ENERGY STUDY REPORT

for the

TRANSFORMATION PROGRAMME
'INVEST-TO-SAVE'

for

STATES OF JERSEY
HEALTH & SOCIAL SERVICES DEPARTMENT

CLIENT

Mr T Crane, Assistant Director Facilities Management,
States of Jersey Treasury & Resources Department,
Jersey Property Holdings Building Maintenance, Highlands Campus,
St Saviour, Jersey JE2 7LF

ISSUED BY

Henderson Green Limited, 31 Carlton Crescent, Southampton SO15 2EW
t: +44 (0)23 8022 5900

Date: August 2011
File Ref: J2110237/2A/03/ESRep

STATES OF JERSEY HEALTH & SOCIAL SERVICES DEPARTMENT
TRANSFORMATION PROGRAMME 'INVEST-TO-SAVE'

ENERGY STUDY REPORT

C O N T E N T S

Prepared By:	R M SPINNEY	**Date:**	AUGUST 2011
Checked By:	R M SPINNEY	**Date:**	12/08/2011
Approved By:		**Date:**	

EXECUTIVE SUMMARY

BACKGROUND

The States of Jersey are committed to increasing the efficiency of service operations and reducing the environmental impact of its day to day activities in delivering its services. In 2010, the States spent almost 5% more on energy than in 2009, largely driven by rising prices in the cost of fuel over the period, thus putting significant pressures on budgets.

Spend analysis on energy and water has identified the potential for significant improvements and efficiency gains. These will not only result in immediate cashable efficiencies, but will also assist the States in achieving an improved performance on sustainability and environmental objectives also.

In April 2011, the States launched 'ECO ACTIVE States', an awareness and action campaign designed to ensure all States Departments achieve ECO ACTIVE accreditation by 2014, but further sustained efficiencies will be realised through investment in energy saving technology across the estate. To this end, the States are seeking to identify the optimum programme of investment that will both sustain the immediate gains made through raising awareness of energy-efficiency, and deliver further gains through use of appropriate technology.

This report has been produced in order to provide support to the Energy Project for the HSSD in identifying and validating the costs and savings associated with all invest-to-save projects within the Healthcare Estate, with a view to identifying projects that will achieve the targeted savings with minimum investment and risk to help to reduce and better manage their energy and water consumption in the future.

SUMMARY OF BUILDINGS SURVEYED AS PART OF THIS STUDY

Site	Departments/Functions	No. Beds	No. Floors	Measured floor Area	Advised Area	Year Built
Block A Phase 2	Wards	161	9	9,330	11,314	1987
Block B - 1960's	A&E, Theatres, ITU, O/P	47	5+B	4,650	4,186	1962
Block C - Granite	X-Ray, Endo, & Wards	67	4+B	4,380	4,792	1862
Block D - Peter Crill	Education, Admin & Nurses	30	6+B	6,330	4,864	1994
Block E - Phase 1 GHW	O/P, DSU, ENT & Renal	0	5+B	6,695	8,255	1979
Block F - Phase 1B	Kitchen, Path & Pharmacy	0	3	2,970	3,194	1983
General Hospital		305		**34,355**	**36,605**	
Westmount Centre	Assessment & Rehab	27	2	2,774	4,062	2005
Sandybrook	Residential Home	25	2	2,097	1,998	1999
The Limes	Residential Home	33	3	2,329	2,200	1992
Le Bas Centre	Out Patients & CN	0	2	4,838	2,998	1924
Orchard House	Mental Illness Unit	18	2	1,184	2,262	1979
Westaway Court	Doctors Accommodation	77	4&10	2,461	4,108	1977

FINDINGS AND RECOMMENDATIONS

The following projects appear to provide the most cost effective opportunities for reducing the energy consumption of the buildings surveyed; and collectively will provide around XX% of savings per year and will require an investment in the order of £XXXM, giving an overall payback of XX years.

The following summarises the findings of the analysis undertaken as part of the project schedule in appendix A, with the priorities for individual projects assessed using the model in section 3.0:

Priority 1 – Low Investment but high Savings Potential

- Power factor correction – JGH Phase 2 (Ess & NE) & the Limes
- Improvements to lighting - i.e. lamp replacement, fitting PIRs, daylight sensing or auto-off controls – throughout estate
- Review scope for Plant and IT equipment shutoff/set back - out of hours and fit set back controls.
- Westmount Centre – Review of lighting and control system
- Westmount Centre – Review of HVAC electrical Consumption
- JGH– Review of electricity consumption early evening (Particularly Gwyneth Huelin) and early morning (particularly phase 1B & 2), to identify potential savings.

Priority 2 – Low Investment with Low Savings Potential

- Replacement of existing white goods plant for new "A" rated items.
- Tariff changes - switching from the existing flat electrical tariffs to E7.
- Fitting a swimming pool cover to the Hydrotherapy Pool.
- Adding urinal (Cistermiser type) controls
- Sandybrook – Review of underfloor heating controls
- Limes – Analysis of night-time electricity consumption to identify potential savings
- Le Bas – Review of early evening electricity consumption to identify potential savings

Priority 3 – High Investment but high Savings Potential

- Window replacement – JGH Gwyneth Huelin Wing
- Cavity wall Insulation - JGH Phase 2 & Gwyneth Huelin Wing
- Roof insulation - JGH Granite Block
- Lagging of HTHW distribution at JGH
- Lagging of pipeline components – Westmount Centre

Priority 4 – High Investment with Low Savings Potential

- Installing plate heat exchangers in lieu of calorifiers.
- Controls upgrades/replacement - i.e. replacing old analogue controls or adding TRVs.
- Solar (PV) panel installation or solar hot water panels - to reduce primary energy consumption.
- Combined Heat and Power (CHP) units - Designed to meet the base (summer) thermal load.
- Replacement of existing lifts
- Replacement of existing Chillers
- Replacing existing WCs with low flush type
- Installing Pushbutton taps to reduce water consumption.

In addition to the above, a separate study is underway into future provision of thermal energy across the General Hospital site.

1.0 TERMS OF REFERENCE

The States of Jersey is presently undertaking a comprehensive spending review ('CSR'), to evaluate all of its present and future public-service provision and expenditure. Part of CSR is looking at realising gains through more efficient procurement across Departments ('the Transformation Programme').

The Transformation Programme is divided into several categories, one of which is FM & Infrastructure. Within this Category, one of the areas of focus is achieving a 10% reduction in the consumption of energy and water between 2011 and 2013 ('the Energy Project).

The Energy Project is concentrating on three main areas:

- Awareness/behavioural change ('hearts and minds')
- Sustainable procurement
- Management of demand

This last area will require investment in technology by all Departments to sustain the savings made through behavioural change; therefore, the scope of this study is to:

- Review the initial long list of potential invest-to-save opportunities across the estate
- Validate the content and phasing of invest-to-save projects identified
- Grade all identified projects to identify quickest pay-back on investment with less risk to States' Departments
- Optimise the phasing to obtain maximum benefit from economies-of-scale within project procurement
- Produce the basis for a Business Case to identify how the future savings identified will be achieved

The HSSD properties covered by this report are as follows:

General Hospital

- Block A - Phase 2 - High Rise Block - Wards (1987)
- Block B- 1960's Wing - A&E, Theatres, ITU, O/P and Paediatrics (1962)
- Block C - Granite Block – X-Ray, Endo, Wards and Admin (1862)
- Block D - Peter Crill House Education, Admin and Nurses Accommodation (1994)
- Block E - Phase 1 - Gwyneth Huelin - O/P, DSU, ENT and Renal (1979)
- Block F - Phase 1B - Kitchen, Path and Pharmacy (1983)

Outlying Sites

- Westmount - Assessment and Rehabilitation Centre (2005)
- Sandybrook - Residential Home for the Elderly (1999)
- The Limes - Residential Home for the Elderly (1992)
- Le Bas Centre - O/P & Community Nurses(1950)
- Orchard House - Mental Illness Unit (1979)
- Westaway Court - Doctors Accommodation (1977)

2.0 APPROACH

Our approach to this commission was a staged process as follows:

a) Validate the Dashboard Information by review of the existing building fabric, Plant performance, controls and occupancy in order to assess end energy usage.
b) Schedule all significant energy consuming plant.
c) Compare the actual consumption with published benchmark data for the relevant building type to identify areas of excessive consumption.
d) Review half-hourly electrical data to determine abnormal usage patterns, Power Factors and implications of tariff changes.
e) Consider the costs and savings potential of each of the relevant projects from the initiatives list using discounted cash flow techniques.

Within the remit of a commission such as this, it is only possible to do initial broad brush budget estimates for the projects under consideration; and therefore we recommend that a pessimistic view of payback is taken, where:

- Cost allowances are 20% higher than the budget
- Savings potential is 20% less than the actual prediction

Using the above adjustments, an attenuated payback is calculated which assumes:

- A maximum project life of 10 years
- That over the 10 year period, interest and inflation rates will be similar; and fuel costs will rise at 5% above this rate.

Table 2.1 Factors to Apply to Simple Payback for NPV calculation

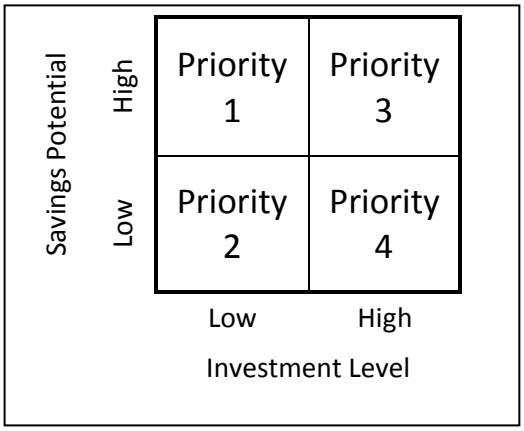
Fuel Inflation = Discount Rate +/-	10 Year Actual	10 Year Pessimistic	5 Year Actual	5 Year Pessimistic
-13%	54%	36%	35%	18%
-5%	77%	51%	43%	26%
0%	100%	67%	50%	33%
5%	132%	88%	58%	44%
10%	175%	116%	67%	58%

Table 2.2 Priority Ranking Model

Using the above recommendations, the "pessimistic" net present value (NPV) of any savings would equate to around 90% of the simple cash payback for a 10 year life; of 75% for a 5 year life.

This demonstrates that for the bulk of the projects under consideration, which should easily last 10 years, simple payback is considered to be a reasonable indication of financial viability.

The priorities shown in table 2.2 have been developed on the basis that the lower the investment level, the quicker the project should be able to be instigated and therefore the sooner the benefits will be realised.



3.0 GENERAL OVERVIEW OF PROPERTIES SURVEYED

3.1 GENERAL HOSPITAL

This is a very compact site, made up of 7 main Blocks; including the Energy Centre and Engineering Block, which were excluded from this commission. The central Boiler House contains 3 No 3.5 MW Robey boilers with Saake burners (max 82% efficiency), which feed heating and domestic hot water calorifiers located in each of the Blocks via HTHW mains operating at 138°C/108°C. The boilers are close to the end of their serviceable life, as they were installed in the late 1980's. The details of the individual Blocks are as follows:

3.1.1 Block A - Phase 2

This is a 9-storey Ward Block constructed in the late 1980's, which joins to the 1960's Wing and Phase 1B. In addition to the 6 Ward floors (160 beds), at ground level there is the Main Entrance, Restaurant and Dining; and a Roof Plantroom.

Most of the plant is original and, whilst the pipework and calorifiers appear to be in reasonable condition, the air handling plant, chillers and controls are at the end of their serviceable life.

The walls are believed to be of empty cavity construction, with a flat insulated roof, solid un-insulated floors and it is mostly double glazed. There are a total of 7 lifts in the Block, none of which have been recently upgraded.

In addition to the lift upgrades, the estate-wide Condition Survey carried out in the past few years recommended replacing all main plant, TRVs and lighting in Circulation areas. It is believed that little of this has been awarded funding.

3.0 GENERAL OVERVIEW OF PROPERTIES SURVEYED - contd

3.1 GENERAL HOSPITAL - contd

3.1.2 Block B- 1960's Wing

This is a 6-storey Block constructed in the late 1960's, which joins to Phase 2 and the Granite Block. This Block contains much of the specialist treatment areas, including: A&E, Theatres, ICU, Outpatients and Paediatrics.

Most of the plant was replaced in the late 1980's when Phase 2 was constructed; and some of the plant serving A&E has been installed in the past few years. Some of the air handling plant is, however, original and well past the end of its serviceable life. As with Block A, the pipework and calorifiers appear to be in reasonable condition, but the 1980's AHUs and controls are at the end of their life.

The walls are believed to be of empty cavity construction, with a flat un-insulated roof and solid un-insulated floors; and it is mostly double glazed. There are 2 lifts in the Block, one of which has been recently upgraded; and upgrade of the second is in hand.

The estate-wide Condition Survey carried out in the past few years recommended replacing all main plant, TRVs and lighting in plant and Circulation areas. With the exception of the lifts, it is believed that little of this has been awarded funding.

3.1.3 Block C - Granite Block

This is the oldest part of the Hospital, dating from 1862, which joins to the 1960's Wing and Peter Crill House. It is a 4-storey Block, containing X-Ray, Endoscopy, Wards area (around 70 beds) and Administration.

The building is mostly naturally ventilated and the building has been extensively remodelled over the years. As with the other Blocks, most of the plant was replaced in the late 1980's when Phase 2 was constructed and the pipework and calorifiers appear to be in reasonable condition.

The walls are of solid construction, with a tiled un-insulated pitched roof, solid un-insulated floors and it is mostly double glazed. There is a single lift in the Block, which is in the process of being upgraded.

The estate-wide Condition Survey carried out in the past few years recommended replacing all main plant, TRVs and lighting in Bartlett Ward and the Endoscopy Theatre. With the exception of the lifts it is believed that little of this has been awarded funding.

3.0 GENERAL OVERVIEW OF PROPERTIES SURVEYED - contd

3.1 GENERAL HOSPITAL - contd

3.1.4 Block D - Peter Crill House

This is the newest Block on the site, dating from the mid 1990's and is made up of 7 storeys, the upper 5 being split between Offices & bedsit accommodation for Medical Staff, with an Education and Admin facility at ground level; and Medical Records and Plant areas in the Basement. The building is mostly naturally ventilated and in good condition throughout.

The walls are believed to be of insulated cavity construction, with a flat insulated roof, solid un-insulated floors and it is fully double glazed. There are 3 lifts in the Block, all of which appear to be in good condition.

The estate-wide Condition Survey carried out in the past few years recommended upgrading the lifts, replacing an A/C unit in the Chief Executive's Office, some TRVs and lighting in Bathrooms and Circulation areas; it is believed that little of this has been awarded funding.

3.1.5 Block E - Phase 1 - Gwyneth Huelin Wing

This is a 6-storey Block constructed in the late 1970's, which joins to Phase 1B and Peter Crill House. This Block contains much of the Outpatients facilities, including Day Surgery Unit, Psychiatric Care, ENT and Renal, Physiotherapy and Hydrotherapy.

Most of the plant was replaced in the late 1980's when Phase 2 was constructed; and the plant serving Renal and Day Surgery has been installed in the past few years. Some of the air handling plant is, however, original and well past the end of its serviceable life. As with Block A, the pipework and calorifiers appear to be in reasonable condition, but the original AHUs and controls are at the end of their serviceable life.

The walls are believed to be of narrow empty cavity construction, with a flat un-insulated roof, solid un-insulated floors and it is mostly single glazed. Much of the ground floor has louvred opening sections within the glazing, which results in excessive uncontrolled ventilation during the heating season and unacceptably high heat losses. There is a single lift in the Block, which has been recently upgraded.

The estate-wide Condition Survey carried out in the past few years recommended replacing all main plant, TRVs and lighting in Offices, Utility, Plant and Circulation areas. With the exception of the lifts, it is believed that little of this has been awarded funding.

3.1 GENERAL HOSPITAL - contd

3.1.6 Block F - Phase 1B

This is a 3-storey Block constructed in the early 1980's, which joins to Phase 2 and Gwyneth Huelin Wing. This Block contains the Main Kitchen, Pathology and Pharmacy.

The AHUs serving some Labs and the Mortuary have been installed in the past few years, but the AHUs and controls serving general areas and the Pharmacy are at the end of their serviceable life.

The walls are believed to be of empty cavity construction, with a flat un-insulated roof, solid un-insulated floors and it has a mix of single and double glazing. There is a single lift in the Block, which has not been upgraded since installation.

In addition to the lift upgrades, the estate-wide Condition Survey carried out in the past few years recommended replacing all main plant, TRVs and lighting in minor areas. It is believed that little of this has been awarded funding.

3.0 GENERAL OVERVIEW OF PROPERTIES SURVEYED - contd

3.2 WESTMOUNT - ASSESSMENT AND REHABILITATION CENTRE

This is the newest of all the buildings surveyed, constructed in 2005 and is made up of 2 storeys; the upper storey being a 27 bed Inpatient Unit; and the lower storey is split between Storage areas and an Outpatient Facility.

The building is highly engineered and is generally in good condition, although there is anecdotal evidence of over-engineering; and not all of the systems appear to be working in accordance with what would be expected. Issues noted during the Survey which have a significant effect on the energy efficiency of the building include:

- The Outpatient Unit lighting appears to be left on out-of-hours
- Lights controlled by the automatic system are on when there appears to be sufficient natural daylight
- The User is unable to effectively manage the lighting control system; and has resorted to simply controlling every other fitting in Circulation areas off
- The large Storage area ventilation plants appear to run continuously
- The number and/or ratings of light fittings in some rooms appears excessive
- There is no insulation on any of the heating pipework pipeline components; and the heating system operates all year round
- The domestic water services booster sets appear to be designed for a far higher pressure than is necessary and appear to be short-circuiting and air locking

The walls are believed to be of insulated cavity construction, with an insulated pitched roof, solid insulated floors and it is double glazed throughout. There are 2 lifts, which appear to be in good condition.

The estate-wide Condition Survey carried out in the past few years made no recommendations for upgrading or replacing any plant, which is not surprising as, at the time it was carried out, the building would have only just been completed.

3.0 GENERAL OVERVIEW OF PROPERTIES SURVEYED - contd

3.3 SANDYBROOK - RESIDENTIAL HOME FOR THE ELDERLY

This is a relatively new building, dating from the late 1990's; and is made up of 2 storeys formed in 5 Blocks, providing 25 long-term Care Beds and associated accommodation.

The building is simply engineered and is generally in good condition, although there is anecdotal evidence of overheating due to poor control of the under-floor heating.

The walls are believed to be of insulated cavity construction, with an insulated pitched roof and solid insulated floors, and it is double glazed throughout. There are 2 lifts, which appear to be in good condition.

The estate-wide Condition Survey carried out in the past few years recommended refurbishing the lifts, replacing all main plant, some TRVs and some lighting in Bedrooms and En-Suites. It is believed that little of this has been awarded funding.

3.4 THE LIMES - RESIDENTIAL HOME FOR THE ELDERLY

This is a relatively new building, dating from the early 1990's, and is of very similar design to Sandybrook but made up of 3 storeys, formed in 3 Blocks, providing 33 long-term Care Beds and associated accommodation. The building is simply engineered and is generally in good condition.

The walls are believed to be of insulated cavity construction, with an insulated pitched roof, solid insulated floors and it is double glazed throughout. There are 2 lifts, which appear to be in good condition.

The estate-wide Condition Survey carried out in the past few years recommended refurbishing the lifts, replacing all main plant, cold room condensers, a water heater and Kitchen lighting. It is believed that little of this has been awarded funding; however, the building is about to go through a remodelling process, which hopefully will act on some of the recommendations.

3.5 LE BAS CENTRE - O/P AND COMMUNITY NURSES

Most of the building dates from the 1920's and was originally constructed as a Maternity Hospital, but was completely refurbished in the 1980's to create Clinics and a Community Nurse facility. It is generally 2 storeys, formed round the original 3-storey house.

The building is simply engineered, although some of the reconfiguring of the accommodation has been done cheaply, resulting in a mixture of heating systems and redundant plant not removed. Users complain of poor levels of heating in some areas and poor control of the heating, leading to overheating in others.

The walls are believed to be a mix of solid and un-insulated cavity construction, with mostly flat roofs, solid insulated floors; it is mostly double glazed and there are no lifts.

The estate-wide Condition Survey carried out in the past few years recommended replacing all main plant, some TRVs and large areas of lighting. It is believed that little of this has been awarded funding; however, the building is about to go through a further change of occupancy, thus it is hoped that many of the existing problems will be addressed as part of the remodelling process.

3.6 ORCHARD HOUSE - MENTAL ILLNESS UNIT

This building dates from the late 1970's but was completely refurbished in 2005. It is 2 storeys, providing 18 bed spaces, although much of the lower floor is storage space.

The building is simply engineered, although the refurbishment was not sufficiently funded to allow for the replacement of the central plant, improvements to insulation or for the installation of TRVs or lighting controls.

The walls are believed to be of un-insulated cavity construction, with a flat un-insulated roof, solid un-insulated floors and it is mostly double glazed; and there are no lifts.

The estate-wide Condition Survey carried out in the past few years recommended replacing all main plant and thermal insulation, although it is believed that little of this has been awarded funding.

3.7 WESTAWAY COURT - DOCTORS ACCOMMODATION

This building, dates from the late 1970's and is formed in 4 Blocks; 3 of which are joined and 3-storeys high with the fourth, a standalone and 10-storeys high. In total, the accommodation provides Flats and Bedsits and associated accommodation for around 75 long-term Medical Staff.

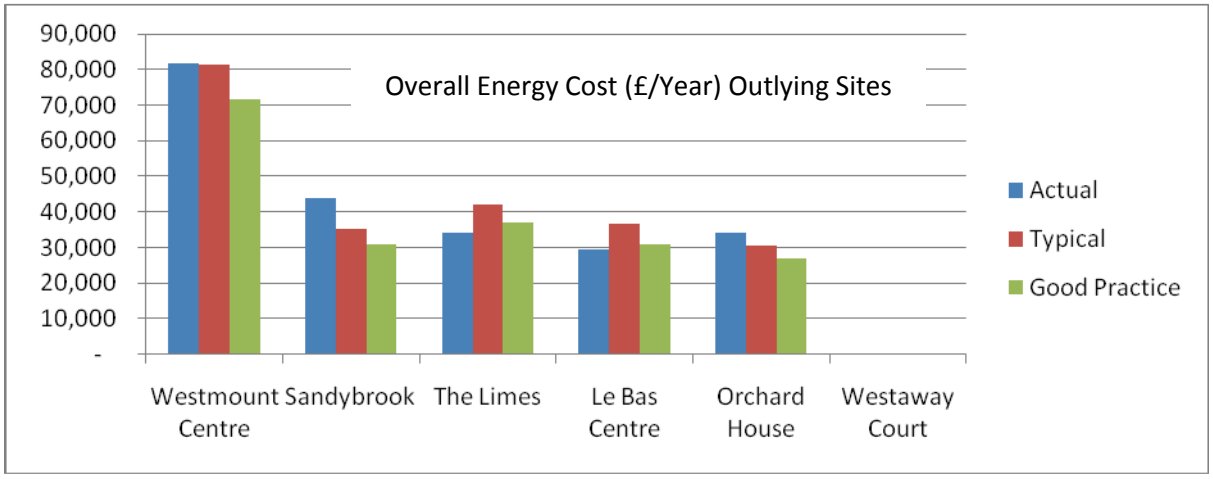
The building is simply engineered with electric heating and hot water throughout, mostly using E7 Tariff (not block B); and the Occupants are responsible for their own energy bills, with the HSSD paying only for the energy used in the common areas. Access was not available to the Bedsits or Flats, but we understand that some of the emitters have recently been replaced.

The walls are believed to be of un-insulated cavity construction, with an insulated pitched roof to the low rise Blocks, solid un-insulated floors and it is double glazed throughout. There are 3 lifts, which appear to be in need of refurbishment.

The estate-wide Condition Survey carried out in the past few years recommended refurbishing the lifts and replacing the calorifiers and controls in the flats.

4.0 RESULTS OF BENCHMARKING

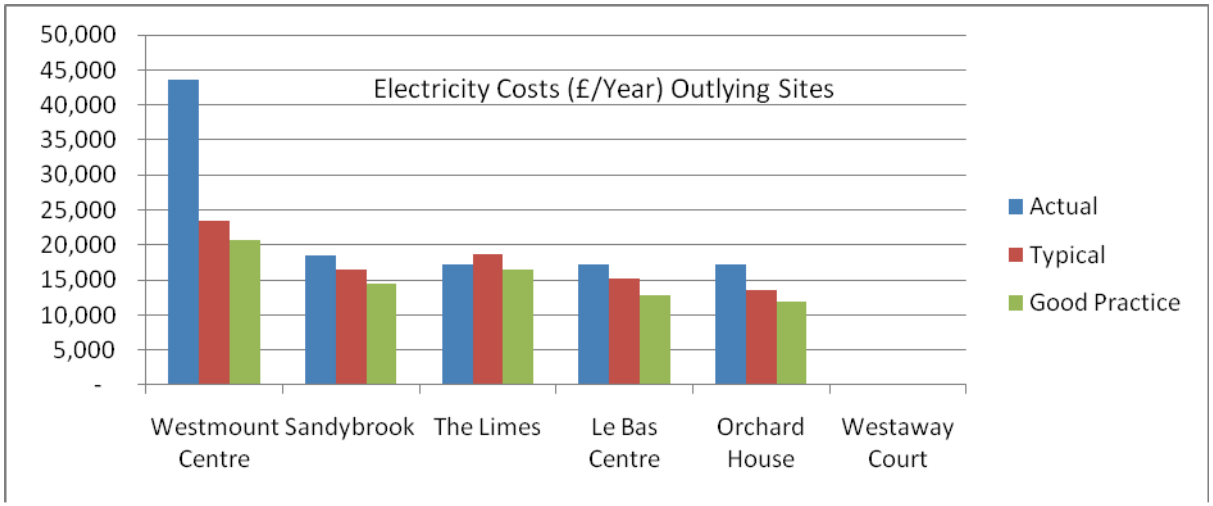
The benchmarking exercise indicates that, in general, the overall energy consumption of the smaller outlying sites surveyed is close to or below typical, i.e.:



Further analysis of this, however, indicates that the most significant areas for cost savings are from reductions in electrical consumption; particularly in the case of the Westmount Centre, which, at £40,000/year, is costing around twice what it should to run electrically.

The exception to this is Sandybrook, where the increase in energy consumption over a "typical" rated property is mainly due to excessive thermal consumption. This appears to validate the user reports of excessive temperatures, the cause of which should be investigated and rectified.

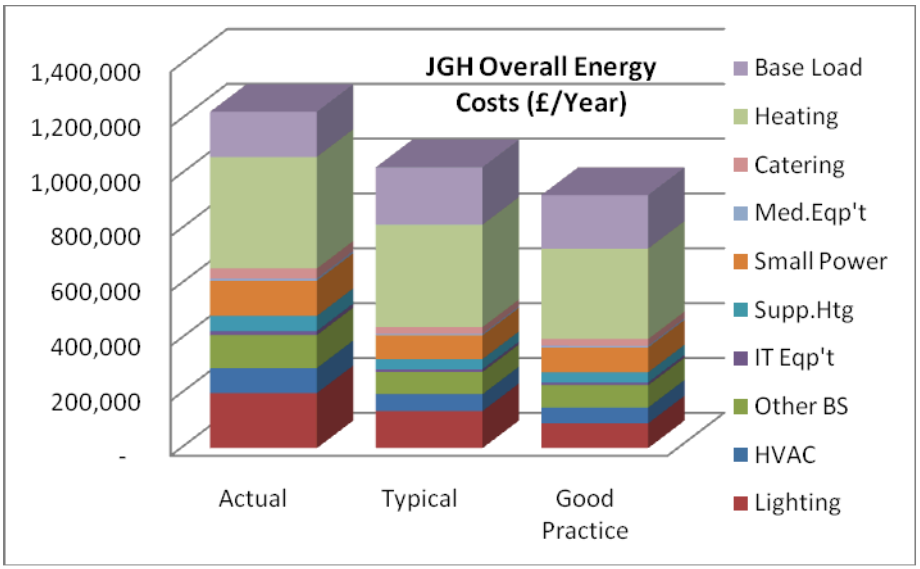
Benchmarking information indicates that lighting is the largest single consumer of electricity, accounting for around 1/3 of the site usage in this type of facility; and a "good practice" rated property uses around 1/3 less lighting energy than a "typical" building.



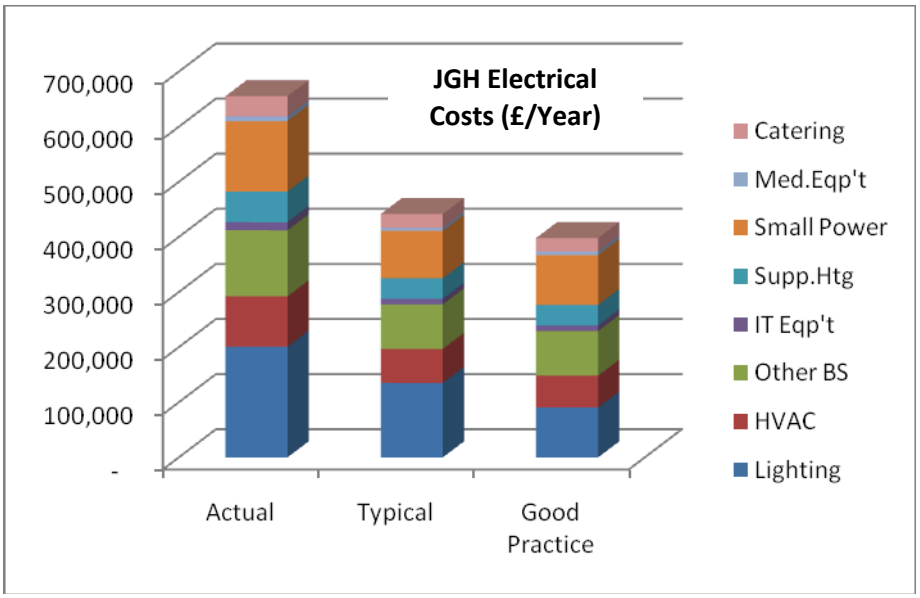
The graph above indicates that the Westmount Centre issues highlighted during the survey, such as the problems lighting and its control installation and domestic water services booster pumps are likely to be having a very significant impact on the cost of running this building; and further analysis of the half hourly data will help to identify this. There is also scope to reduce consumption on the other sites, albeit much reduced.

4.0 RESULTS OF BENCHMARKING - contd

The benchmarking exercise indicates that the General Hospital consumes 5 times the amount of energy of all the other sites surveyed put together, which means that this provides some of the best opportunities for big cash savings.



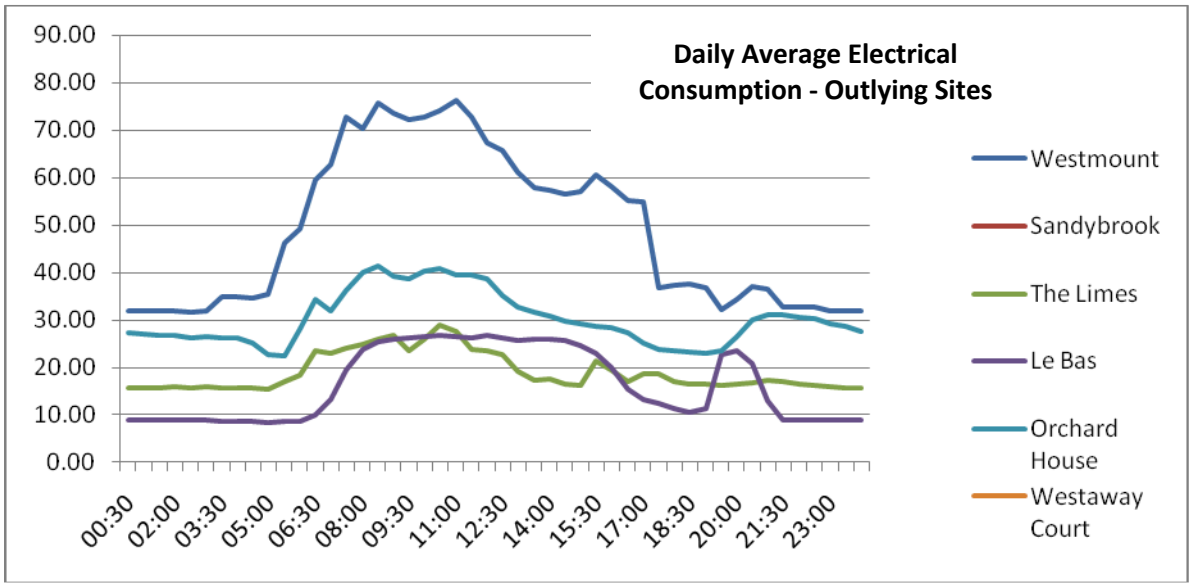
The graphs indicate that both overall and electrical energy consumption of the General is around £200,000 higher than for a typical Acute Hospital; so, again, there should be good scope for reducing electricity, particularly lighting energy consumption.



5.0 RESULTS OF ANALYSIS OF ELECTRICAL DATA

Whilst all properties are different, comparison of the daily electrical consumption between properties is a useful way of highlighting potential excessive consumption. The points to note from the following graph are:

- **Westmount Assessment & Rehabilitation Centre** - This property is most similar to the Limes in terms of floor area and number of beds. Although the nature of the Occupants is different, this is not considered to be the significant factor in the vastly different level and daily variation in electrical consumption. The most significant factors are considered to be consumption by plant and lighting.
- **Sandybrook Residential Home** - No data available, but should be similar to the Limes.
- **The Limes Residential Home** - This appears to be a well-run building, performing between typical and good practice, efforts to reduce consumption should be focused on the relatively high level of night-time consumption.
- **Le Bas Centre** - This is a very typical profile for an intermittently occupied building, the one exception being the spike in demand in the early evening, which presumably is when the Cleaners are in, but this almost equals the peak daytime consumption suggesting that all the lights are switched on for most of the time the Cleaners are in the building.
- **Orchard House** - This is an interesting profile, with night-time consumption almost ¾ of peak daytime consumption and low points coming at around 5.00 am and 7.00 pm. This may have something to do with the specific nature and needs of the Occupants of the building, but further investigation may reveal savings opportunities.
- **Westaway Court - Doctors Accommodation** - No data available.



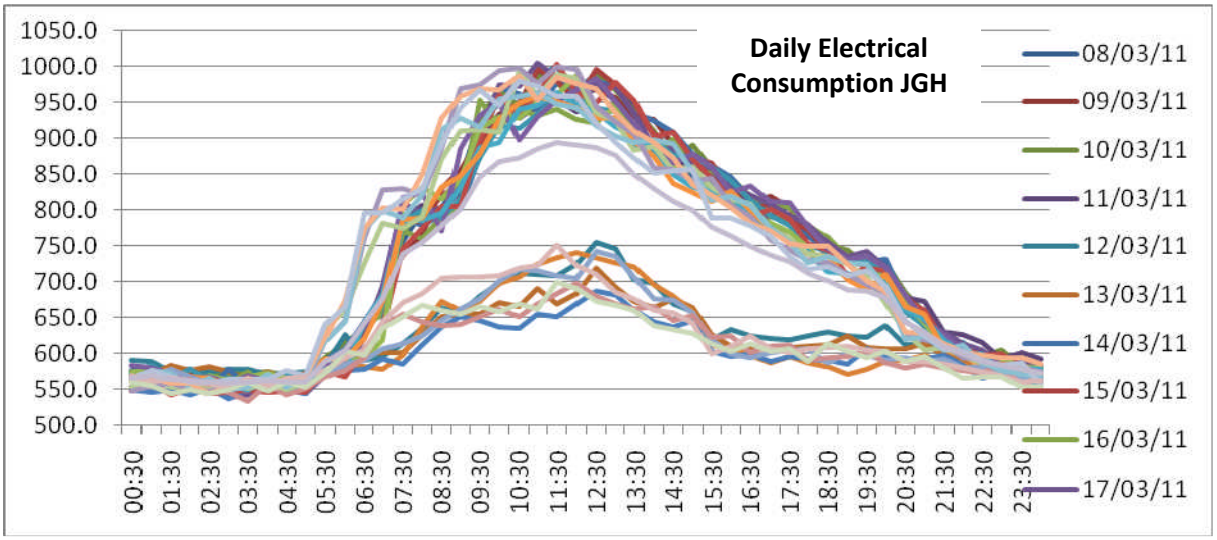
The power factor analysis below indicates a large range across the estate, with excellent figures for Le Bas and Orchard House, but a very poor power factor of 0.84 at the Limes, which definitely warrants further investigation.

Table 5.1 Power Factors for Outlying Sites

Westmount	Sandybrook	The Limes	Le Bas	Orchard House	Westaway Court
0.91	No Info	0.84	0.99	0.98	No Info

Whilst there are 4 Substations on the General Site; as the site is metered on High Voltage, we only have detailed data for the incoming supply. Analysis of this shows night-time consumption at over 50% of daytime, which appears abnormally high; and a very sharp increase from around 6.00 am to a peak at around 10.00 am, which does not fall back to its night-time level until around 10.00 pm.

5.0 RESULTS OF ANALYSIS OF ELECTRICAL DATA - contd



The tracks which peak at around 700 kVA are the weekend profiles. We would expect that once most day-time administration staff had left; and clinics closed, that the weekday consumption should quickly return to follow the weekend profile, which the graph shows that it does not do until around 9.00pm. There is therefore a 3 hour period in the early evening where there is potential for up to 100 kVA of consumption reduction.

Further analysis of the consumption profiles at the individual transformers (below) shows that consumption for most of the Blocks is relatively proportional to the floor area, with the exception of Blocks C&D (Granite Block and Peter Crill), which have significantly lower consumption by area probably due to the fact that these buildings are generally naturally ventilated with low services intensity. Phases 1A and 1B conversely have the highest relative consumption as they contain the Energy Centre, Kitchen and Pathology Departments; all of which are intensively serviced.

Table 5.2 Energy Consumed by General Hospital Transformers

Block	Description	Total kVA			Annualised	% Total	% Floor Area
		Max	Min	Ave	Cons (kWh)		
A&B	Phase 2 Ess	305	76	113	993,384	12%	39%
A&B	Phase 2 NE	474	120	223	1,953,480	25%	Inc
C&D	Granite + PC	388	104	213	1,867,632	23%	30%
E	Phase 1 - GHW	223	84	144	1,257,936	16%	18%
F&G	Phases 1A&B	503	136	214	1,877,268	24%	12%
Totals:		**1893**	**519**	**908**	**7,949,700**	**100%**	**100%**

Moving onto the individual load profiles, Gwyneth Huelin Wing has a much higher relative night-time consumption than any of the other Blocks, which is difficult to explain given that apart from the Renal Unit which operates until 10.00pm, it should effectively close down in the early evening; and this may account for a significant part of the excessive weekday evening consumption discussed above. We recommend further investigation is carried out in this area.

The Table also shows the times of the peak demand, which, for Phases 1B and 2, occur before 8.30 am, which is much earlier than would normally be expected; and, again, this is worthy of further investigation.

The other significant issues highlighted by this Table are the very low power factors experienced in Phase 2; averaging 0.81 but at times as low as 0.52.

Table 5.3 Analysis of Energy Consumed by General Hospital Transformers

Block	Description	Max: Min	Max: Ave	Power Factors			Time kVA	
		Ratio	Ratio	Max	Min	Ave	Max	Min
A&B	Phase 2 Ess	4.0	2.7	0.55	0.88	0.81	8.22	5.30
A&B	Phase 2 NE	4.0	2.1	0.52	0.92	0.81	11.35	3.11
C&D	Granite + PC	3.7	1.8	0.75	0.93	0.85	14.20	6.28
E	Phase 1 - GHW	2.7	1.6	0.75	0.97	0.89	12.26	23.04
F&G	Phases 1A&B	3.7	2.3	0.82		0.94	8.15	
Totals:		**3.6**	**2.1**	**0.68**	**0.92**	**0.86**		

6.0 INVEST-TO-SAVE PROJECTS REJECTED

Some of the projects scheduled to be reviewed were not considered feasible for the following reasons and, therefore, no detailed financial assessment has been undertaken for these:

i) Review Main Kitchen practices - Due to the specific nature of the activity, review of catering operations, we would recommend that this be undertaken by a Catering Specialist, potentially as part of the Hearts & Minds campaign.

ii) Reduce heating flow temperatures - This was not considered technically feasible due to risk of damage to the central boilers; and the costs associated with replacement of heat exchangers and control elements.

iii) Load lopping with generators - This was not considered technically feasible in the Healthcare Environment as it would lead to significantly increased maintenance shutdowns and the need for temporary generators to be brought in during these periods; and the noise issues created.

iv) Heat recovery AHUs - This was considered financially unviable as none of the existing AHUs surveyed, which did not already have heat recovery, could have heat recovery added without extensive modifications; and most were approaching the end of their useful life.

v) New washing equipment and improved steam efficiency at the Central Laundry - This was excluded as the Central Laundry was not included within the schedule of buildings; and we would recommend that this be undertaken by a Laundry/Steam Specialist.

vi) Fire vents to lift shafts - This was excluded as it is a fire safety issue; and there is no energy benefit.

vii) Electrical supply voltage reduction - This was not considered technically feasible in the Healthcare environment due to the range of demand fluctuation and the sensitivity of essential medical equipment to the resulting voltage fluctuations.

viii) Decentralise boiler plant and the use of innovative heating technologies, such as Heat pump boilers at the General Hospital - This is the subject of a separate investigation, as detailed in section 9.0.

ix) Replacing existing motor controls with inverter controls for pumps and fans - This was considered financially unviable as, in order to really benefit from inverter controls, it would be necessary to change the system from a constant to a variable volume one, which would require extensive and expensive controls modifications.

x) Review satellite Laundry use - This was not assessed as it would only provide any benefit if carried out in accordance with a tariff change; and would have staffing and other implications well beyond the terms of reference of this study.

xi) Change BPWs to macerators - This is more of an operational or infection control decision than an energy one; and, as the drainage requirements are much more onerous for a macerator than a washer, it is not just a case of swapping one for the other. We understand that this is currently underway in ICU; and it is intended to role this out though the remainder of the hospital in parallel with the drainage replacement works.

7.0 INVEST-TO-SAVE PROJECTS REVIEWED AND CONSIDERED

The following is a schedule of projects, which were considered in detail although not all projects were appropriate for all sites:

i) Power factor correction - Where the existing average power factor is less than 0.9.
ii) Lagging of services and pipeline components - Where the existing is significantly lower than current standards; and installing plate heat exchangers in lieu of calorifiers to reduce standing losses.
iii) Window replacement - Where there is currently only single glazing.
iv) Cavity wall and roof insulation - Where the existing is significantly lower than current standards.
v) Controls upgrades/replacement - i.e. replacing old analogue controls or adding TRVs.
vi) Improvements to lighting - i.e. lamp replacement, fitting PIRs, daylight sensing or auto-off controls.
vii) Solar (PV) panel installation or solar hot water panels - to reduce primary energy consumption.
viii) Combined Heat and Power (CHP) units - Designed to meet the base (summer) thermal load.
ix) Replacement of existing plant for new - e.g. lifts, chillers and white goods.
x) Review scope for Plant and IT equipment shutoff/set back - out of hours and fit set back controls.
xi) Tariff changes - switching from the existing flat electrical tariffs to E7.
xii) Fitting a swimming pool cover to the Hydrotherapy Pool.
xii) Adding urinal (Cistermiser type) controls; replacing existing WCs with low flush type; and installing Pushbutton taps to reduce water consumption.

In addition to the above, there are a number of additional areas with significant energy saving potential highlighted during the survey and analysis, as mentioned in the preceding sections of this report. These have been added to the projects schedule; and include:

xiii) Westmount Centre – Review of lighting and control system
xiv) Westmount Centre – Review of HVAC electrical Consumption
xv) Sandybrook – Review of underfloor heating controls
xvi) Limes – Analysis of night-time electricity consumption to identify potential savings
xvii) Le Bas – Review of early evening electricity consumption to identify potential savings
xviii) JGH– Review of electricity consumption early evening (Particularly Gwyneth Huelin) and early morning (particularly phase 1B & 2), to identify potential savings.

The Project Schedule in Appendix A provides a comparison of each of the projects under consideration and identifies:

- Project overview - nature and purpose of the works
- Approximate value, timescales and significant factors influencing the project budget
- Outline procurement strategy
- Outline phasing/scheduling of the projects to deliver best value
- Scope for cost savings and value engineering opportunities
- Risks and issues registers

8.0 JGH ENERGY CENTRE OPTIONS

The central Boiler House contains 3 No 3.5 MW Robey boilers with Saake burners (max 82% efficiency), which feed heating and domestic hot water calorifiers located in each of the Blocks via HTHW mains operating at 138°C/108°C
The boilers and the chimney, to which they are connected, are close to the end of their serviceable life as they were installed in the late 1980's; and we have been requested, as part of this report, to explore options relating to how the local marketplace can offer suggested technologies to assist with replacement of heat-source equipment at JGH, including outsourcing a Contract Energy Management (CEM) package to a specialist provider.

There are five main options under consideration, i.e.:

Option 0 - Do nothing, apart from keeping the existing boilers running and maintained
Option 1 - Like-for-Like Replacement of existing boilers with new
Option 2 - Decentralise and provide localised Heat Sources in each of the main Blocks
Option 3 - Out-source Energy Supply under a CEM Contract with a private sector provider
Option 4 - Replacement of existing boilers with new plant including CHP and other technologies to reduce overall site energy consumption

Table 8.1 Current Site Thermal Energy Requirements

Block	**Max Heat Loss**	**Annual Heat Loss**	**Annual Vent Load**	**HWS Demand**	
	(kW)	**(kWh/y)**	**(kWh/y)**	**(L/d)**	**(kWh/y)**
Block A - Phase 2	462	1,363,396	518,752	775	446,103
Block B - 1960's Wing	235	586,617	711,023	2,945	225,734
Block C - Granite Block	393	928,132	-	2,920	223,818
Block D - Peter Crill House	222	369,962	-	4,850	371,753
Block E - Phase 1 GHW	492	640,271	1,154,693	3,100	121,469
Block E - Phase 1 GHW					8,762
Block F - Phase 1B	157	301,761	443,055	1,425	109,226
Block G - Phase 1A	50	100,000	-		50,000
Annual Heat Load (kWh/y)	**2,011 kW**	**4,290,140**	**2,827,523**	**16,015**	**1,556,865**
Annual Vent Load (kWh/y)	1,325 kW	2,827,523	Central HTHW Heating System Losses (kWh/y)		
Annual HWS Load (kWh/y)	934 kW	1,556,865	Distribution	15.0%	1,301,179
Total Annual Load (kWh/y)	4,271 kW	**8,674,527**	Boiler Eff'y	70.0%	2,992,712
Total Energy Used (kWh/y)	**4,911 kW**	**12,968,418**	**Total Losses**	**49.5%**	**4,293,891**

Table 8.1 (above) Indicates the assessed thermal energy parameters for the site and correlates well with the oil delivery data for 2010, which equated to around 14,000,000 kWh.

Option 0 is obviously the cheapest capital option; although is not a long term solution and will result in an increasing energy consumption due to a drop off in efficiency; and an increasing number of failures over time, resulting in potential risks to the Hospital Users.

With regard to Option 1, it is normal, in a Healthcare facility, to install plant on an n+1 basis of the total load +20% margin; therefore, to meet the predicted peak demand of the options for the central Boiler House, which including margin equates to around 5 MW, would require either:

- 3 No Firing Units @ 2.5 MW
- 4 No Firing Units @ 1.6 MW
- 5 No Firing Units @ 1.3 MW
- 6 No Firing Units @ 1.0 MW
- 7 No Firing Units @ 0.8 MW
- 10 No Firing Units @ 0.55 MW
- 12 No Firing Units @ 0.45 MW

For this site, if plant were to be retained in the central Energy Centre, the optimum plant configuration in order to minimise standing losses would be for the smallest firing units to be rated to supply the base Summer Load each (i.e. the total of the HWS demand, plus mains losses). The base load equates to around 450 kW. This correlates well with the 12 firing unit option; although spatial and chimney restrictions imposed by the siting of the existing Boiler House may mean that the ideal plant configuration is impractical as well as expensive and, therefore, it may be better to seek plant with good turn-down efficiencies.

In the event of a CHP unit being proposed for the site, again it should be rated at no more than the summer base load, i.e. around 450 kW thermal (275 kWe).

With regards to Option 2, it is not considered feasible to site boiler plant in every Block; however, a hybrid solution may be workable. We are aware that a brief is currently being formulated to invite the local Energy Supply Companies to develop proposals for the provision of heat sources local to the existing Calorifier Rooms.

Options 3 and 4 are basically the same but with different procurement strategies, resulting in Option 3 needing lower capital investment by the HSSD; but exposing them to higher revenue costs. Under this Option, the HSSD would invite proposals for a Third Party to take on the existing installation and reconfigure it to meet the specified performance requirement.

A significant consideration for Option 3 is whether the HSSD can be certain that the demand will remain for the duration of the contract (i.e. there is no possibility of relocating significant elements of the Hospital to another site). A contract should only be considered for the period of time that there is a reasonable level of certainty as the CEM provider will be making a significant investment in the site and penalty charges will be high.

9.0 PROJECT ASSESSMENTS AND RECOMMENDATIONS

All the project assessments have been made on the basis of a 10 year life (unless the equipment being installed has a shorter lifespan); as that is as far as there is a reasonable expectation that the building usage is unlikely to change significantly in terms of energy consumption.

The priorities for individual projects have been assessed using the model in section 3.0, as follows:

- **Priority 1** – Low Investment but high Savings Potential, i.e. those projects with the shortest payback times.
- **Priority 2** – Low Investment with Low Savings Potential, i.e. quick wins
- **Priority 3** – High Investment but high Savings Potential, i.e. large technology projects
- **Priority 4** – High Investment with Low Savings Potential, i.e. those projects with the longest payback times, therefore the least attractive on a purely financial basis, but which if there were other motivators are worthy of consideration.

The following summarises the findings of the financial analysis undertaken as part of the project schedule in appendix A:

Priority 1 – Low Investment but high Savings Potential

- Power factor correction – JGH Phase 2 (Ess & NE) & the Limes
- Improvements to lighting - i.e. lamp replacement, fitting PIRs, daylight sensing or auto-off controls – throughout estate
- Review scope for Plant and IT equipment shutoff/set back - out of hours and fit set back controls.
- Westmount Centre – Review of lighting and control system
- Westmount Centre – Review of HVAC electrical Consumption
- JGH– Review of electricity consumption early evening (Particularly Gwyneth Huelin) and early morning (particularly phase 1B & 2), to identify potential savings.

Priority 2 – Low Investment with Low Savings Potential

- Replacement of existing white goods plant for new "A" rated items.
- Tariff changes - switching from the existing flat electrical tariffs to E7.
- Fitting a swimming pool cover to the Hydrotherapy Pool.
- Adding urinal (Cistermiser type) controls
- Sandybrook – Review of underfloor heating controls
- Limes – Analysis of night-time electricity consumption to identify potential savings
- Le Bas – Review of early evening electricity consumption to identify potential savings

Priority 3 – High Investment but high Savings Potential

- Window replacement – JGH Gwyneth Huelin Wing
- Cavity wall Insulation - JGH Gwyneth Huelin Wing
- Roof insulation - JGH Granite Block
- Lagging of HTHW distribution at JGH
- Lagging of pipeline components – Westmount Centre

Priority 4 – High Investment with Low Savings Potential

- Installing plate heat exchangers in lieu of calorifiers.
- Controls upgrades/replacement - i.e. replacing old analogue controls or adding TRVs.
- Solar (PV) panel installation or solar hot water panels - to reduce primary energy consumption.
- Combined Heat and Power (CHP) units - Designed to meet the base (summer) thermal load.
- Replacement of existing lifts
- Replacement of existing Chillers
- Replacing existing WCs with low flush type

- Installing Pushbutton taps to reduce water consumption.

APPENDIX A

PROJECT SCHEDULE

APPENDIX B

SURVEY AND ASSESSMENT DATA - GENERAL HOSPITAL

APPENDIX C

SURVEY AND ASSESSMENT DATA - OUTLYING SITES