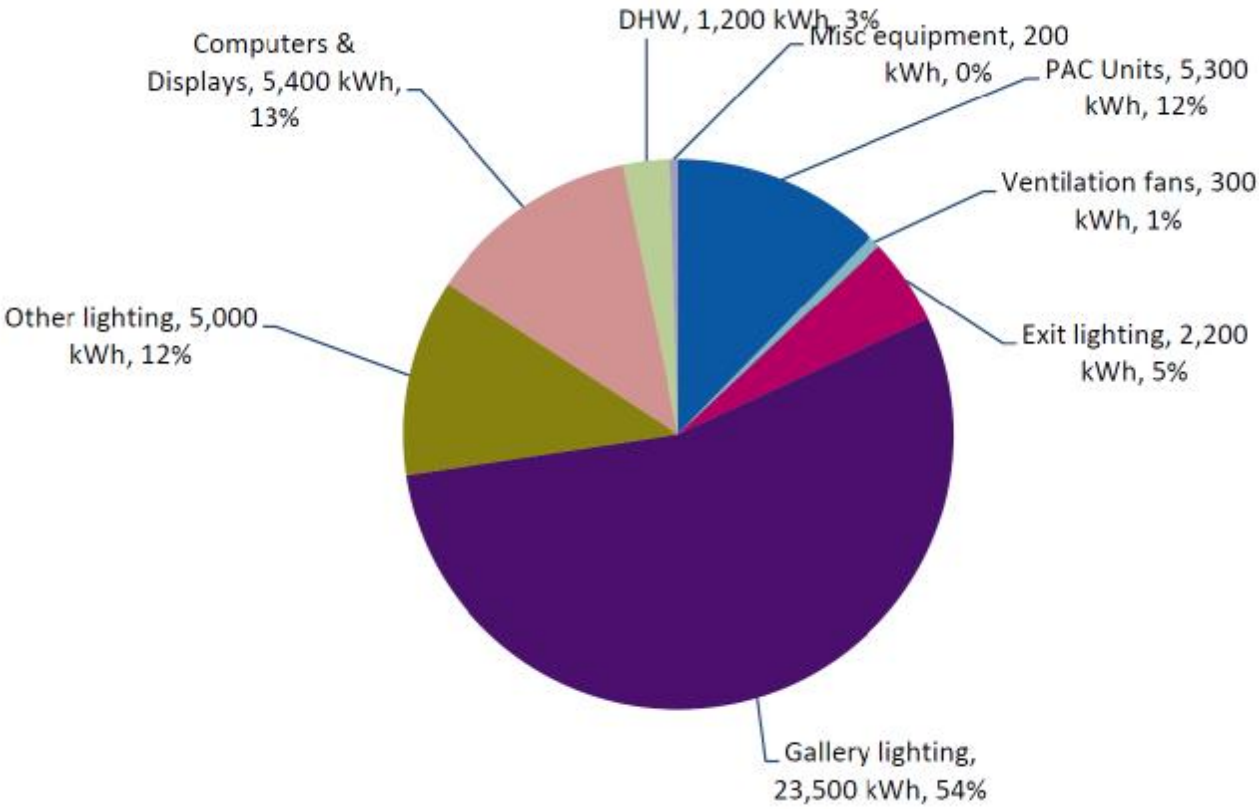


Figure 29: Electrical end use breakdown by area for Michael Wenden Aquatic Leisure Centre

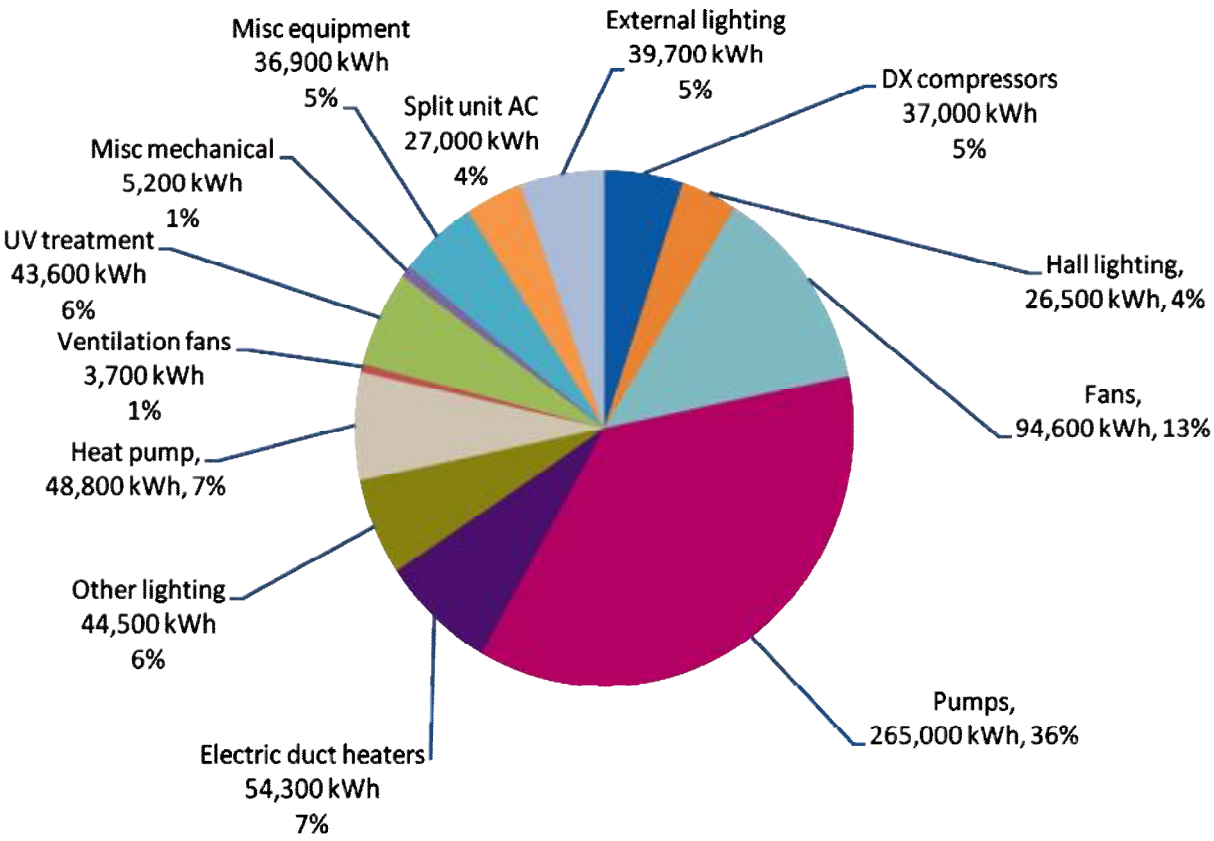


Figure 30: Electrical end use breakdown for Northumberland Street Carpark

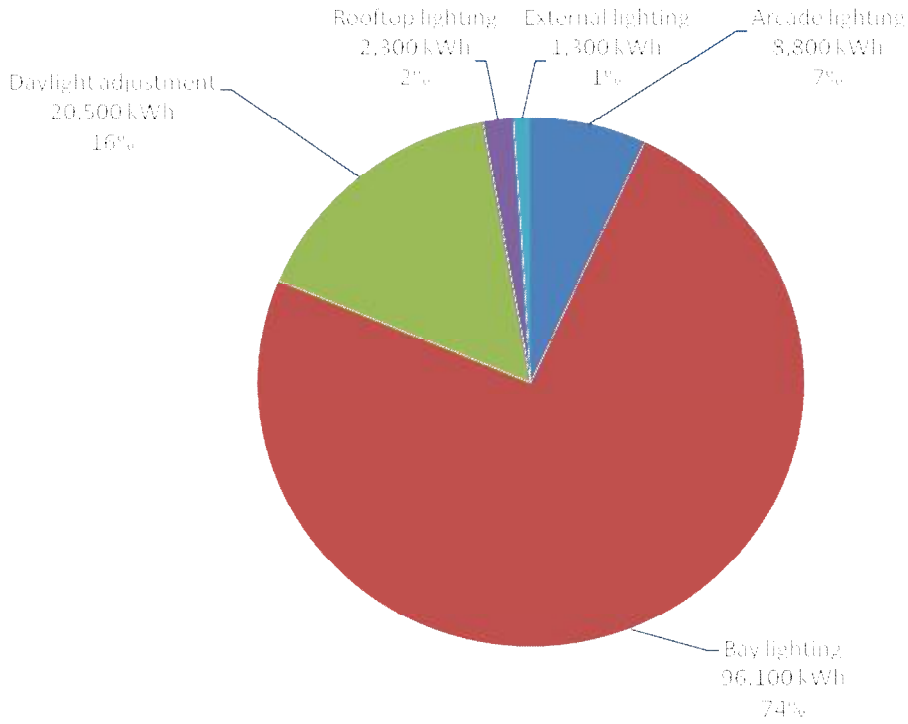


Figure 31: Electrical end use breakdown by area for Rose Street Depot

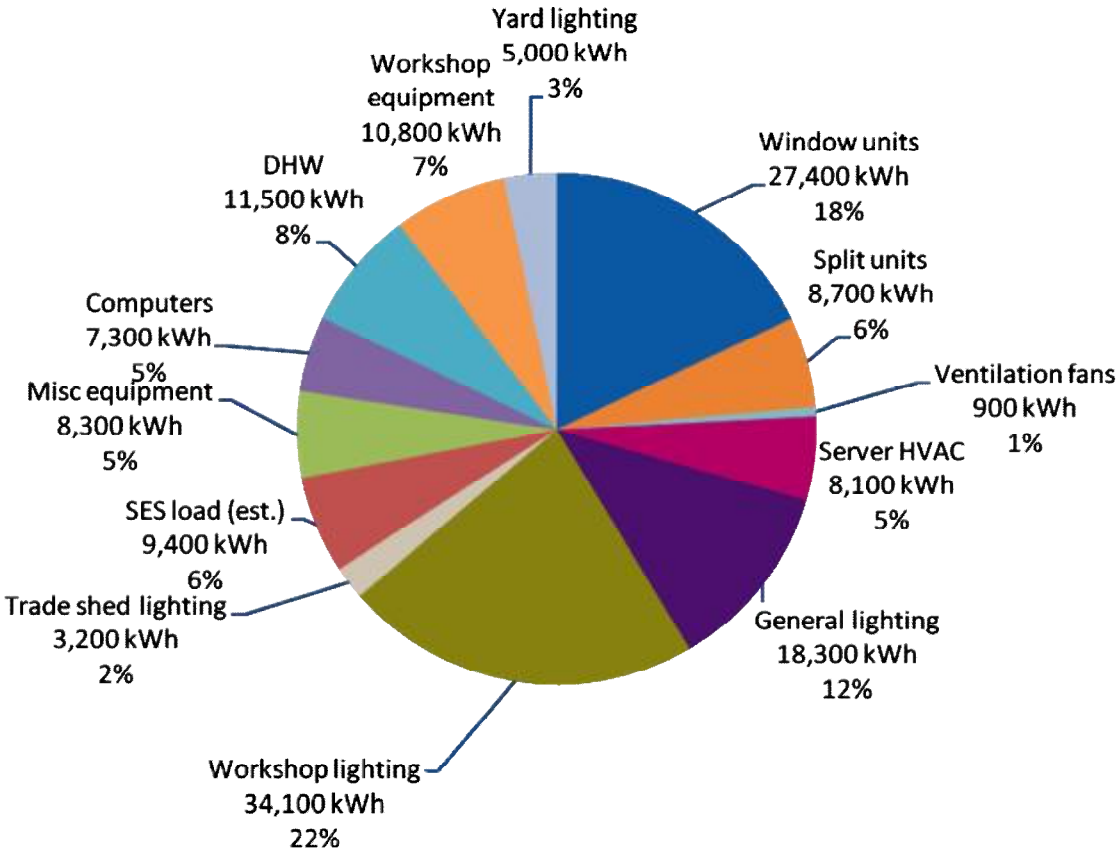


Figure 32: Electrical end use breakdown by area for Whitlam Leisure Centre

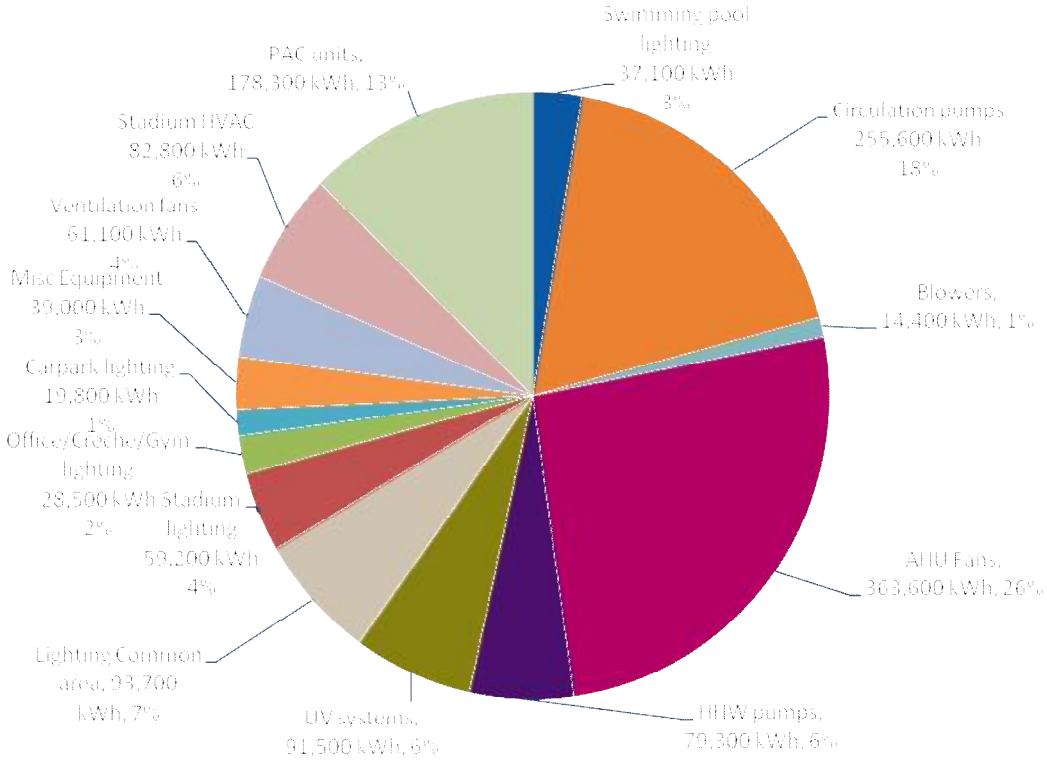
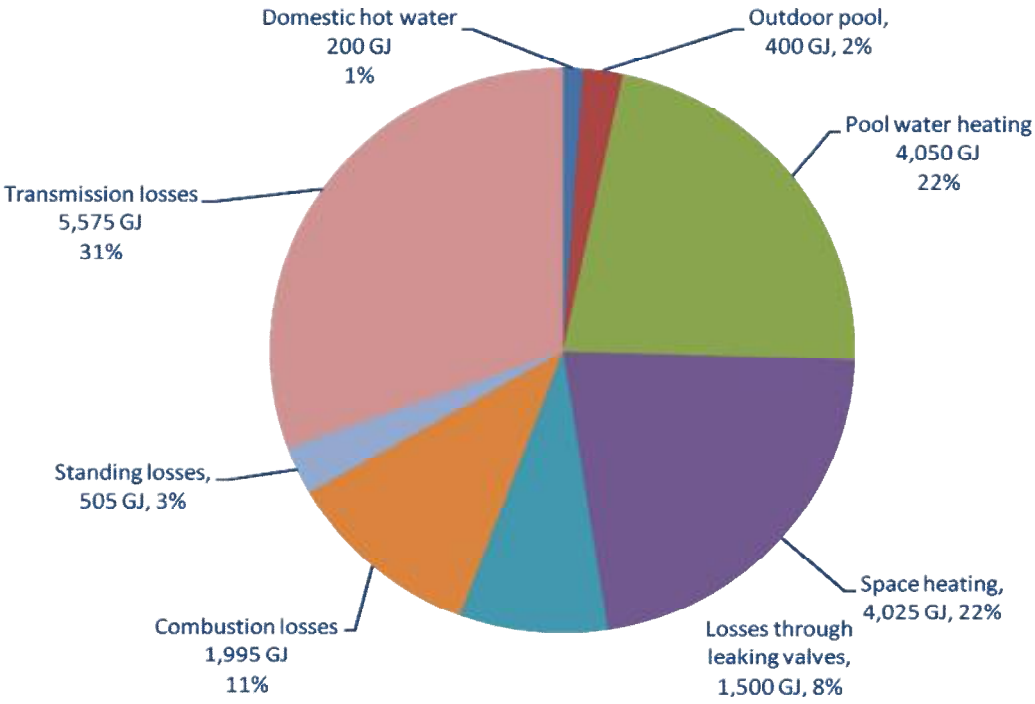


Figure 33: Gas end use breakdown by area for Whitlam Leisure Centre



6. Summary of Core Projects for Key Sites

The following list of Energy Management actions will be a priority for Council over the four-year term of this Energy Management Plan. The actions are primarily taken from the audit reports included in Section 7. However this list is not exhaustive. As facilities are renovated, expanded and otherwise enhanced new actions may be added to this list.

Council may also choose to reduce energy at 'demonstration' sites by acting on recommendations outside the scope of the audits. For example energy actions are addressed as part of the Liverpool City Council *Waste and Sustainability Improvement Payment program Action Table*. While priorities may change over time, Council continues to be committed to reducing Energy use and operating efficiently.

Table 5: Summary of core energy retrofit actions for key energy using facilities

Site	Electricity saving (kWh / yr)	Elec-tricity saving (%)	Gas saving (MJ / yr)	Gas saving (%)	Emissions saving (t CO2-e/yr)	Financial saving ($/yr)	Capital cost ($)	Payback period (years)
Council Administration Building	620,600	79%	0	-	714.3	113,380	532,220	4.7
Carnes Hill Reserve	2,600	12%	1,550	48%	3.59	440	11,700	26.6
Casula Community Centre	2,700	10%	1,500	100%	2.994	930	760	0.8
Casula Library	25,390	29%	0	-	27.3	4,825	7,900	1.6
Casula Powerhouse Arts Centre	210,100	26%	0	-	224.6	43,130	193,200	4.5
Chipping Norton Recreation Centre	3,250	24%	0	-	3.4	740	4,750	6.4
Hammondville Park	5,170	10%	0	-	5.48	785	400	0.5
Liverpool City Library	388,700	29%	113,000	100%	432.4	62,700	474,400	7.6
Liverpool Regional Museum	16,650	39%	0	-	16.8	3,275	12,950	4
Northumberland Street Car park	49,300	38%	0	-	65.7	8,100	38,000	4.7
Michael Wenden Centre	211,000	29%	-450,000	-	197.9	23,790	158,370	6.6
Rose Street Depot	49,100	32%	0	-	52.2	10,310	14,600	1.4
Whitlam Leisure Centre	171,500	12%	5,420,000	30%	529	78,365	177,750	2.3
Total	**1,756,060**	**22%**	**5,086,050**	**28%**	**2,276**	**$350,770**	**$1,627,000**	**4.6**

Note: Gas usage data was unavailable for several key sites. As such the figure provided for percentage savings is only a guide. In fact natural gas may replace electricity use at some sites (especially for water heating) and as such total natural gas consumption will rise. Though, this will be offset by a fall in total energy use and greenhouse gas emissions.

Table 6: List of energy retrofit actions for key LCC energy using facilities

Site	Council Administration Building											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($/year)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP1	Behavioural change Opportunities	Manager Property Services	5,300	0.3%	NA	NA	5.7	NA	$560	$0	Immediate	2012-13
EMP2	Implement Power Factor Correction	Manager Property Services	0	0.0%	NA	NA	50	NA	$10,680	$2,000	0.2	2012-13
EMP3	Install New Building Management System (BMS)	Manager Property Services + Manager Buildings and Open Space Construction	85,000	5.3%	NA	NA	91	NA	$15,480	$135,000	5.3	Post HVAC renewal works
EMP4	Install Sub-Meter	Manager Property Services + Manager Buildings and Open Space Construction	13,600	0.9%	NA	NA	14.6	NA	$1,990	$5,000	0.9	Post HVAC renewal works

EMP5	Install Economy Cycle System	Manager Property Services + Manager Buildings and Open Space Construction	119,700	7.5%	NA	NA	128.1	NA	$17,080	$83,400	7.5	Post HVAC renewal works
EMP6	Install window film on windows	Manager Property Services + Manager Buildings and Open Space Construction	45,600	2.9%	NA	NA	48.8	NA	$8,970	$63,600	2.9	pending retrofit advice
EMP7	Install VSD control on A/C Fans and Pumps	Manager Property Services + Manager Buildings and Open Space Construction	66,900	4.2%	NA	NA	71.6	NA	$9,760	$35,500	4.2	Post HVAC renewal works
EMP8	Install Smartcool compressor optimisation units on chillers units	Manager Property Services + Manager Buildings and Open Space Construction	45,300	2.8%	NA	NA	48.5	NA	$6,610	$60,000	2.8	pending retrofit advice
EMP9	Replace existing T8 fluorescent tubes with Matrix LED tubes	Manager Buildings and Open Space Construction	170,100	10.7%	NA	NA	182	NA	$30,550	$128,500	10.7	2013-14 (pending funding allocation)

EMP10	Replace 50W halogen downlights with 16W MatrixLED downlights	Manager Buildings and Open Space Construction	8,000	0.5%	NA	NA	8.6	NA	$1,570	$4,300	0.5	2013-14
EMP11	Install occupancy sensors in office areas	Manager Property Services + Manager Buildings and Open Space Construction	7,900	0.5%	NA	NA	8.5	NA	$1,550	$12,400	0.5	pending review of office layout
EMP12	Turn off lights in Ground Floor Food Court Area	Manager Property Services	30,300	1.9%	NA	NA	32.4	NA	$5,530	$0	1.9	2012-13
EMP13	Disconnect unused Domestic Hot Water Units and Boiling Water Units	Manager Property Services + Manager Buildings and Open Space Construction	6,800	40.0%	NA	NA	7.3	NA	$1,000	$0	0.4	2012-13
EMP14	Control Electric BWU units via 7-day time-switches	Manager Property Services + Manager Buildings and Open Space Construction	16,100	1.0%	NA	NA	17.2	NA	$2,050	$2,520	1	2012-13
Core sub-total			**620,600**	**79%**			**714.3**		**$113,380**	**$532,220**	**4.7**	
Non-core measures												

EMP15	Replace traditional hand dryers with Dyson Airblade	Manager Buildings and Open Space Construction	7,930	0.5%	NA	NA	8.5	NA	$1,590	$18,000	11.3	2012-13
EMP16	Install Solar Energy Generation System	Manager Property Services + Manager Buildings and Open Space Construction	13,600	0.9%	NA	NA	14.6	NA	$2,310	$60,800	26.3	2015-16
EMP17	Change Chillers hours of operation	Manager Property Services + Manager Buildings and Open Space Construction	111,300	7.0%	NA	NA	119.1	NA	$12,100	$2,400	0.2	Pending end of NSW Police tenancy
Non-core sub-total			**132,830**	**8%**			**142.2**		**$16,000**	**$81,200**	**5.1**	
Total			**753,430**	**87%**			**856.5**		**$129,380**	**$613,420**	**4.7**	

Site	Carnes Hill Reserve (GREENWAY PARK)											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP18	Daylight sensor for external lighting	Manager Recreation, CBD and Cleansing Services	1,300	6%	0	0%	1.8	NA	$160	$350	2.2	Pending funding allocation
EMP19	Water saving showerheads	Manager Recreation, CBD and Cleansing Services	0	0%	1,200	37%	0.07	NA	$90	$300	3.4	Pending funding allocation
EMP20	Playing field daylight control	Manager Recreation, CBD and Cleansing Services	1,300	6%	0	0%	1.7	NA	$150	$1,050	6.9	Pending funding allocation
EMP21	Condensing gas hot water units	Manager Recreation, CBD and Cleansing Services	0	0%	350	11%	0.02	NA	$40	$10,000	240	Pending funding allocation
EMP22	Verify BBQ run on	Manager Recreation, CBD and Cleansing Services	0	0%	0	0%	N/A	NA	N/A	N/A	N/A	Pending funding allocation
			2,600	**12%**	**1,550**	**48%**	**3.59**		**$440**	**$11,700**	**27**	
Non-core measures												

EMP23	High efficiency refrigerators	Manager Recreation, CBD and Cleansing Services	1,000	5%	0	0%	1.3	NA	$120	$5,500	44	Pending funding allocation
EMP24	T5 lighting	Manager Recreation, CBD and Cleansing Services	450	2%	0	0%	0.6	NA	$53	$2,800	53	Pending funding allocation
Non-core sub-total			**1,450**	**7%**	**0**	**0%**	**1.9**		**$173**	**$8,300**	**48**	
Total			**4,050**	**19%**	**1,550**	**48%**	**5.49**		**$613**	**$20,000**	**33**	

Site	Casula Community Centre and Pre-School											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP25	Gas disconnection	Facilities Maintenance Section + Manager Recreation, CBD and Cleansing Services	-100	0%	1,500	100%	-0.006	NA	$440	$30	0.07	Pending funding allocation and liaison with Early Child hood Service
EMP26	Instant hot water heater timer control	Facilities Maintenance Section + Manager Recreation, CBD and Cleansing Services	730	3%	0	0%	0.8	NA	$180	$200	1.1	Pending funding allocation and liaison with Early Child hood Service
EMP27	Pre-school holiday shutdown	Facilities Maintenance Section + Manager Recreation, CBD and Cleansing Services	670	3%	0	0%	0.7	NA	$30	$30	1	Pending funding allocation and liaison with Early Child hood Service

EMP28	Community centre DHW time switch	Facilities Maintenance Section + Manager Recreation, CBD and Cleansing Services	1,400	5%	0	0%	1.5	NA	$280	$500	1.8	Pending funding allocation
Core sub-total			**2,700**	**10%**	**1,500**	**100%**	**2.994**		**$930**	**$760**	**0.8**	
Non-core measures												
EMP29	Pre-school DHW upgrade	Manager Recreation, CBD and Cleansing Services + Manager Community Services	960	4%	0	0%	1	NA	$190	$6,000	32	Pending funding allocation and liaison with Early Child hood Service
EMP30	Lighting hardware upgrade	Facilities Maintenance Section + Manager Buildings and Open Space Construction	530	2%	0	0%	0.6	NA	$100	N/A	N/A	2015-16
Non-core sub-total			**1,490**	**6%**	**0**	**0%**	**1.6**		**$290**	**$6,000**	**20.7**	
Total			**4,190**	**16%**	**1,500**	**100%**	**4.594**		**$1,220**	**$6,760**	**5.5**	

Site	Casula Library											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP31	Streamline air conditioning set-points	Manager Library Services + Manager Buildings and Open Space Construction	13,000	15%	0	-	14	NA	$2,800	N/A	N/A	2012-13
EMP32	After-hours lighting levels	Manager Library Services + Manager Buildings and Open Space Construction	4,900	6%	0	-	5.3	NA	$640	$0	N/A	2012-13
EMP33	Instant hot water heater timer control	Manager Library Services + Manager Buildings and Open Space Construction	790	1%	0	-	0.8	NA	$85	$100	1.2	2012-13

EMP34	External lighting lamp maintenance	Manager Library Services + Manager Buildings and Open Space Construction	0	0%	0	-	N/A	NA	N/A	N/A	N/A	2012-13
EMP35	Staff area occupancy sensors	Manager Library Services + Manager Buildings and Open Space Construction	1,400	2%	0	-	1.5	NA	$300	$1,000	3.3	2012-13
EMP36	Window treatment	Manager Library Services + Manager Buildings and Open Space Construction	5,300	6%	0	-	5.7	NA	$1,000	$6,800	6.5	2012-13
Core sub-total			**25,390**	**29%**	**0**	**-**	**27.3**		**$4,825**	**$7,900**	**1.6**	
Non-core measures												

EMP37	Blind installation	Manager Library Services + Manager Buildings and Open Space Construction	900	1%	0	-	0.9		$170	$9,300	55	2015-16
Non-core sub-total			900	1%	0	-	**0.9**		**$170**	**$9,300**	**55**	
Total			**26,290**	**30%**	**0**	**-**	**28.2**		**$4,995**	**$17,200**	**3.4**	

Site	Casula Powerhouse Arts Centre											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP38	Modify FCU schedules	Business Manager + Technical Manager CPAC	4,200	1%	0	-	3.5	NA	$600	$0	Immediate	2012-13
EMP39	Climate controlled areas – setpoint adjustment	Business Manager + Technical Manager CPAC	0	0%	0	-	N/A	NA	N/A	$200	N/A	2012-13
EMP40	Sensor verification and replacement	Business Manager + Technical Manager CPAC	20,000	2%	0	-	22	NA	$3,000	$21,000	6.8	2012-13
EMP41	Controls review	Business Manager + Technical Manager CPAC	86,000	11%	0	-	92	NA	$13,000	$32,000	2.5	2012-13
EMP42	Gallery lighting upgrade	Business Manager + Technical Manager CPAC	97,000	12%	0	-	104	NA	$26,000	$138,000	5.3	2012-13

EMP43	Dressing room lighting upgrade	Business Manager + Technical Manager CPAC	2,900	0%	0	-	3.1	NA	$530	$2,000	4.25	2012-13
Core sub-total			**210,100**	**26%**	**0**	**-**	**224.6**		**$43,130**	**$193,200**	**4.5**	
Non-core measures												
EMP44	Theatre lighting upgrade	Business Manager + Technical Manager CPAC	21,000	3%	0	-	23	NA	$7,600	$190,000	25	2015-16
EMP45	Air leakage test	Business Manager + Technical Manager CPAC	0	0%	0	-	N/A	NA	N/A	$17,000	N/A	2015-16
EMP46	PV Installation	Business Manager + Technical Manager CPAC	54,500	7%	0	-	57	NA	$3,500	$117,000	34	2015-16
EMP47	Install a floating ceiling above	Business Manager + Technical Manager CPAC	7,200	1%	0	-	7.7	NA	$1,100	$110,000	1000	2015-16
Non-core sub-total			**82,700**	**10%**	**0**	**-**	**87.7**		**$12,200**	**$434,000**	**35.6**	
Total			**292,800**	**36%**	**0**	**-**	**312.3**		**$55,630**	**$627,200**	**11.3**	

Site	Chipping Norton Recreation Centre (BOATSHED)											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($/year)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP48	Water saving shower heads	Facilities Maintenance Section + Manager Buildings and Open Space Construction	650	5%	0	-	0.7	NA	$130	$100	0.8	Pending funding allocation
EMP49	Upgrade exit lights	Facilities Maintenance Section + Manager Buildings and Open Space Construction	400	3%	0	-	0.4	NA	$170	$1,000	5.8	Pending funding allocation
EMP50	Verify HVAC set-points	Manager Buildings and Open Space Construction	0	0%	0	-	N/A	NA	N/A	N/A	N/A	Pending funding allocation
EMP51	Reconfigure floodlights	Facilities Maintenance Section + Manager Buildings and Open Space Construction	0	0%	0	-	N/A	NA	N/A	N/A	N/A	Pending funding allocation

EMP52	High efficiency refrigerators	Facilities Maintenance Section + Manager Buildings and Open Space Construction	2,200	16%	0	-	2.3	NA	$440	$3,650	8.3	Pending funding allocation
Core sub-total			**3,250**	**24%**	**0**	**-**	**3.4**		**$740**	**$4,750**	**6.4**	
Non-core measures												
EMP53	Daylight harvesting	Facilities Maintenance Section + Manager Buildings and Open Space Construction	200	1%	0	-	0.2	NA	$40	$650	16.3	Pending funding allocation
EMP54	Electric boosted solar hot water units	Facilities Maintenance Section + Manager Buildings and Open Space Construction	900	7%	0	-	1	NA	$180	$3,000	16.7	Pending funding allocation
Non-core sub-total			**1,100**	**8%**	**0**	**-**	**1.2**		**$220**	**$3,650**	**16.6**	
Total			**4,350**	**32%**	**0**	**-**	**4.6**		**$960**	**$8,400**	**8.8**	

Site	Hammondville Park											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP55	Field lighting switch off	Manager Recreation, CBD and Cleansing Services	1,800	4%	0	-	1.9	NA	$260	$230	0.9	Pending 2012-13 funding allocation
EMP56	Refrigerator shutdown	Manager Recreation, CBD and Cleansing Services	3,200	6%	0	-	3.4	NA	$500	$0	Immediate	2012-13
EMP57	Switch off campaign	Manager Recreation, CBD and Cleansing Services	170	0%	0	-	0.18	NA	$25	$170	6.8	Pending 2012-13 funding allocation
Core sub-total			**5,170**	**10%**	**0**	**-**	**5.48**		**$785**	**$400**	**0.5**	
Non-core measures												
EMP58	Refrigerator upgrade	Cricket Club and/or on site sporting groups	3,300	6%	0	-	3.5	NA	$500	$7,500	15	2015-16

EMP59	Domestic hot water unit upgrade	Manager Buildings and Open Space Construction	7,000	14%	-6,500	Increased	7	NA	$1,000	$25,000	25	2015-16
EMP60	Lighting hardware upgrade	Manager Buildings and Open Space Construction	320	1%	0	-	0.34	NA	$50	N/A	N/A	2015-16
Non-core sub-total			**10,620**	**21%**	**-6,500**	**Increase**	**10.84**		**$1,550**	**$32,500**	**21**	
Total			**15,790**	**31%**	**-6,500**	**Increase**	**16.32**		**$2,335**	**$32,900**	**15**	

Site	Liverpool City Library Complex											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP61	Mechanical retro-commissioning	Manager Buildings and Open Space Construction	44,000	3%	0	0%	60	NA	$6,900	$17,000	2.4	Scoping for HVAC major works begun
EMP62	Library servicing – Forward strategy	Manager Library Services + Manager Buildings and Open Space Construction	155,000	11%	113,000	100%	168	NA	$26,000	$390,000	15	Scoping for HVAC major works begun
EMP63	Emergency battery bank	Manager Buildings and Open Space Construction	16,000	1%	0	0%	17	NA	$2,500	N/A	N/A	2012-13
EMP64	HVAC controls – Stage 1	Manager Library Services + Manager Buildings and Open Space Construction	42,000	3%	0	0%	45	NA	$6,500	$4,800	0.7	Scoping for HVAC major works begun

EMP65	Car park lighting control – Warren Serviceway	Manager Builldings and Open Space Construction	53,000	4%	0	0%	57	NA	$8,200	$12,000	1.5	2012-13
EMP66	Car park lighting control – Underground library	Manager Builldings and Open Space Construction	17,000	1%	0	0%	19	NA	$2,700	$3,500	1.3	2012-13
EMP67	Server room HVAC	Manager Buildings and Open Space Construction	3,100	0%	0	0%	3.4	NA	$500	$1,000	2	2012-13
EMP68	Frances Greenway lighting	Manager Builldings and Open Space Construction	9,400	1%	0	0%	10	NA	$1,500	$3,200	2.2	2013-14 (pending lighting major works)
EMP69	Library lighting – Flood lights	Manager Builkdings and Open Space Construction	13,000	1%	0	0%	14	NA	$2,100	$4,800	2.3	2013-14
EMP70	Library lighting – Exhibition area	Manager Buildings and Open Space Construction	7,000	1%	0	0%	7.9	NA	$1,100	$3,800	3.3	2013-14
EMP71	Library lighting – Open library areas	Manager Builldings and Open Space Construction	17,000	1%	0	0%	18	NA	$2,700	$19,500	7.3	2013-14

EMP72	Library lighting – Exit lights	Manager Buildings and Open Space Construction	7,100	1%	0	0%	7.6	NA	$1,200	$8,800	7.3	2013-14
EMP73	Library lighting system controls	Manager Buildings and Open Space Construction	5,100	0%	0	0%	5.5	NA	$800	$6,000	7.5	2013-14
Core sub-total			**388,700**	**29%**	**113,000**	**100%**	**432.4**		**$62,700**	**$474,400**	**7.6**	
Non-core measures												
EMP74	PV system	Manager Builldings and Open Space Construction	91,000	7%	0	0%	96	NA	$21,500	$197,000	9	2012-13
EMP75	HVAC controls – Stage 2	Manager Builldings and Open Space Construction	68,000	5%	0	0%	73	NA	$11,000	$198,000	19	2015-16 (pending HVAC major works)
Non-core sub-total			**91,000**	**7%**	**0**	**0%**	**96**		**$21,500**	**$197,000**	**9**	
Total			**479,700**	**36%**	**113,000**	**100%**	**528**		**$84,200**	**$671,400**	**8**	

Site	Liverpool Regional Museum											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP76	Genealogy room lighting	Manager Buildings and Open Space Construction	650	2%	0	-	0.7	NA	$130	$150	1.2	Pending funding allocation
EMP77	Exhibition display time of use	Manager Builldings and Open Space Construction	300	1%	0	-	0.3	NA	$55	$150	2.7	Pending funding allocation
EMP78	Exhibition lighting strategy	Manager Buildings and Open Space Construction	13,000	30%	0	-	13	NA	$2,560	$10,000	3.9	Pending funding allocation
EMP79	Exit light replacement	Manager Buildings and Open Space Construction	1,600	4%	0	-	1.7	NA	$330	$1,400	4.2	Pending funding allocation
EMP80	Western lighting time of use	Manager Buildings and Open Space Construction	1,100	3%	0	-	1.1	NA	$200	$1,250	6.1	Pending funding allocation
Core sub-total			**16,650**	**39%**	**0**	**-**	**16.8**		**$3,275**	**$12,950**	**4**	

Non-core measures												
EMP81	HVAC system replacement	Manager Buildings and Open Space Construction	2,200	5%	0	-	2.3	NA	$420	$9,000	21	2012-13
EMP82	DHW replacement	Manager Library Services + Manager Buildings and Open Space Construction	1,700	4%	-3,700	-	1.6	NA	$50	$3,300	66	2015-16
Non-core sub-total			**3,900**	**9%**	**-3,700**	**-**	**3.9**		**$470**	**$12,300**	**26.2**	
Total			**20,550**	**48%**	**-3,700**	**-**	**20.7**		**$3,745**	**$25,250**	**6.7**	

Site	Michael Wenden Aquatic Leisure Centre											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP83	Exit lighting upgrade	Manager-Recreation and Community Services + Facility Manager	3,000	0%	0	-	3.2	NA	$400	$3,000	8	Pending funding allocation and negotiation with Facility Manager
EMP84	Corridor lighting	Manager-Recreation and Community Services + Facility Manager	1,100	0%	0	-	1.2	NA	$140	$50	0.4	Pending funding allocation and negotiation with Facility Manager
EMP85	Heat circulation pump control	Manager-Recreation and Community Services + Facility Manager	37,000	5%	0	-	40	NA	$4,800	$3,600	0.8	Pending funding allocation and negotiation with Facility Manager

EMP86	Indoor pool cover	Manager-Recreation and Community Services + Facility Manager	9,000	1%	0	-	9.6	NA	$1,200	$1,300	1.1	Pending funding allocation and negotiation with Facility Manager
EMP87	HVAC controls and scheduling	Manager-Recreation and Community Services + Facility Manager	24,000	3%	0	-	25	NA	$3,100	$3,500	1.2	Pending funding allocation and negotiation with Facility Manager
EMP88	Filter pump control	Manager-Recreation and Community Services + Facility Manager	60,000	8%	0	-	64	NA	$7,700	$17,000	2.2	Pending funding allocation and negotiation with Facility Manager
EMP89	Central heating plant conversion	Manager-Recreation and Community Services + Facility Manager	37,000	5%	-395,000	-	15	NA	$1,800	$100,000	55	Pending funding allocation and negotiation with Facility Manager

EMP90	Stadium change room lighting	Manager-Recreation and Community Services + Facility Manager	4,300	1%	0	-	4.6	NA	$550	$1,700	3	Pending funding allocation and negotiation with Facility Manager
EMP91	External change room lighting	Manager-Recreation and Community Services + Facility Manager	800	0%	0	-	0.9	NA	$100	$500	4.8	Pending funding allocation and negotiation with Facility Manager
EMP92	HVAC upgrade	Manager-Recreation and Community Services + Facility Manager	22,000	3%	0	-	24	NA	$2,900	$17,000	6.1	Pending funding allocation and negotiation with Facility Manager
EMP93	Reception lighting upgrade	Manager-Recreation and Community Services + Facility Manager	800	0%	0	-	0.9	NA	$100	$720	7	Pending funding allocation and negotiation with Facility Manager

EMP94	Domestic hot water	Manager-Recreation and Community Services + Facility Manager	12,000	2%	-55,000	-	9.5	NA	$1,000	$10,000	9.8	Pending funding allocation and negotiation with Facility Manager
Core sub-total			**211,000**	**29%**	**-450,000**	**-**	**197.9**		**$23,790**	**$158,370**	**6.6**	
Non-core measures												
EMP95	Stadium lighting upgrade – End of life guidelines	Manager-Recreation and Community Services + Facility Manager	6,000	1%	0	-	6.4	NA	$800	$9,000	12	August - September 2012
EMP96	Consolidate kiosk kitchen refrigerators	Manager-Recreation and Community Services + Facility Manager	0	0%	0	-	N/A	NA	N/A	N/A	N/A	Pending funding allocation and negotiation with Facility Manager
Non-core sub-total			**6,000**	**1%**	**0**	**-**	**6.4**		**$800**	**$9,000**	**12**	
Total			**217,000**	**30%**	**-450,000**	**-**	**204**		**$24,590**	**$167,370**	**6.8**	

Site	Northumberland Street Car Park											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP97	Utility meter coverage	Manager Builldings and Open Space Construction	0	0%	0	-	N/A	NA	N/A	$10,000	N/A	Pending funding allocation
EMP98	Daylight adjustment control	Manager Builldings and Open Space Construction	15,000	12%	0	-	20	NA	$2,400	$1,400	0.6	Pending funding allocation
EMP99	Arcade lighting time of use	Manager Builldings and Open Space Construction	6,600	5%	0	-	8.8	NA	$1,100	$1,600	1.4	Pending funding allocation
EMP100	Rezone store room lighting	Manager Builldings and Open Space Construction	3,000	2%	0	-	4	NA	$500	$1,000	2	Pending funding allocation
EMP101	Occupancy sensor switching	Manager Builldings and Open Space Construction	21,000	16%	0	-	28	NA	$3,500	$22,000	6.4	Pending funding allocation

EMP102	Car park after-hours management	Manager Builldings and Open Space Construction	3,700	3%	0	-	4.9	NA	$600	$2,000	3.3	Pending funding allocation
Core sub-total			**49,300**	**38%**	**0**	**-**	**65.7**		**$8,100**	**$38,000**	**4.7**	
Non-core measures												
Non-core sub-total			0	0%	0	-	**0**		**$0**	**$0**	**0**	
Total			**49,300**	**38%**	**0**	**-**	**65.7**		**$8,100**	**$38,000**	**4.7**	

Site	**Rose Street Depots**											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP103	Disable existing HVAC when offices are centralised	Manager Civil Maintenance	14,000	9%	0	-	15	NA	$2,900	$0	Immediate	2012-13
EMP104	Server room HVAC Control	Manager Civil Maintenance	4,100	3%	0	-	4.3	NA	$850	$0	Immediate	2012-13
EMP105	Workshop lighting power density	Manager Civil Maintenance	18,000	12%	0	-	19	NA	$3,800	$6,300	1.7	2012-13
EMP106	Domestic hot water	Manager Civil Maintenance	7,400	5%	0	-	8	NA	$1,600	$3,500	2.3	2012-13

EMP107	Lighting re-zoning - Workshop and warehouse	Manager Civil Maintenance	4,000	3%	0	-	4.2	NA	$830	$3,200	3.9	2012-13
EMP108	Lighting time of use control - Bathrooms and breakout spaces	Manager Civil Maintenance	1,600	1%	0	-	1.7	NA	$330	$1,600	4.8	2012-13
Core sub-total			**49,100**	**32%**	**0**	**-**	**52.2**		**$10,310**	**$14,600**	**1.4**	
Non-core measures												
Non-core sub-total			**0**	**0%**	**0**	**-**	**0**		**$0**	**$0**	**N/A**	
Total			**49,100**	**32%**	**0**	**-**	**52.2**		**$10,310**	**$14,600**	**1.4**	

Site	Whitlam Leisure Centre											
Project No.	**Project Description**	**Respons-ibility**	**Electricity Savings (kWh)**	**Electricity Savings (%)**	**Gas Savings (MJ)**	**Gas Savings (%)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core measures												
EMP109	Retro-commissioning and maintenance	Manager-Recreation and Community Services + Facility Manager	0	0%	0	0%	N/A	NA	N/A	N/A	N/A	Pending planned HVAC major works
EMP110	Stadium HVAC control	Manager-Recreation and Community Services + Facility Manager	34,000	2%	0	0%	36	NA	$4,500	$2,000	0.5	Pending planned HVAC major works
EMP111	Power factor correction replacement	Manager-Recreation and Community Services + Facility Manager	0	0%	0	0%	N/A	NA	$11,000	$14,000	1.4	Pending funding allocation and negotiation with Facility Manager

EMP112	Heating circuit retro-commissioning	Manager-Recreation and Community Services + Facility Manager	0	0%	1,470,000	8%	93	NA	$12,000	$18,000	1.5	Pending funding allocation and negotiation with Facility Manager
EMP113	Circulation pump static commissioning	Manager-Recreation and Community Services + Facility Manager	33,000	2%	0	0%	36	NA	$4,400	$7,000	1.6	Pending funding allocation and negotiation with Facility Manager
EMP114	Indoor pool hall HVAC control	Manager-Recreation and Community Services + Facility Manager	29,000	2%	530,000	3%	64	NA	$8,100	$18,000	2.2	Pending planned HVAC major works
EMP115	“Old” section lighting power density	Manager-Recreation and Community Services + Facility Manager	9,600	1%	0	0%	10	NA	$1,300	$2,700	2.2	Pending funding allocation and negotiation with Facility Manager

EMP116	Heat Exchanger AHU retrofit	Manager-Recreation and Community Services + Facility Manager	0	0%	2,800,000	15%	180	NA	$23,000	$63,000	2.7	Pending planned HVAC major works
EMP117	Stadium lighting	Manager-Recreation and Community Services + Facility Manager	24,000	2%	0	0%	26	NA	$3,175	$9,000	2.8	Pending funding allocation and negotiation with Facility Manager
EMP118	Indoor swimming pool covers	Manager-Recreation and Community Services + Facility Manager	10,000	1%	320,000	2%	31	NA	$3,900	$17,000	4.4	Pending funding allocation and negotiation with Facility Manager
EMP119	Hot water circuit control	Manager-Recreation and Community Services + Facility Manager	22,000	2%	0	0%	23	NA	$2,800	$13,000	4.8	Pending funding allocation and negotiation with Facility Manager

EMP120	HHW temperature reset	Manager-Recreation and Community Services + Facility Manager	0	0%	300,000	2%	19	NA	$2,400	$5,300	2.2	Pending funding allocation and negotiation with Facility Manager
EMP121	LED exit light retrofit	Manager-Recreation and Community Services + Facility Manager	9,900	1%	0	0%	11	NA	$1,790	$8,750	4.9	Pending funding allocation and negotiation with Facility Manager
EMP122	Car park lighting time of use	Manager-Recreation and Community Services + Facility Manager	0	0%	0	0%	N/A	NA	N/A	N/A	N/A	Pending funding allocation and negotiation with Facility Manager
EMP123	Indoor pool hall HVAC airside retro-commissioning	Manager-Recreation and Community Services + Facility Manager	0	0%	0	0%	N/A	NA	N/A	N/A	N/A	Pending funding allocation and negotiation with Facility Manager
Core sub-total			**171,500**	**13%**	5,420,000	**30%**	**529**		**$78,365**	**$177,750**	**2.3**	
Non-core measures												

EMP124	Foyer area lighting	Manager-Recreation and Community Services + Facility Manager	7,800	1%	0	0%	8.3	NA	$1,000	$12,000	12	Pending funding allocation and negotiation with Facility Manager
EMP125	Low load boiler	Manager-Recreation and Community Services + Facility Manager	0	0%	390,000	2%	25	NA	$3,200	$64,000	20	Pending funding allocation and negotiation with Facility Manager
EMP126	Dry area chilled water conversion	Manager-Recreation and Community Services + Facility Manager	88,000	6%	0	0%	94	NA	$12,000	$1,090,000	95	Pending funding allocation and negotiation with Facility Manager
EMP127	Dry area HVAC replacement strategy	Manager-Recreation and Community Services + Facility Manager	39,000	3%	0	0%	42	NA	$5,100	$500,000	97	Pending funding allocation and negotiation with Facility Manager

EMP128	Dry area HVAC control	Manager-Recreation and Community Services + Facility Manager	0	0%	0	0%	N/A	NA	N/A	N/A	N/A	Pending funding allocation and negotiation with Facility Manager
Non-core sub-total			**134,800**	**10%**	**390,000**	**2%**	**169.3**		**$21,300**	$1,666,000	**78.2**	
Total			**306,300**	**23%**	5,810,000	**32%**	**698**		**$99,665**	$1,843,750	**18.5**	

All site totals										
	Electricity Savings (kWh)	**Electricity Savings (% total Council use)**	**Gas Savings (MJ)**	**Gas Savings (% total Council use)**	**Emission Savings (t CO2-e)**	**Peak Electrical Demand Savings (kVA)**	**Financial Savings ($)**	**Capital Cost ($)**	**Financial Payback (years)**	**Planned Comple-tion Date**
Core	1,756,060	22%	5,079,300	28%	2,276	NA	350,770	1,627,000	4.6	2015-16
Non-core	466,790	5.8%	379,800	5.5%	522	NA	74,673	2,459,250	32.9	2015-16
Combined	2,222,850	27.8%	5,459,100	33.5%	2,798	NA	425,443	4,086,250	9.6	2015-16

As Table 6 demonstrates, actions to reduce energy consumption have been developed for all key energy using facilities. The figures below illustrate the total energy used by each. With the addition that for each facility, the total reduction in consumption as a portion of baseline energy use is also illustrated.

Figure 34: Improvement to energy use through implementation of core retrofit actions at Casula Community Centre and Casula Pre-School

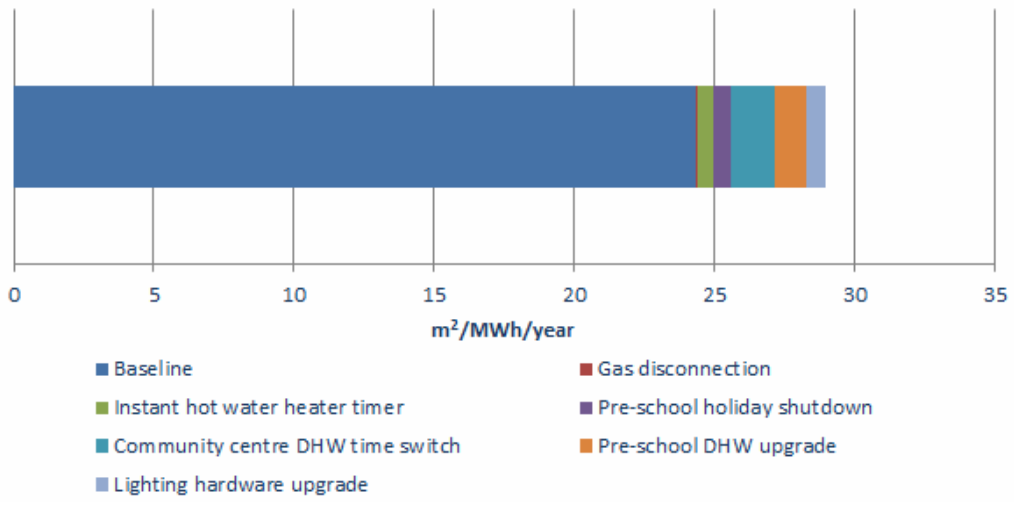


Figure 35: Improvement to energy use through implementation of core retrofit actions at Casula Library

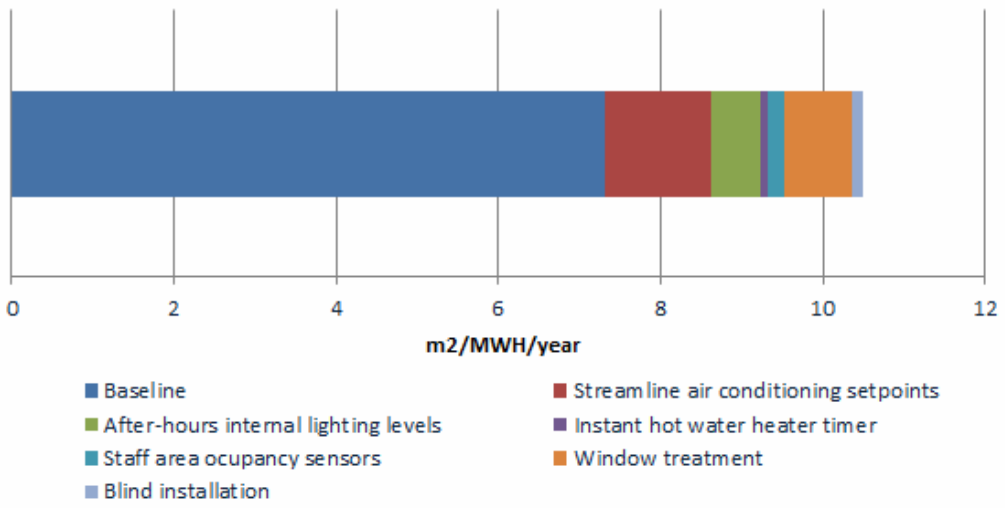


Figure 36: Improvement to energy use through implementation of core retrofit actions at Casula Powerhouse Arts Centre

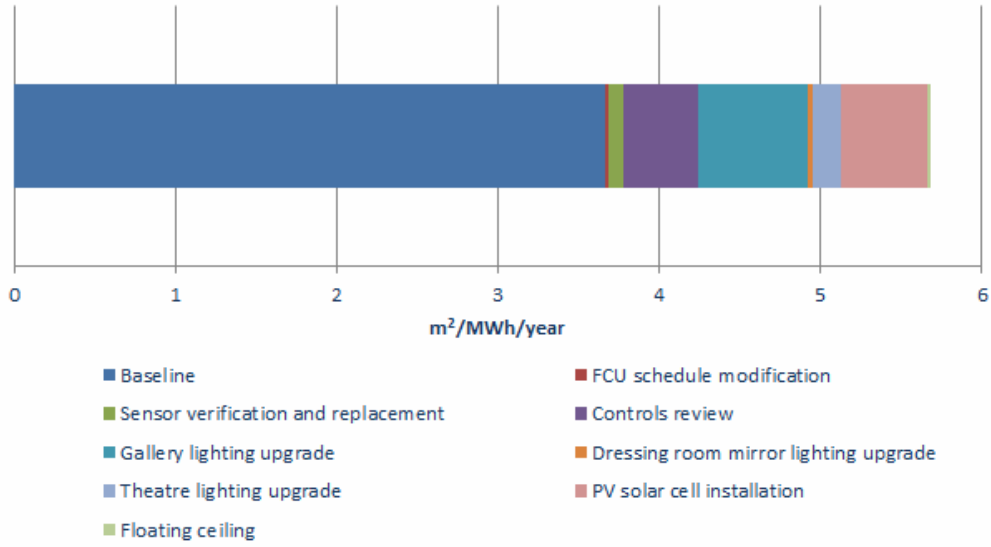


Figure 37: Improvement to energy use through implementation of core retrofit actions at Chipping Norton Recreation Centre

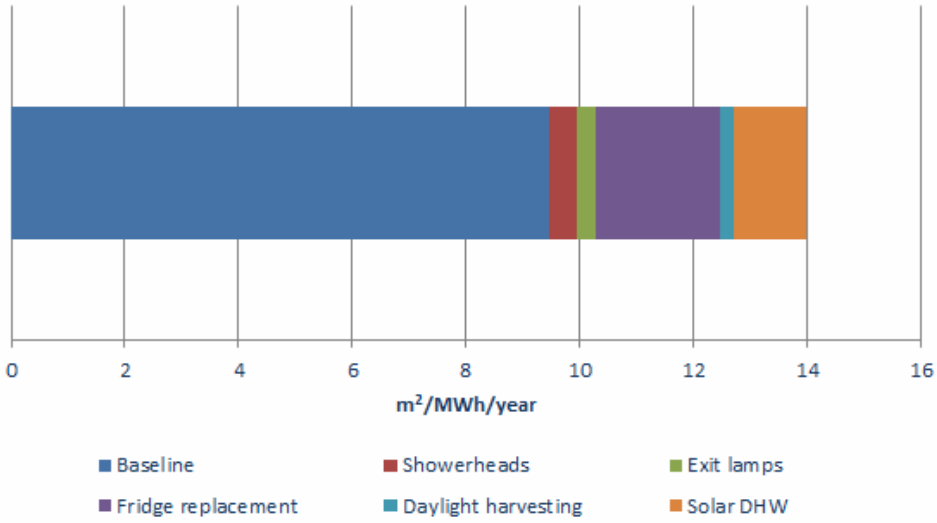


Figure 38: Improvement to energy use through implementation of core retrofit actions at Liverpool City Library Complex

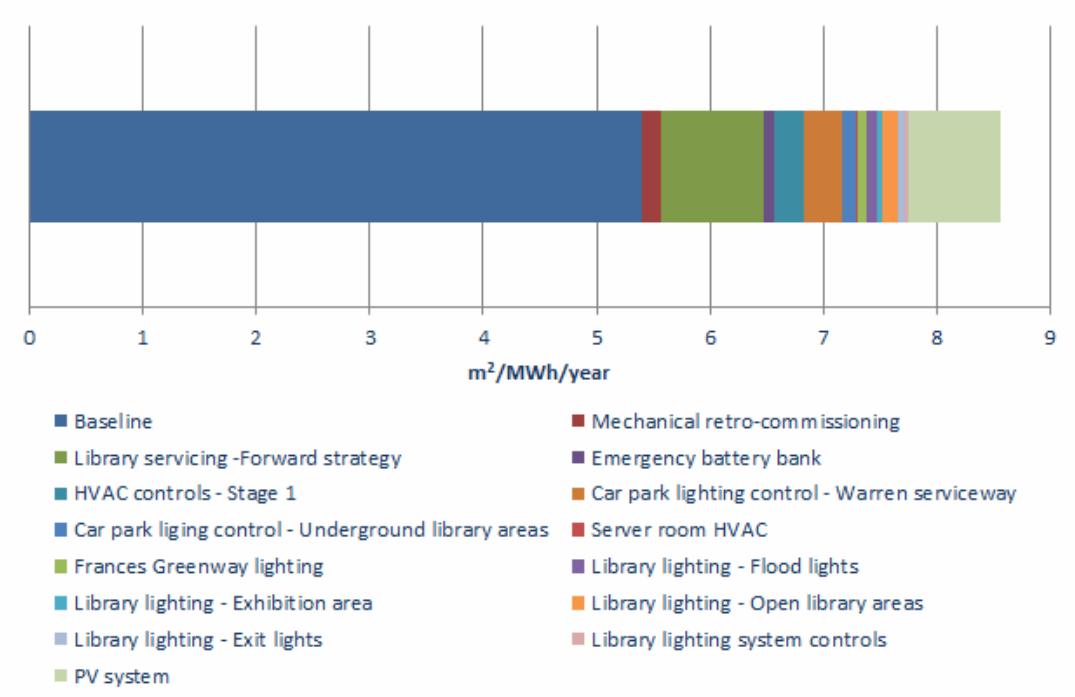


Figure 39: Improvement to energy use through implementation of core retrofit actions at Liverpool Regional Museum

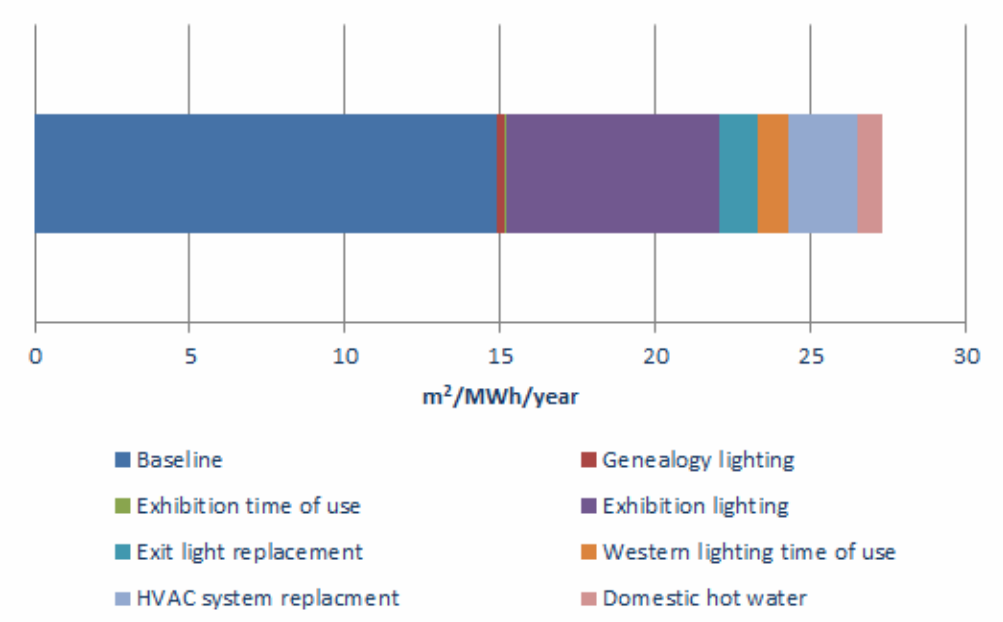


Figure 40: Improvement to energy use through implementation of core retrofit actions at Michael Wenden Aquatic Leisure Centre

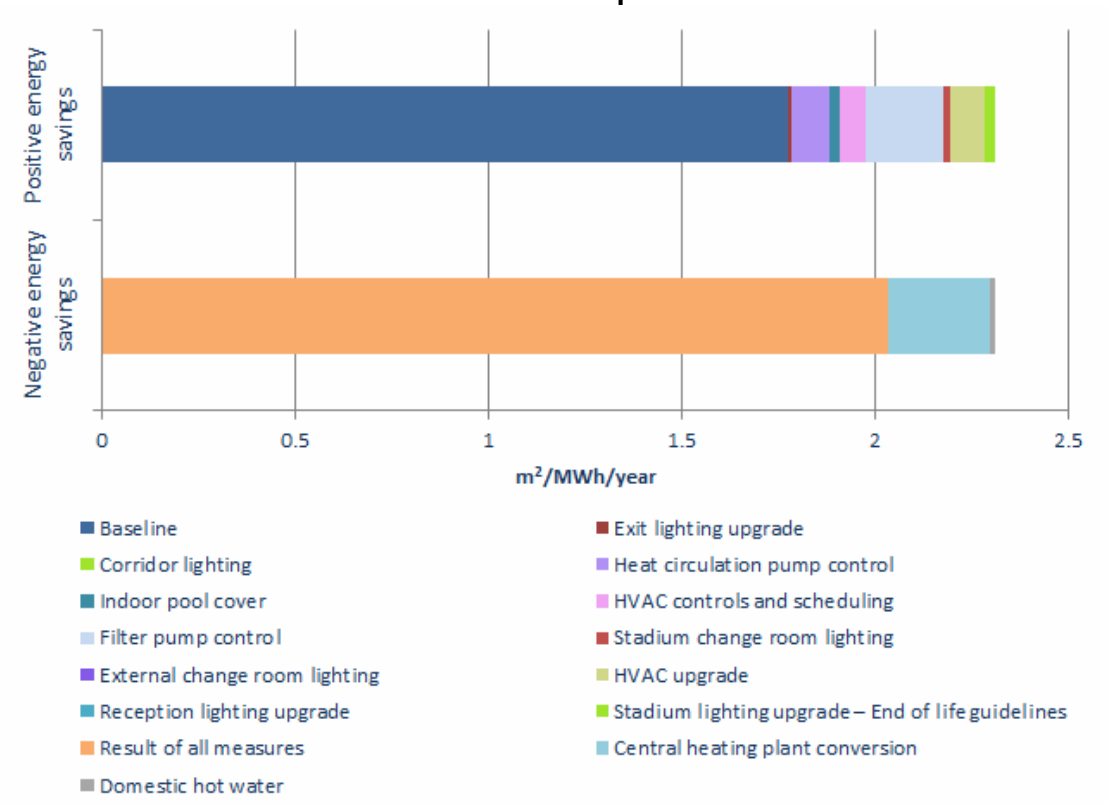


Figure 41: Improvement to energy use through implementation of core retrofit actions at Northumberland Street Car Park

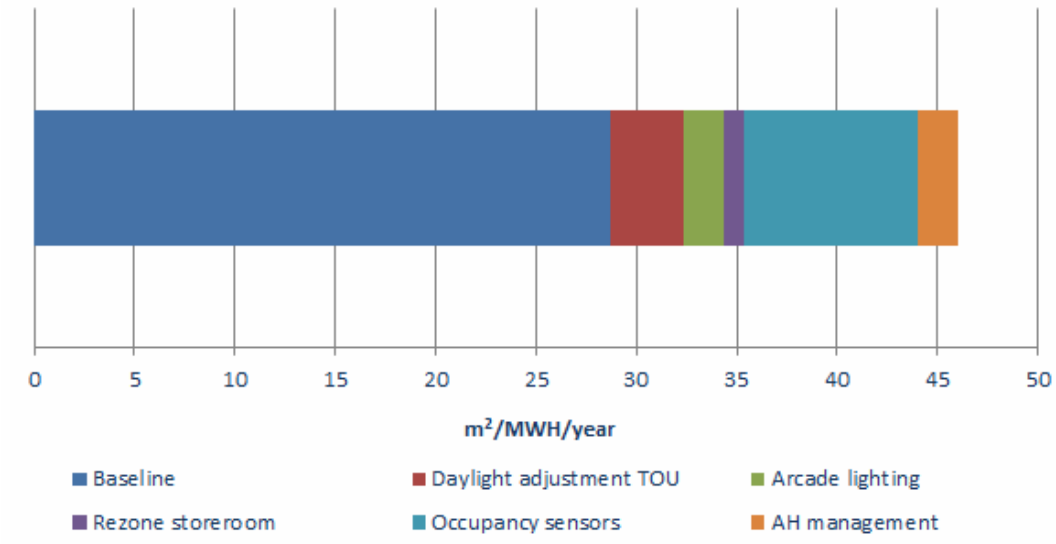


Figure 42: Improvement to energy use through implementation of core retrofit actions at Rose Street Depots

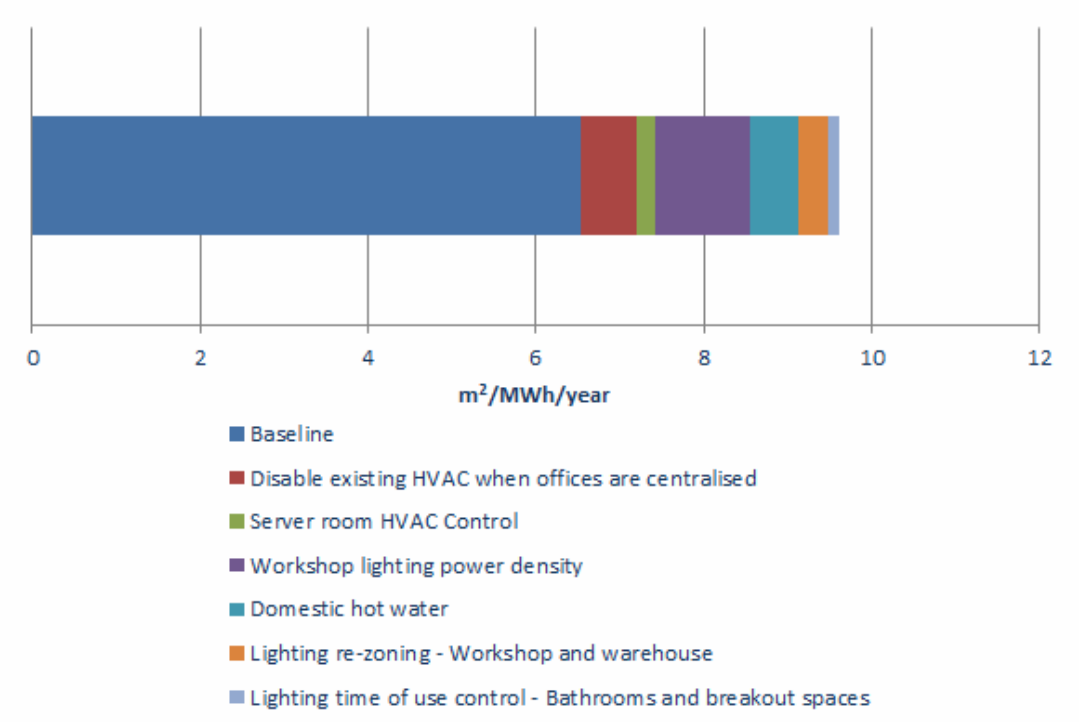
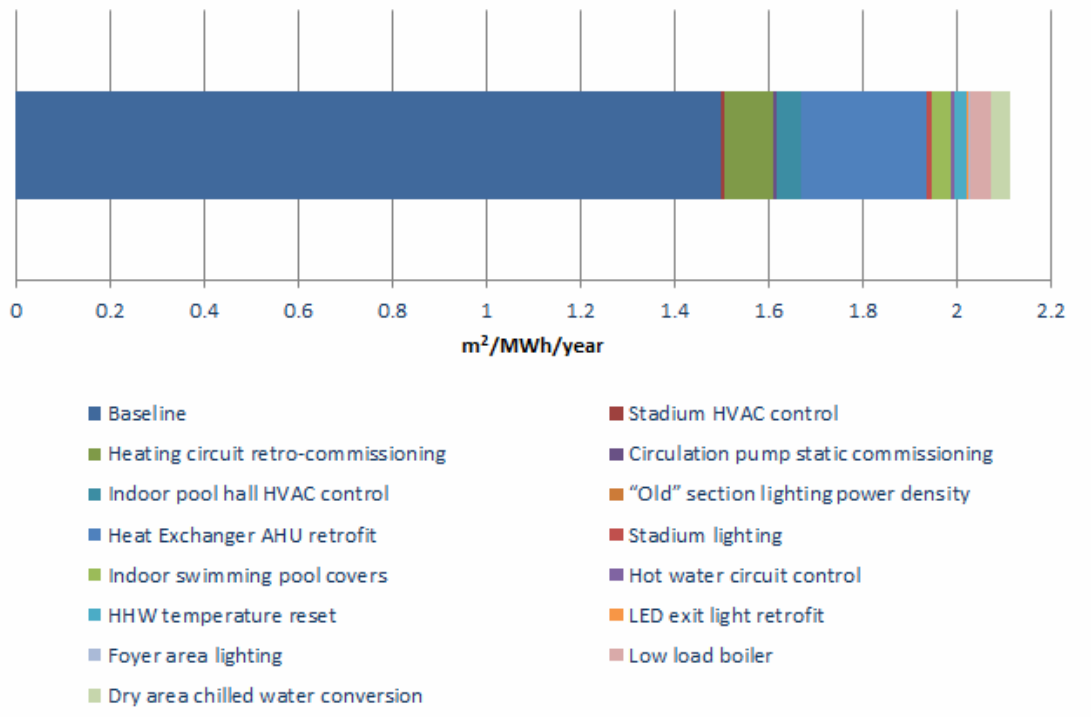


Figure 43: Improvement to energy use through implementation of core retrofit actions at Whitlam Leisure Centre



7. Appendix - Energy Audit Reports