

LEVEL 7 ASSESSMENT SPECIFICATION

Student name:	Richard Black	Student ID number:	1803287
Programme:	MSc Facilities and Property Management MSc Sustainable Construction		
Module:	Management of Integrated Work Environment		
Module code:	M7X01810/ACBA7006	Contribution to Overall Module Assessment (%):	100%/70%
Lecturer:	Dr Juan A Ferriz-Papi	Internal Verifier:	Prof Chris House
Assignment Title:	Energy Management system	Word count (or equivalent):	3,000 (+/- 10%) / 4,000 (+/- 10%)
Submission deadline:	9 th January, 2020	Return date of provisional marks & written feedback:	6 th February, 2020
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 50%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Module Learning Outcomes (from module syllabus)

- Evaluate current resource management methods for a wide range of resources in building operations, including energy provision, and establish risk management strategies which affect property management.

TASK DESCRIPTION

Energy management systems are key for industry to be able to achieve 2030 and 2050 goals about carbon emission reduction. For the completion of this assignment, you have to write a 3,000/4,000 word report regarding the implementation of an energy management system to work energy performance of one organization. This organization can develop any activity, which should be defined properly, and will be inserted in one of these sectors: education, health, construction, administration, etc. In any case, you should agree with your module tutor about the organization to work with.

Your work will develop the following aspects:

- Identification of Significant Energy Uses (SEUs)
- Definition of objectives and targets
- Selection of one SEU and development of Action Plan specifically for that one
- Definition of Energy Baseline (EnB) and Energy Performance Indicators (EnPIs)
- Explanation of how to carry out with implementation, monitoring and review

You will present a 3,000/4,000-word, formal document where you will solve these questions in a proper manner, using BS ISO 50001:2018 as the main reference, but also providing evidence of other standards, legislation and other references and case studies when needed.

Any additional information (e.g. interview transcriptions, documentation, drawings, etc.) will be organised and attached as appendixes, so that it can support your work. There will NOT be any calculations in the body of the report. These results will be linked to the calculations that should be attached as appendixes too.

You will submit only one file by Turnitin, including the whole of the document (and graphical content when applicable), no need to provide a hard copy, by the 9th January 2020. This document will be structured as follows:

- Front page (with author name and identification of assignment)
- Index
- Written document (3,000/4,000 words), which can be structured as follows:
 - o Introduction (aim and description of project)
 - o Body of the written work
 - o Conclusions
- References
- Appendixes (drawings, calculations, etc.)

Please, DO NOT attach this assignment descriptor to your online submission.

GUIDANCE FOR STUDENTS IN THE COMPLETION OF TASKS

NOTE: The guidance offered below is linked to the five generic assessment criteria overleaf.

1. Engagement with Literature Skills

Your work must be informed and supported by scholarly material that is *relevant* to and *focused* on the task(s) set; you should make use of scholarly reviews and primary sources, as appropriate (for example, refereed research articles and/or original materials appropriate to the discipline). You should provide evidence that you have accessed a wide *range* of sources, which may be academic, governmental and industrial; these sources may include academic journal articles, textbooks, current news articles, organisational documents, and websites. You should consider the *credibility* of your sources; academic journals are normally highly credible sources while websites require careful consideration/selection and should be used sparingly. Any sources you use should be current and up-to-date, mostly published within the last five years or so, though seminal/important works in the field may be older. You must provide *evidence* of your research/own reading throughout your work, using correctly a suitable referencing system, including in-text citations in the main body of your work and a reference list at the end of your work.

Guidance specific to this assessment:

2. Knowledge and Understanding Skills

At level 7, you should be able to demonstrate a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of your academic discipline, field of study or area of professional practice, with a comprehensive understanding of techniques applicable to your own research or advanced scholarship. Your work must demonstrate your growing mastery of these concepts, principles, current challenges, innovation and insights associated with the subject area. *Knowledge* relates to the facts, information and skills you have acquired through your learning. You demonstrate your *understanding* by interpreting the meaning of the facts and information (knowledge). This means that you need to select and include in your work the contemporary concepts, techniques, models, theories, etc. appropriate to the task(s) set. You should be able to explain the theories, concepts, etc. meaningfully to show your understanding. Your mark/grade will also depend upon the *extent* to which you demonstrate your knowledge and understanding; ideally each should be complete and detailed, with comprehensive coverage.

Guidance specific to this assessment:

3. Cognitive and Intellectual Skills

You should be able to: evaluate critically current research and advanced scholarship in the discipline; evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses; deal with complex issues both systematically and creatively to make sound judgements in the absence of complete data. Your work must contain evidence of logical, analytical thinking, evaluation and synthesis. For example, to examine and break information down into parts, make inferences, compile, compare and contrast information. This means not just describing what! But also justifying: Why? How? When? Who? Where? At what cost? At all times, you must provide justification for your arguments and judgements. Evidence that you have reflected upon the ideas of experts within the subject area is crucial to you providing a reasoned and informed debate within your work. Your choice of methodologies to gather data and information must be rigorously defended. Furthermore, you should provide evidence that you are able to make sound judgements and convincing arguments using data and concepts. Sound, valid, persuasive conclusions are necessary and must be derived from the content of your work. Where relevant, alternative solutions and recommendations may be proposed.

Guidance specific to this assessment:

4. Practical Skills

At level 7, you should be able to demonstrate originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline. This includes acting autonomously in planning and implementing tasks at a professional or equivalent level, originality in tackling and solving problems, and decision-making in complex and unpredictable contexts or situations.

You should be able to demonstrate mastery of the leading edge subject-related concepts and ideas as they relate to real world situations and/or particular contexts. How do they work in practice? You will deploy models, methods, techniques, and/or theories, in those contexts or circumstances, to assess current situations, perhaps to formulate plans or plausible, justifiable recommendations to solve problems, or to propose new models, or to create artefacts, which may be innovative and creative, thereby demonstrating your understanding of how the boundaries of knowledge are advanced through research and/or application. This is likely to involve, for instance, the use of real world artefacts, examples and cases, the application of a model within an organisation and/or benchmarking one theory or organisation against others.

Guidance specific to this assessment:

5. Transferable Skills for Life and Professional Practice

Your work must provide evidence of the qualities and transferable skills necessary for postgraduate-level employment in circumstances requiring sound judgement, personal responsibility and initiative in complex and unpredictable professional environments. This includes demonstrating: the independent learning ability for continuing professional development to advance existing skills and acquire new competences of a professional nature that will enable you to assume significant responsibility within organisations; that you can initiate and complete tasks, projects and procedures, whether individually and/or collaboratively, to a professional level; that you can use appropriate media to effectively communicate information, arguments and analysis in a variety of forms for a variety of audiences; fluency of expression; clarity and effectiveness in presentation and organisation. Work should be coherent and well-structured in presentation and organisation.

Guidance specific to this assessment:

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
	10	
2. Knowledge and Understanding Skills		
	15	
3. Cognitive and Intellectual Skills		
	30	
4. Practical Application Skills		
	30	
5. Transferable Skills for Life and Professional Practice		
	15	

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		%
	Up to 1 week late (50% Max)		
	Over 1 week late (0%)		

GENERIC ASSESSMENT CRITERIA

Level 7

In accordance with the Framework for Higher Education Qualifications, at the end of Level 7 students should be able to demonstrate: a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline or area of professional practice; a comprehensive understanding of techniques applicable to their own research or advanced scholarship; originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline; conceptual understanding that enables the student to evaluate critically current research and advanced scholarship in the discipline to evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses. They will be able to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences. They will demonstrate self-direction and originality in tackling and solving problems, and act autonomously in planning and implementing tasks at a professional or equivalent level to continue to advance their knowledge and understanding, and to develop new skills to a high level. They the qualities and transferable skills necessary for employment requiring the exercise of initiative and personal responsibility; decision-making in complex and unpredictable situations/professional environments; and the independent learning ability required for continuing professional development.

Level 7	FAIL	FAIL	MARGINAL FAIL	SATISFACTORY (Pass)	GOOD to VERY GOOD (Merit)	EXCELLENT (Distinction)	EXCEPTIONAL (Distinction)
Category	0-29%	30-44%	45-49%	50-59%	60-69%	70-84%	85-100%
Engagement with literature (including current research, referencing, academic conventions and academic honesty)	Little or no evidence of reading and/or reliance on inappropriate sources. Views and findings mostly unsupported and non-authoritative. Referencing conventions used incoherently or largely absent.	Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources, and/or indiscriminate use of sources. Heavily reliant on information gained through class contact. Inconsistent and weak use of referencing.	Engagement with a very limited range of relevant and credible sources. Some omissions and minor errors. Referencing conventions evident though not always applied accurately or consistently.	Engagement with an appropriate range of research-informed literature, including sources retrieved independently. Some over-reliance on texts. Referencing may show minor inaccuracies or inconsistencies.	Engagement with a wide range of research-informed literature, including sources retrieved independently. Selection of relevant and credible sources. Very good use of referencing, with no/very few inaccuracies or inconsistencies.	Engagement with an extensive range of relevant and credible literature, informed by the latest research. Consistently accurate application of referencing.	Exceptional engagement with an extensive range of relevant and credible literature, informed by the latest research. High-level referencing skills consistently and professionally applied.
Knowledge and	Major gaps in knowledge and	Gaps in knowledge, with	Limited knowledge and	Knowledge is accurate and	Knowledge has a well-defined	Excellent mastery of a	Exceptional mastery of a

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understanding (A systematic, conceptual understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of the discipline; a comprehensive understanding of techniques applicable to their own research)	understanding of the subject matter is not systematic. Substantial inaccuracies. No awareness of current problems, insights or the latest research and/or advanced scholarship within the discipline.	only superficial systematic understanding. Some significant inaccuracies and/or irrelevant material. No critical awareness of current problems, insights, or latest research within the discipline.	systematic understanding of the concepts and principles within the subject area, which to some marginal extent, is informed by current research and scholarship. Some critical awareness of current problems and/or new insights, but often under-developed.	reasonably detailed. A systematic understanding of the field of study informed by, to some extent, current research and scholarship. A critical awareness of current problems and/or new insights though this may be under-developed occasionally.	focus, which is reasonably extensive, coherent and detailed, with a critical awareness of current problems and/or new insights. Exhibits good understanding of the breadth and depth of contemporary and established views, and the work is, at least in part, well-informed by current research and scholarship.	complex and specialised area of knowledge. A systematic, excellent understanding of the concepts of the subject informed by current research and scholarship. Highly critical awareness of current problems and/or new insights. A critical, awareness of how the boundaries of knowledge are advanced through research.	complex and specialised area of knowledge. An exceptionally critical awareness of current problems and/or new insights. An outstanding understanding of the concepts of the subject, well-informed by current research and scholarship. A critical, sophisticated and nuanced awareness of how the boundaries of knowledge are advanced through research.
Cognitive and intellectual skills (Critical evaluation of current research and methodologies and develop critiques of them and, where appropriate, to propose new hypotheses; make sound	Wholly or almost wholly descriptive work. Little or no evaluation or critique or attempt at a systematic approach. Failure to develop arguments, leading to illogical or invalid	Largely descriptive work, with superficial use of critical evaluation of research and methodologies. Absent or weak development of hypotheses and judgements. Information accepted uncritically, uses	Limited attempt at critical evaluation/ critique of current research and methodologies, tending towards description. Limited attempt to propose new hypotheses. Can deal with complex issues	Some critical evaluation/ critique of current research and methodologies, though slightly underdeveloped in places, Proposes adequate but limited new hypotheses, where relevant.	Sound critical evaluation/ critique of current research and methodologies, Proposes new hypotheses, where appropriate. Can deal with complex issues systematically and with some	Excellent critical evaluation/ critique of current research and methodologies, Proposes innovative hypotheses, where appropriate. Can synthesise complex issues systematically	Exceptional critical evaluation/ critique of current research and methodologies, Proposes innovative hypotheses, where appropriate. Exemplary systematic and

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judgements in the absence of complete data.)	judgements. Unsubstantiated generalisations, made without use of credible evidence.	generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory.	but not systematically or creatively. Some evidence to support emerging judgements but these may be underdeveloped or with a little inconsistency / mis-interpretation. May assert rather than argue a case.	Can deal with complex issues but not fully systematically or creatively. Ability to make judgements based on data (that may be incomplete) but with some tendency to assert/state opinion rather than argue on the basis of reason and evidence.	creativity. Ability to make sound judgements based on data (that may be incomplete)	and creatively. Ability to investigate contradictory or incomplete information and make strong, persuasive, arguments and sophisticated judgements.	creative synthesis of complex issues. Ability to investigate contradictory or incomplete information and make strong, persuasive, arguments and sophisticated, nuanced, judgements. Potential for journal publication or doctoral research.
Practical skills (Originality / creativity in the application of knowledge, tools and techniques and in tackling and solving problems in complex and unpredictable professional situations; practical use of established techniques of research and enquiry to create and interpret knowledge in the discipline.)	Limited or no use of methods, materials, tools and/or techniques. Little or no appreciation of the context of the application. Limited understanding of the application of theory to practice or making appropriate links between the two. Very weak problem-solving skills in complex and	Rudimentary application of methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application. Weak understanding of the application of theory to practice, with only occasional evidence of	An awareness and mostly appropriate application of well-established methods, materials, tools and/or techniques, with occasional errors. Basic appreciation of the context of the application. Theoretical knowledge and understanding applied in practice, but not always making	An appropriate application of standard methods, materials, tools and/or techniques. Clear appreciation of the context of the application. Mainly consistent, accurate and logical application of theory to practice, making appropriate links between the two.	A very good application of a range of methods, materials, tools and/or techniques. Very good consideration of the context of the application, with perceptive insights. Can identify problems and propose appropriate solutions in complex and unpredictable contexts.	An advanced application of knowledge, methods, materials, tools and/or techniques. The context of the application is well considered, and insightful. Can identify complex problems and propose excellent solutions. An excellent grasp of techniques applicable to own research or	Exceptional application skills in complex, unpredictable, contexts, drawing skilfully on the latest research within the discipline. Can identify complex problems and propose sophisticated, original solutions. An outstanding application of techniques applicable to own research or

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	unpredictable contexts.	making appropriate links between the two. Weak problem-solving skills in complex and unpredictable contexts.	logical links between the two. Can identify problems and propose basic solutions without fully appreciating the complexity of unpredictable contexts.	Can identify problems and propose mostly appropriate solutions in complex and unpredictable contexts, with elements of originality.	Evidence of originality and creativity.	advanced scholarship. Shows originality in application of knowledge and techniques, and of how established techniques of enquiry create and interpret knowledge in the discipline.	advanced scholarship. Shows originality in application of knowledge and techniques, and of how established techniques of enquiry create and interpret knowledge in the discipline with assimilation and development of cutting edge processes and techniques.
Transferable skills for life and professional practice (Exercise of self-direction, autonomy and personal responsibility; plan and implement tasks at a professional level; independent learning; use appropriate media to communicate effectively and professionally to a variety of audiences; fluency of expression; systematic	Communication medium is inappropriate or misapplied. Work is poorly structured, disorganised and/or confusingly expressed. Very weak use of language and/or very inappropriate style. Little or no evidence of autonomy (or collaboration, where relevant) in the completion of tasks. Little or no evidence of	Communication medium is poorly designed and/or not suitable for the audience. Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas often poorly expressed. Weak use of language and/or inappropriate style. Weak independent	Can communicate in a suitable medium but with some room for improvement. Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may lack coherence in places. Can work as part of a team, but with limited involvement in group activities.	Can communicate effectively in a suitable format, but may have minor errors. Mostly coherent, organised work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with clear contribution to group activities. Demonstrates the skills	Can communicate well, confidently and consistently in a suitable format. Work is coherent, fluent, well-structured and organised. Can work very well autonomously and/or as part of a team, with a good contribution to group activities. Demonstrates comprehensive professional, postgraduate	Can communicate professionally confidently and consistently in a suitable format. Work is coherent, very fluent and is presented professionally. Can work autonomously with initiative. Where relevant can work professionally within a team, showing leadership skills as appropriate, managing	Can communicate with an exceptionally high level of professionalism. Work is remarkably coherent, very fluent and is presented professionally. Can work outstandingly well and professionally within a team, showing advanced leadership skills. Demonstrates exemplary

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approach; clarity and effectiveness in presentation and organisation.)	the skills required in professional, postgraduate employment.	initiative (or collaboration, if relevant). Limited evidence of the skills required in professional, postgraduate employment.	Demonstrates some but not all of the basic skills required in professional, postgraduate employment, with some areas of minor weakness.	required in professional, postgraduate employment, with some areas of strength and some of minor weakness.	employment skills.	conflict and meeting obligations. Demonstrates excellent professional, postgraduate employment skills and a strong appetite for further development.	professional, postgraduate employment skills and a strong appetite for further development.

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Programme: MSc Property and Facilities Management

Module: Management of the Integrated Working Environment.

Module Code: M7X01810

Lecturer: Dr Juan Ferriz-Papi

Assignment Title: Energy Management System: Case Study UWE Building 640 I.T. office/data centre.

Submission Date: 9th January 2020

Completed by: Richard Black

Student I.D. 1803287

Table of Contents

1.0	Introduction	4
2.0	Energy Policy and Commitments (Plan)	5
3.0	Energy Review (Plan).....	7
4.0	Energy Consumption Analysis and Evaluation (Plan)	8
4.1	Utility Consumption showing SEU's and Costs	8
4.2	Table 1 - Tabulates the case study building 640 energy consumption over a 36 month period between October 2016 and September 2019 identifying significant energy usage (SEUs).	8
4.3	Figure 1 – Displays a Graphical representation of the overall energy consumption in respect to the identified SEUs for the case study building 640.....	8
4.4	Figure 2 – Offers graphical representation of the costs that are respective of the identified SEUs for the case study building 640.....	9
5.0	Electric and Gas Consumption data comparison (Plan)	10
5.1	Figure 3 – Offers graphical representation of the total electric and gas consumption data in respect to the two main identified utilities for the case study building 640 over the 36 month period to determine trends, risks and opportunities..	10
5.2	Figure 4 – Offers graphical representation of the total electric and gas consumption data in respect to the two main identified utilities for the case study building 640 over last two years to offer more clarity.....	11
6.0	Gas Heating Consumption Degree Data Analysis (Plan)	12
6.1	Figure 5 – The graphical representation above compares data gathered during the period of Oct 2016 – September 2019 against heating degree day data for the same period and location.....	12
7.0	Electrical and Gas Regression Analysis (Plan)	13
7.1	Figure 6 – Electrical consumption Kwh regression data analysis (Period Oct 2016 - 2019).....	13
7.2	Figure 7 – Electrical consumption Kwh regression data analysis (Period Oct 2016 - 2017).....	14
7.3	Figure 8 – Electrical consumption Kwh regression data analysis (Period Oct 2017 - 2018).....	14
7.4	Figure 9 – Electrical consumption Kwh regression data analysis (Period Oct 2018 - 2019).....	15
7.5	Figure 10 – Gas seasonal consumption Kwh regression data analysis (Period Oct 2016 - 2019).....	15
7.6	Figure 11 – Gas seasonal consumption Kwh regression data analysis (Period Oct 2016 - 2017).....	16

7.7	Figure 12 – Gas seasonal consumption Kwh regression data analysis (Period Oct 2017 - 2018).	16
7.8	Figure 13 – Gas seasonal consumption Kwh regression data analysis (Period Oct 2018 - 2019).	17
8.0	Energy Management Matrix Evaluation (Plan)	18
8.1	Figure 6 – Energy Management Matrix Evaluation Example	18
9.0	Future Implementation and Monitoring (Do, Check and Act).	19
10.0	Recommendations for Improvements (Do, Check and Act)	20
11.0	References & Bibliography	21
12.0	Appendix 1 – Operations and Maintenance Organisational structure for Energy Management system.	22
13.0	Appendix 2 – Project Organisational structure for Energy Management system.	23
14.0	Appendix 3 – Further Recommendations for continual improvement.	24
15.0	Appendix 4 – Airdale system information for Bldg 640 and Life expectancy.	25

1.0 Introduction

The purpose of this assignment case study is to provide an independent interpretation of an energy management system (EnMS) with the aim of it being representative of energy management commitments currently in place at UWE Bristol.

As the UWE appointed energy manager I have been assigned the task to implement an energy management system dealing with the interested parties. This process should commence by the arranging and empowering a dedicated energy team that will be solely responsible for examining the current status regarding energy review strategies in place to identify significant energy uses (SEUs) across a dynamic and complex university campus. It should be noted that (ISO 50001, 2018) refers to energy reviews and not energy audits as these will be covered in (ISO 16247 2012) whereby energy audit processes will be defined and will exceed the requirements of (ISO 50001, 2018).

This process of identifying the significant energy uses within this case study example will be limited to one selected building only as it has been acknowledged through an initial energy consumption analysis to be indicative of significant energy usage. Conducting an analysis of existing metering and sub-metering arrangements aligned with also reviewing current energy tariff costs for comparisons being made with energy bills for the building in question will allow energy baseline identification (EnBs), energy performance indicators (EnPIs) and action plans to be developed that also manage any identified non-conformities. The aim of this will be to develop and implement a comprehensive energy management system (EnMS) in compliance with the industry standard (ISO 50001, 2018). It shall also be reflective of the organisational interested party commitments for continually improving the energy performance within this diverse environment at the UWE Bristol.

Due to the size and dynamic nature of the university complex the appointed energy team are very uniquely placed to characterise and cultivate a new culture of transformation within the UWE Bristol that embraces the complete energy management system (EnMS) managing risks, opportunities and future improvements that are available. By agreeing a comprehensive energy management system (EnMS) that aims to follow a comprehensive approach embracing (ISO 50001, 2018) with the full governance of the UWE Bristol interested parties will allow the energy team to create and employ an energy management system (EnMS). This energy management system will introduce an energy policy that subsequently integrates realistic objectives, energy management targets along with associated energy management plans in relation to the UWE Bristol's current and future energy efficiency, usage and consumption requirements whilst ensuring legal compliance.

2.0 Energy Policy and Commitments (Plan)

An energy policy should in its self be a brief document usually made up of one to two pages that depicts the commitment of an organisation such as the UWE Bristol to reduce its energy consumption. An energy policy should be realistic and display a clear rational that is reinforced with an appropriate strategy to convey its intentions to the wider interested parties.

The UWE Bristol was established as a polytechnic in 1969, and has since advanced into one of the most highly acclaimed and ranked universities in the UK. The UWE Bristol currently operates with around 30,000 plus students all supported by a dedicated number of 4,500 academic and professional staff members across the continually evolving and expanding campuses.

The UWE has over 400,000m² of Building floor area across five campuses complete with on-campus student residential accommodation for over 3,600 students with plans currently in motion for further new academic and residential buildings and major refurbishments. As it currently stands this provides the energy team and the interested parties with ample planning time for the identification of risks and opportunities associated with energy and water consumption saving strategies ensuring the appropriate legal compliance conforming to the respective energy planning frameworks and guidance set out within [\(ISO 50001, 2018\)](#).

The energy management system shall adopt a plan-do-check-act (PDCA) cycle which embodies a systematic approach that is based on factual data derived information gathered through reliable sources aimed at the continual pursuit of energy performance improvements.

The energy management system will also look to incorporate a suitable set of contingency plans that address and manage any risks should any solutions fail by determining and arranging further opportunities for advancing energy performance.

These identified risks and opportunities will also be aligned with a carbon management plan which shall identify and set out how reduction targets and continual energy performance improvements will be achieved.

In order for the energy team to provide a successful energy management system which includes an energy policy that has realistic and defined action plans, key objectives and energy targets that reflect the UWE's ongoing commitment will require the full ratification of the interested parties. In gaining the backing of the interested parties it will undoubtedly provide the greatest prospects for the energy team in securing an advantageous outcome in reducing energy consumption. It will also increase business efficiency by taking advantage of all related organisational costs.

It is the intention of UWE Bristol to remain committed to the reduction of energy consumption by setting realistic target reductions of around 10% for 2020 closely followed by more ambitious target reductions of 15% for 2021 once more awareness from interested parties is ascertained over a specified periods of time. By creating an energy policy that reflects the organisations carbon reduction strategy, environmental targets and objectives.

The University's directorate and or interested parties will:

Consider energy management in strategic decisions.

Ensure suitable budget and resource is made available to deliver the energy management targets, ensure legal compliance, and maintain certification to management systems such as [ISO 14001, \(2015\)](#), [ISO 50001, \(2018\)](#) and [\(ISO 16247, 2012\)](#)

Encourage staff and students to take responsibility for their impact on our carbon emissions. Communicate relevant information in a timely manner across the University to facilitate the delivery of the strategic objectives of this policy.

Review and update the appropriateness, scope and ambition of energy reduction targets annually.

Every individual, staff and student member at the University will:

Ensure they personally use energy and water as efficiently as possible.

Work together to achieve the challenging carbon reduction targets set out in the Sustainability Strategy.

Strategic Objectives

The University interest parties and directorate commitment to the following objectives and practices:

Carbon Emissions:

Continually reduce absolute and relative energy and water consumption in line with the University's Carbon Management Plan and Water Management Plan.

Maintain an up-to-date carbon and water reduction plan; report publically; and share examples of good practice, for the benefit of students, industry and the wider community.

Maintain good systems for metering, monitoring and reporting energy and water use.

Design, Operate and Maintain for Energy and Water Efficiency:

Use the principles of the efficiency hierarchy to prioritise any design, operation and maintenance decisions:

Reduce demand/need for energy and water consumption through behavior change, space utilisation, and passive design measures.

Maintain good working systems throughout the estate, reducing failure costs, and increasing longevity of the infrastructure.

Use smart controls to manage energy and water use e.g. suitable BMS set points and scheduling, presence detection lighting controls.

Use efficient technologies e.g. efficient boilers, low energy lighting, low flow water.

Reduce/manage peak demands to reduce strain on the national supply network as well as the associated tariff charges.

Ensure low, or zero-carbon supply of energy and water e.g. on-site renewables.

3.0 Energy Review (Plan)

Therefore, the first step for the energy team will be to undertake a systematic approach for the UWE Bristol's energy management system (EnMs) that as expressed previously will adopt and demonstrate conformity of its energy management systems under the fundamental framework described in the [ISO 50001, \(2018\)](#) as the **Plan-Do-Check-Act (PDCA)** cycle.

Upon establishing an energy policy the process will extend further to administrate an energy base line(s) (EnBs) analysis through use of the UWE Bristol's recent energy bills along with any measured data set over a period of the last two years with the aim of identifying significant energy uses (SEU's). Through this process of statistical analysis we will look to determine energy performance indicators (EnPIs), and energy baseline (EnBs) whilst also integrating realistic objectives, energy management targets that aim to show usage and energy predictions through applying UWE Bristol's commitment savings of around 10% - 15% per annum highlighting briefly opportunities and any associated risks to save energy complete with inspired and appropriate recommendations.

It is evident from the data analysis that the UWE Bristol has areas of high energy usage although in reality it is not unique in that it probably shares similarities with other educational environments in relation to energy consumption. However, the task was to evaluate the UWE Bristol and show and informed knowledge and understanding of what it takes to successfully implement and improve energy management systems (EnMS).

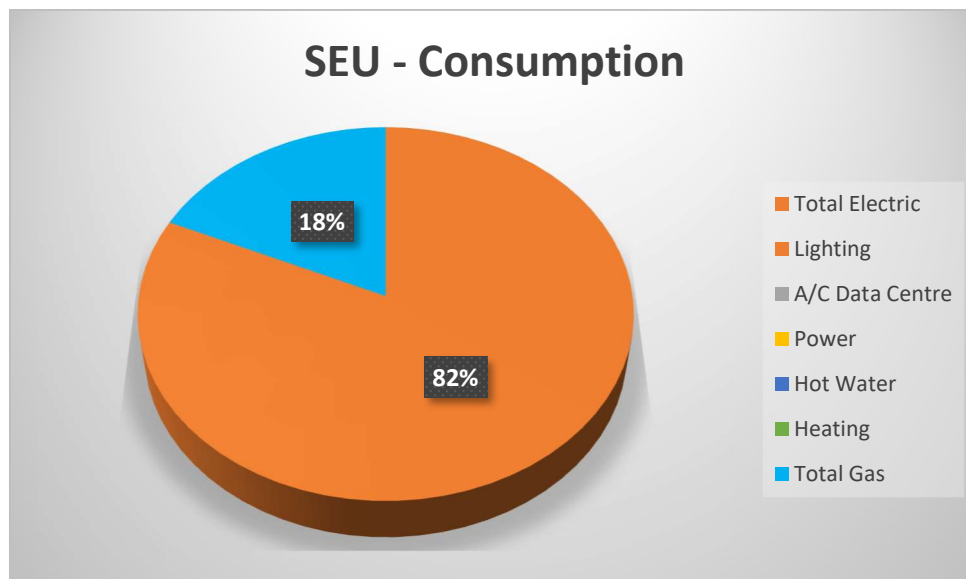
One of the main areas identified as having SEUs through this analysis was the UWE building 640 a two storey remotely located property on the adjacent business park to the main frenchay campus. This Building is home to the UWEs dedicated information technology (I.T) team and also houses the main data centre controlling that supports all UWE wide campuses. Therefore as part of this assignment case study I have selected this building because it can be seen through energy consumption analysis that it has SEUs thus allowing for the exploration of energy saving options for improvement in consumption.

4.0 Energy Consumption Analysis and Evaluation (Plan)

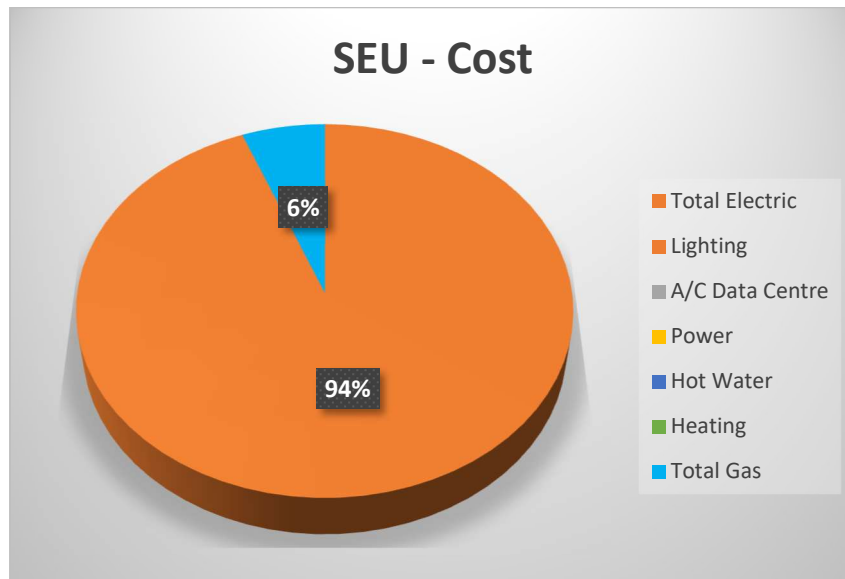
4.1 Utility Consumption showing SEU's and Costs

Utility	Units 36M (Kwh)	%	Cost (£/Kwh)	Cost (£)	%	Carbon Trust Applying Factors	Carbon Emissions (kg/co ₂) 36M
Electric	2,098,198.20	82	£7.0724	£ 296,674.14	94	0.41205	865
Gas	467,127.00	18	£0.04	£ 18,685.08	6	0.1836	86
Total	2,565,325.20	100		£ 315,359.22	100		950

4.2 Table 1 - Tabulates the case study building 640 energy consumption over a 36 month period between October 2016 and September 2019 identifying significant energy usage (SEUs).



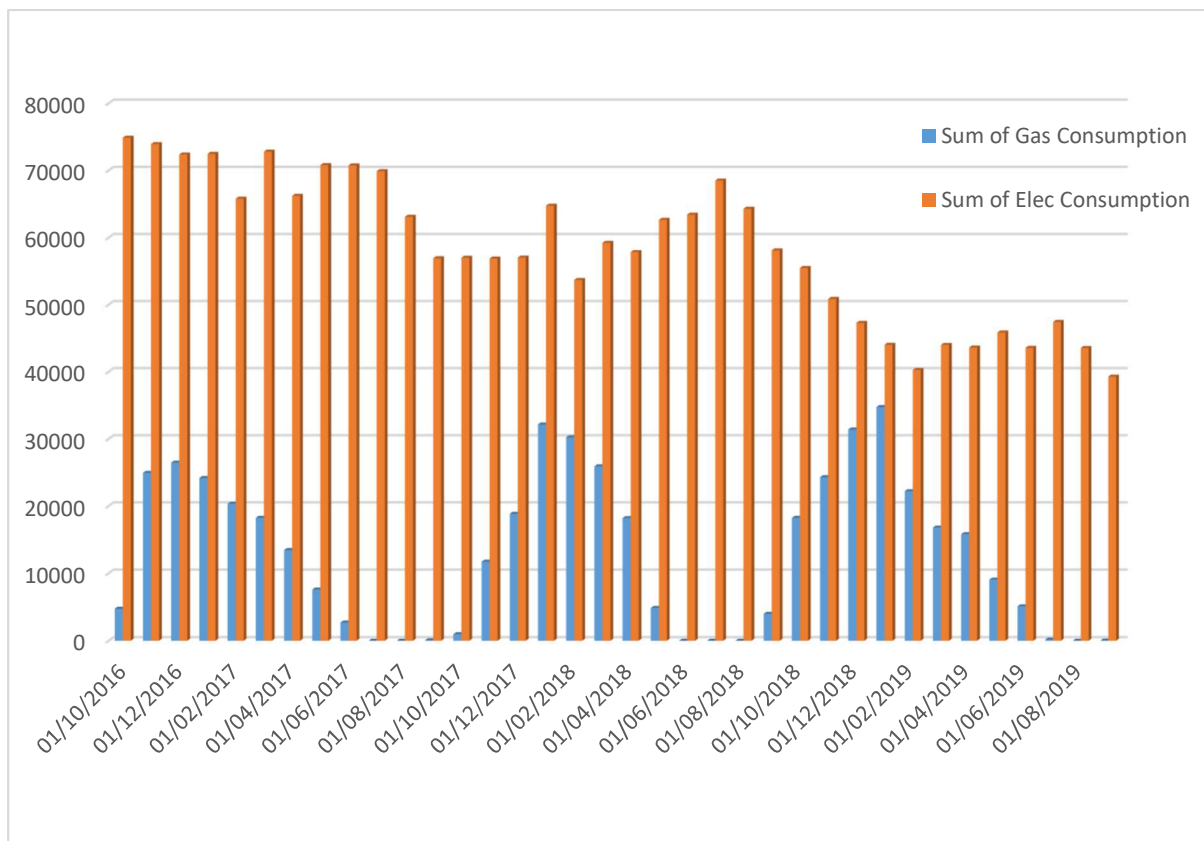
4.3 Figure 1 – Displays a Graphical representation of the overall energy consumption in respect to the identified SEUs for the case study building 640.



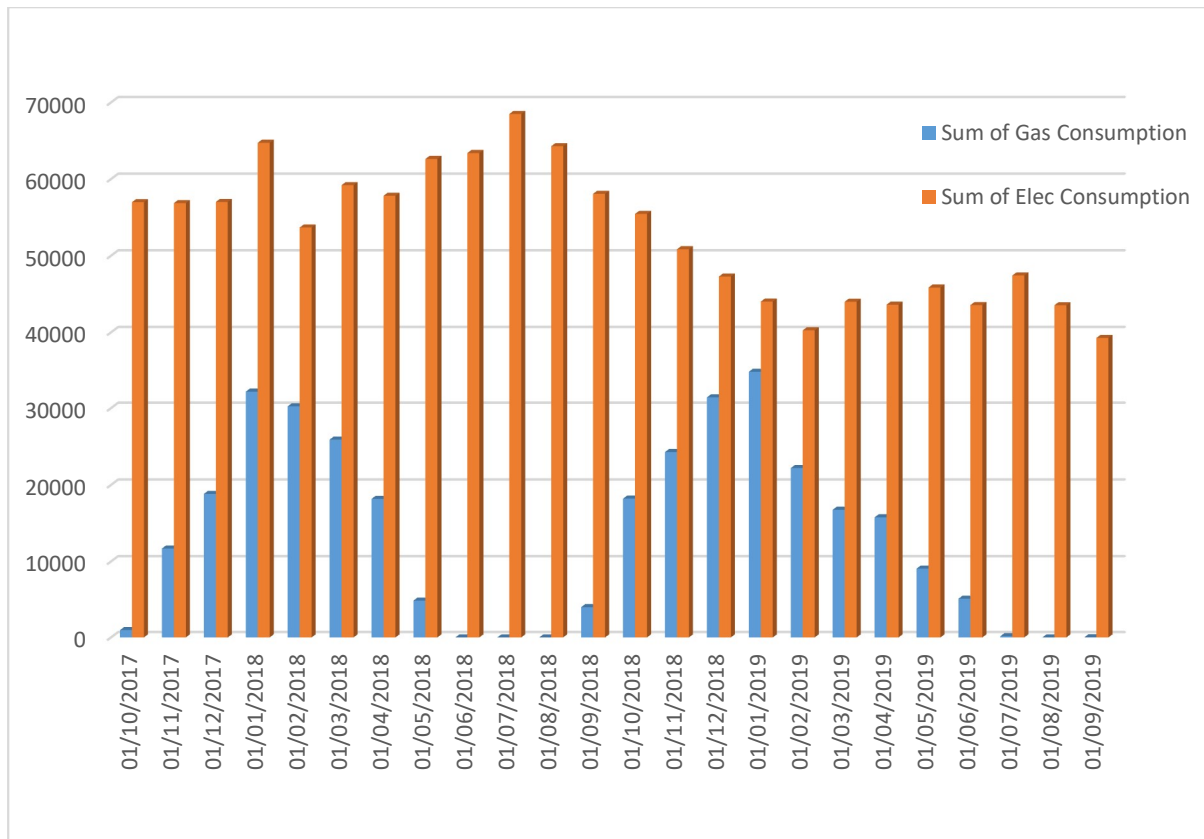
4.4 Figure 2 – Offers graphical representation of the costs that are respective of the identified SEUs for the case study building 640.

It can be determined from the information above that the electricity energy consumption of the building is a significant factor. In order to reduce this energy consumption further understanding of the building and how it operated and used with the aid of further monitoring and targeting processes and the use of sub-metering more accurate identification of the SEUs on an individual level could be ascertained. However, as the building houses the main data centre serving the UWE it can be assumed this is the perhaps the main area for energy consumption. Therefore if we hypothetically establish this area as the main SEU for the purpose of this case study then with additional control, monitoring and targeting procedures we can look to make simple but effective improvements which in turn will offer energy reductions.

5.0 Electric and Gas Consumption data comparison (Plan)



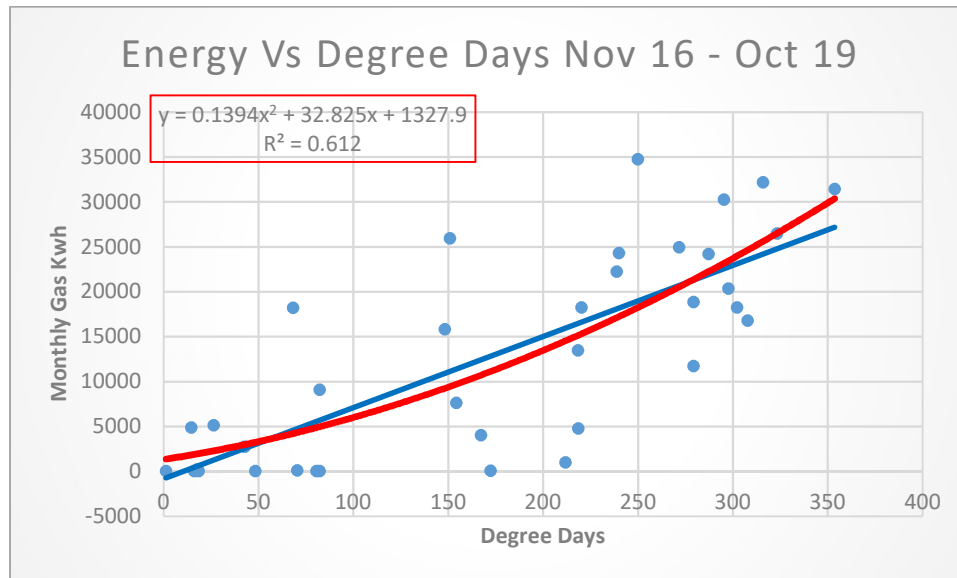
5.1 Figure 3 – Offers graphical representation of the total electric and gas consumption data in respect to the two main identified utilities for the case study building 640 over the 36 month period to determine trends, risks and opportunities.



5.2 Figure 4 – Offers graphical representation of the total electric and gas consumption data in respect to the two main identified utilities for the case study building 640 over last two years to offer more clarity.

It can be determined from the information above figures 5.1 and 5.2 that the electrical energy consumption of the building has reduced over the three years but the Gas consumption however, has risen even though the winter periods for this region have been seasonally warmer from a weather perspective. Therefore we have an opportunity to investigate and improve this situation further and reduce energy consumption by applying additional controls, monitoring and targeting procedures.

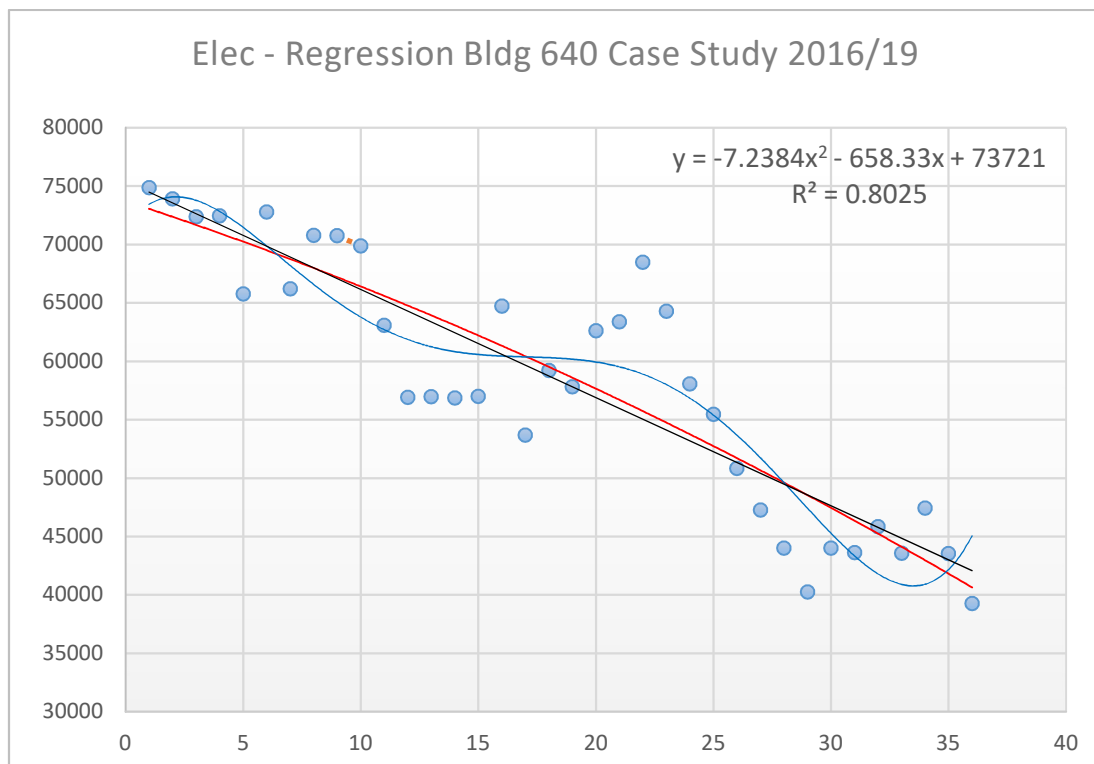
6.0 Gas Heating Consumption Degree Data Analysis (Plan)



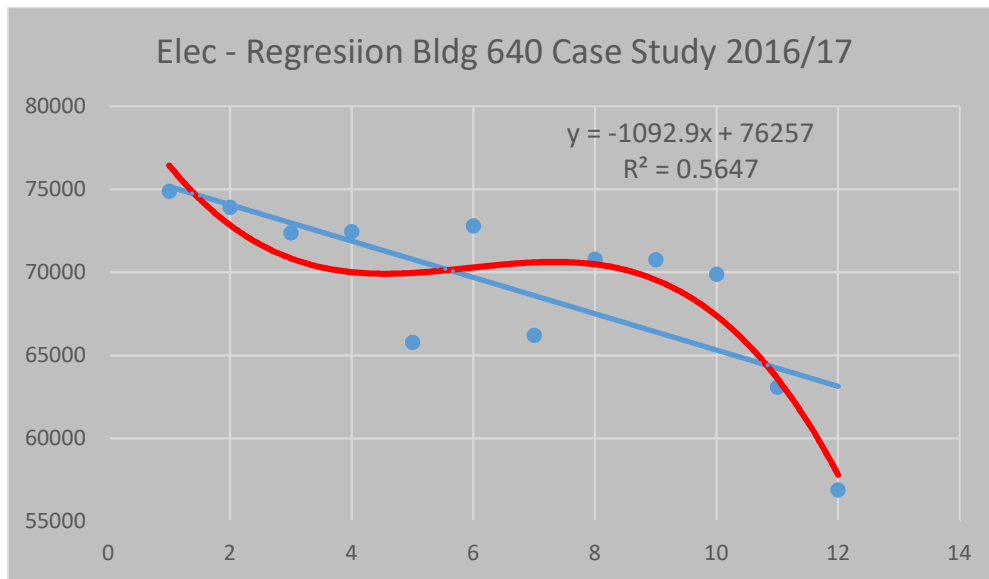
6.1 Figure 5 – The graphical representation above compares data gathered during the period of Oct 2016 – September 2019 against heating degree day data for the same period and location.

If the system is being adequately controlled then the results should fall on or be close to the regression line. In the case of Building 640 the R² result of 0.612 indicates it being having some form of control however, other variables such as heating and cooling metered together with other energy consumption could effect this result meaning further investigation of the current control philosophy could require adjustment. Therefore the nearer the R² value is to one the better the relationship between consumption and HDD's.

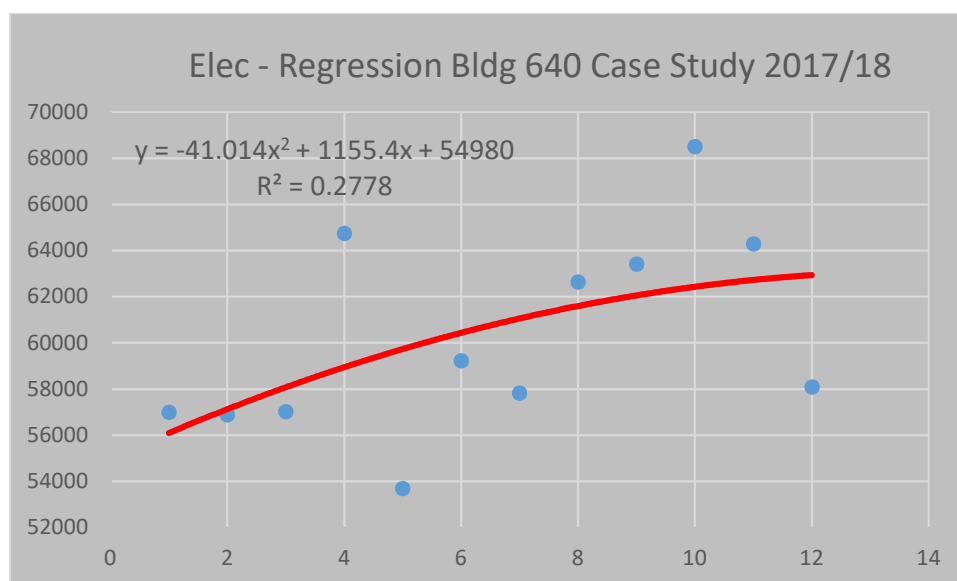
7.0 Electrical and Gas Regression Analysis (Plan)



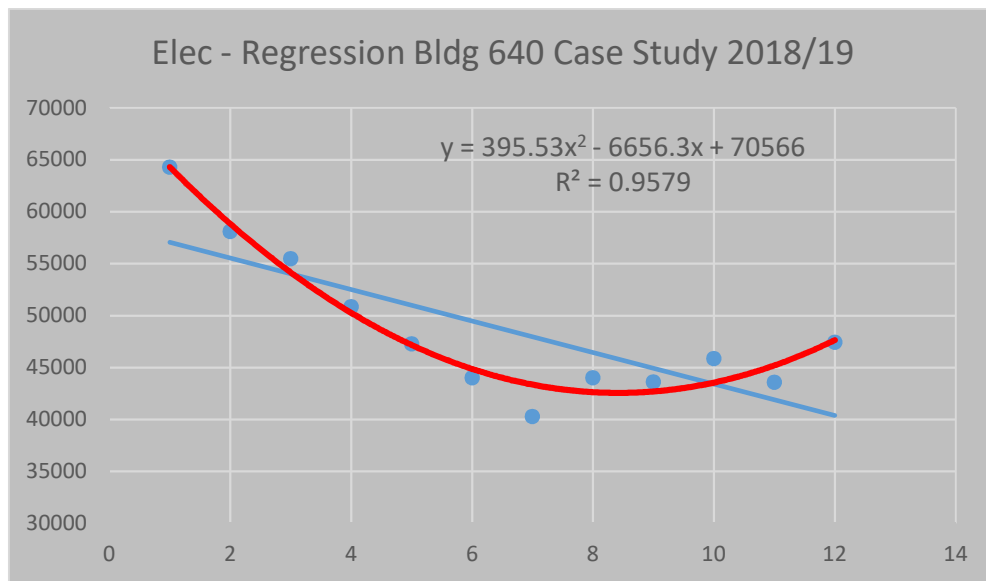
7.1 Figure 6 – Electrical consumption Kwh regression data analysis (Period Oct 2016 - 2019)



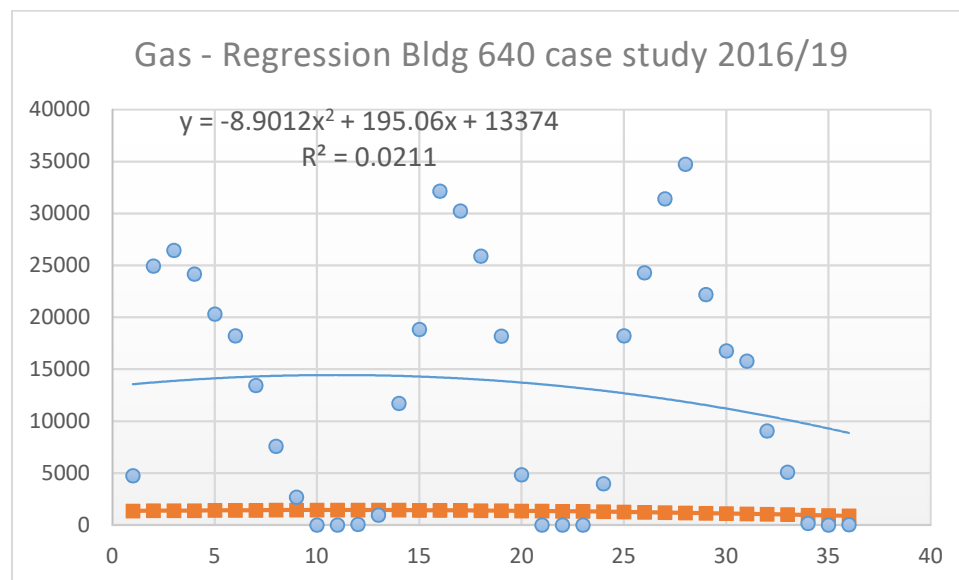
7.2 Figure 7 – Electrical consumption Kwh regression data analysis (Period Oct 2016 - 2017).



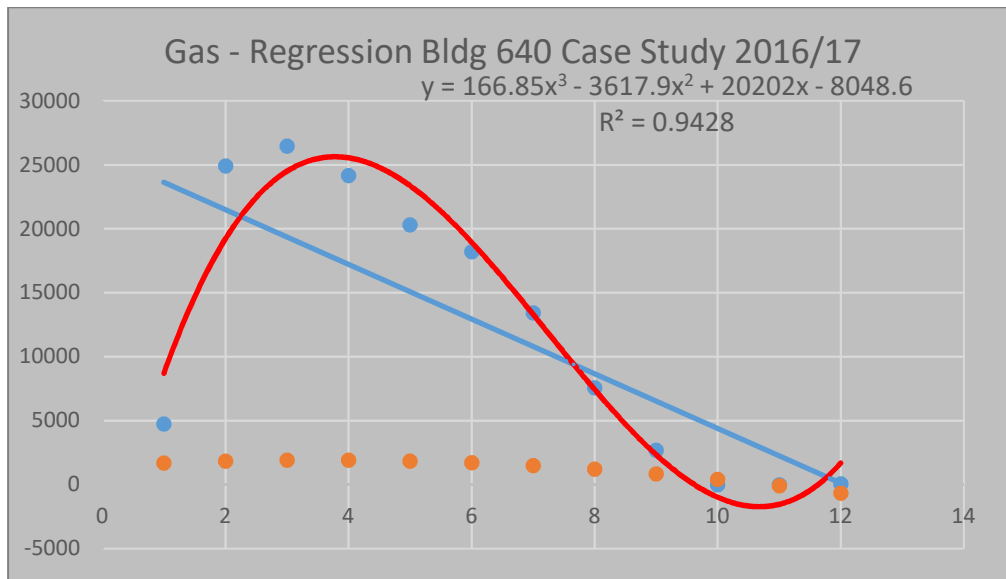
7.3 Figure 8 – Electrical consumption Kwh regression data analysis (Period Oct 2017 - 2018).



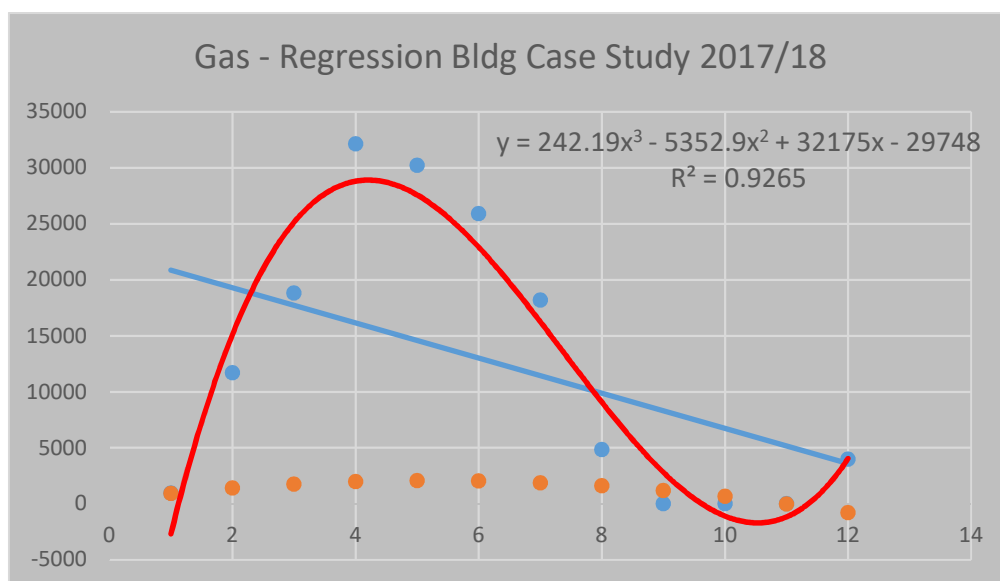
7.4 Figure 9 – Electrical consumption Kwh regression data analysis (Period Oct 2018 - 2019).



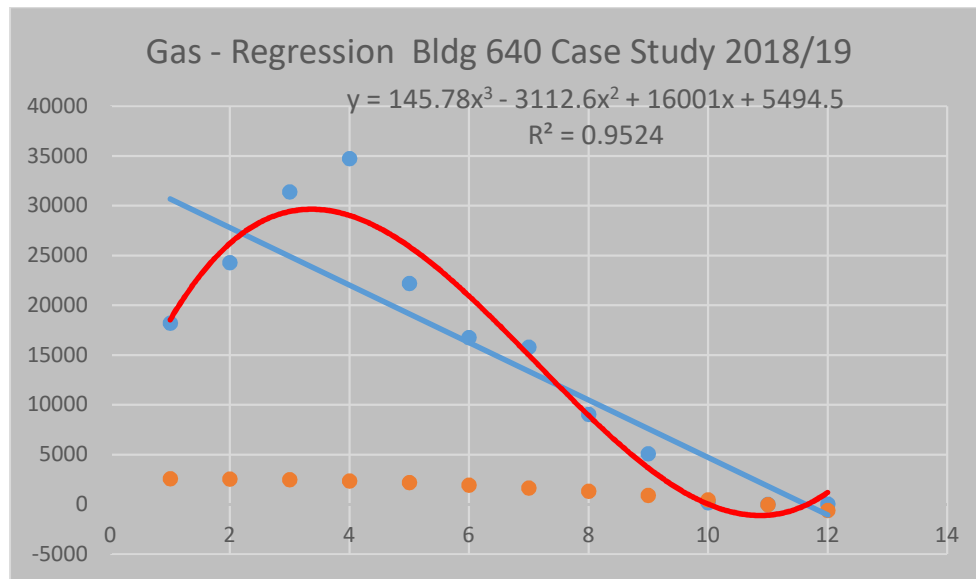
7.5 Figure 10 – Gas seasonal consumption Kwh regression data analysis (Period Oct 2016 - 2019).



7.6 Figure 11 – Gas seasonal consumption Kwh regression data analysis (Period Oct 2016 - 2017).



7.7 Figure 12 – Gas seasonal consumption Kwh regression data analysis (Period Oct 2017 - 2018).



7.8 Figure 13 – Gas seasonal consumption Kwh regression data analysis (Period Oct 2018 - 2019).

8.0 Energy Management Matrix Evaluation (Plan)

L e v e l	Energy Policy	Organising	Motivation	Info. System	Marketing	Investment
4	Energy policy, action plan and regular review have commitment of top management as part of an environmental strategy	Energy management fully integrated into management structure. Clear delegation of responsibility for energy consumption	Formal and informal channels of communication regularly exploited by energy manager and energy staff at all levels	Comprehensive system sets targets, monitors consumption, identifies faults, quantifies savings and provides budget tracking	Marketing the value of energy efficiency and the performance of energy management both within the organisation and outside it	Positive discrimination in favour of 'green' schemes with detailed investment appraisal of all new build and refurbishment opportunities
3	Formal energy policy, but no active commitment from top management	Energy manager accountable to energy committee representing all users, chaired by a member of the managing board	Energy committee used as a main channel together with direct contact with major users	M&T reports for individual premises based on sub-metering, but savings not reported effectively to users	Programme of staff awareness and regular publicity campaigns	Same payback criteria employed as for all other investment
2	Unadopted energy policy set by energy manager or senior departmental manager	Energy manager in post, reporting to ad-hoc committee, but line management and authority are unclear	Contact with major users through ad-hoc committee chaired by senior departmental manager	Monitoring and targeting reports based on supply meter data. Energy unit has ad-hoc involvement in budget setting	Some ad-hoc staff awareness training	Investment using short term pay back criteria only
1	An unwritten set of guidelines	Energy management the part-time responsibility of someone with only limited authority or influence	Informal contacts between engineer and a few users	Cost reporting based on invoice data. Engineer compiles reports for internal use within technical department	Informal contacts used to promote energy efficiency	Only low cost measures taken
0	No explicit policy	No energy management or any formal delegation of responsibility for energy consumption	No contact with users	No information system. No accounting for energy consumption	No promotion of energy efficiency	No investment in increasing energy efficiency in premises

8.1 Figure 6 – Energy Management Matrix Evaluation Example

It is important to gather as much information about the building and how is currently being managed and operated. By completing this it will enable any initiatives to be taken forward into an action plan. In order this to happen we must follow an energy management matrix that examines the buildings optimum operation and identifies its priorities.

It is apparent from case study that through the analytical review conducted by the use of energy consumption data and associated comparison meter reading results has enabled the energy team to identify the main data centre (UWE building 640) as one of the main contenders for high energy consumption.

As this result has helped determine the data centre as displaying significant energy usage the energy team must now look to evaluate this consumption in further detail in order to provide viable options to improve this energy consumption. It is the understanding that the data centre has had its existing cooling systems replaced through an agreed end of life strategy by two number replacement Airedale (SmartCool) systems installed during the summer 2018 to take over and help manage the environmental cooling requirements. Although it is evident from the meter readings that these new systems offer some level of energy efficiency they are perhaps still a little way off meeting UWE Bristol energy targets. For instance the systems were aimed at being a like for like system replacement with a room set point of 22°C however, they still need to operate 24/7 in order to manage the environmental demand from a temperature perspective.

9.0 Future Implementation and Monitoring (Do, Check and Act)

A successful implementation of an EnMS with the support of the interested parties aligned with an energy policy and carbon management plan vision for the future will allow for cultural changes to be managed in a more sensible and sensitive phased approach ensuring ongoing conformity through audit processes. All objectives and associated action plans with any agreed energy targets shall be clearly defined and adopted as part of the future UWE commitment processes. These committed processes should offer continual energy efficiency reflecting reductions in energy consumption that should be embraced by all interested parties for results to be fully recognised. The energy manage systems will also need to be regularly re-evaluated by the directorate and updated in accordance with the UWE's future strategic vision and direction.

Consideration should also be given to current and future maintenance regimes in order to provide the optimum efficiency from systems and where applicable operatives should be given the support and training as determined by any use of specialist systems. Implementing a robust maintenance, monitoring and control strategy that identifies any non-conformities will certainly help support and improve energy consumption which can also be subject to fluctuation whilst further thought should also be given into reviewing utility tariff costs as part of good practice. Whereby any non-conformities are identified every effort should be taken by the respective energy representatives and interest parties to manage and resolve them accordingly. This will include understanding what may have led to or caused the non-conformity and also reassessing any measures used to resolve it updating the energy management system where applicable to continually improving and demonstrating energy performance and compliance.

10.0 Recommendations for Improvements (Do, Check and Act)

Therefore, future recommendations would be to conduct a comprehensive energy audit or survey of the building and data centre environments that will aim to take into consideration the possible opportunities along with any risk that maybe prevalent to support a program of reducing energy usage and running costs. The main aim of an energy audit or survey will be to allow the energy team to investigate and identify further savings in a more quantifiable manner prompting them to record and present the savings by order of a priority rating or scale. This process can assist the energy team with any associated business cases requirement by them producing a clear and concise program of recommended energy improvements back to the directorate. This also help support financial decision making processes enabling the directorate to authorise procurement, formalise budgets from an exact understanding of how capital expenditure is going to spent against energy saving priorities identified along with knowing what the payback return will look like over a given or agreed period of time.

Improvements such as passive cooling/natural ventilation, re-use of waste heat during winter to offset heating demands, improved/optimised control philosophies, system assessments to ascertain exact demand/heat load requirements some items of data equipment capable of working and operating at higher temperatures, temperature monitoring and reporting, hybrid solutions iCloud, outsourcing data centre requirements, Solar PV strategies to help offset carbon emissions and electrical demand/consumptions.

- Assessing the building energy performance and bench marking it against other similar establishments.
- Implement metering and sub-metering strategies to observe and identify energy usage trends capturing them for further energy improvement. Also consider energy delivery, providers and supply provision.
- Gain further understanding of the buildings occupancy levels and staff distribution and usage of the building.
- Give consideration to any environmental obligations such as temperature and humidity control including any additional requirements there may in place.
- Consider maintenance regimes conducted in the building.
- Assess any management procedures and policies for the building including monitoring, targeting and procurement requirements.
- Identify and categorise subsequent energy and cost saving opportunities for example which will be the most cost effective taking into consideration payback periods and any associated carbon saving potential.
- Recommend energy saving solutions ranging from the no cost followed by low cost up to those that require major capital investment input.
- Provide a clear and concise prioritised scheme and foundation for investment.
- Conduct an analysis of the significant energy usage in the building in terms of departments or specific areas such as a data centre to distinguish the main users.
- Assessment of the building façade and fabric composition to identify heat loss and heat gains.

It is apparent from research that limited procedures in a way that standardises the management of data centre equipment are present in the UWE. Dramatic savings would be evident from just making some basic changes to the UWE data centre processes and

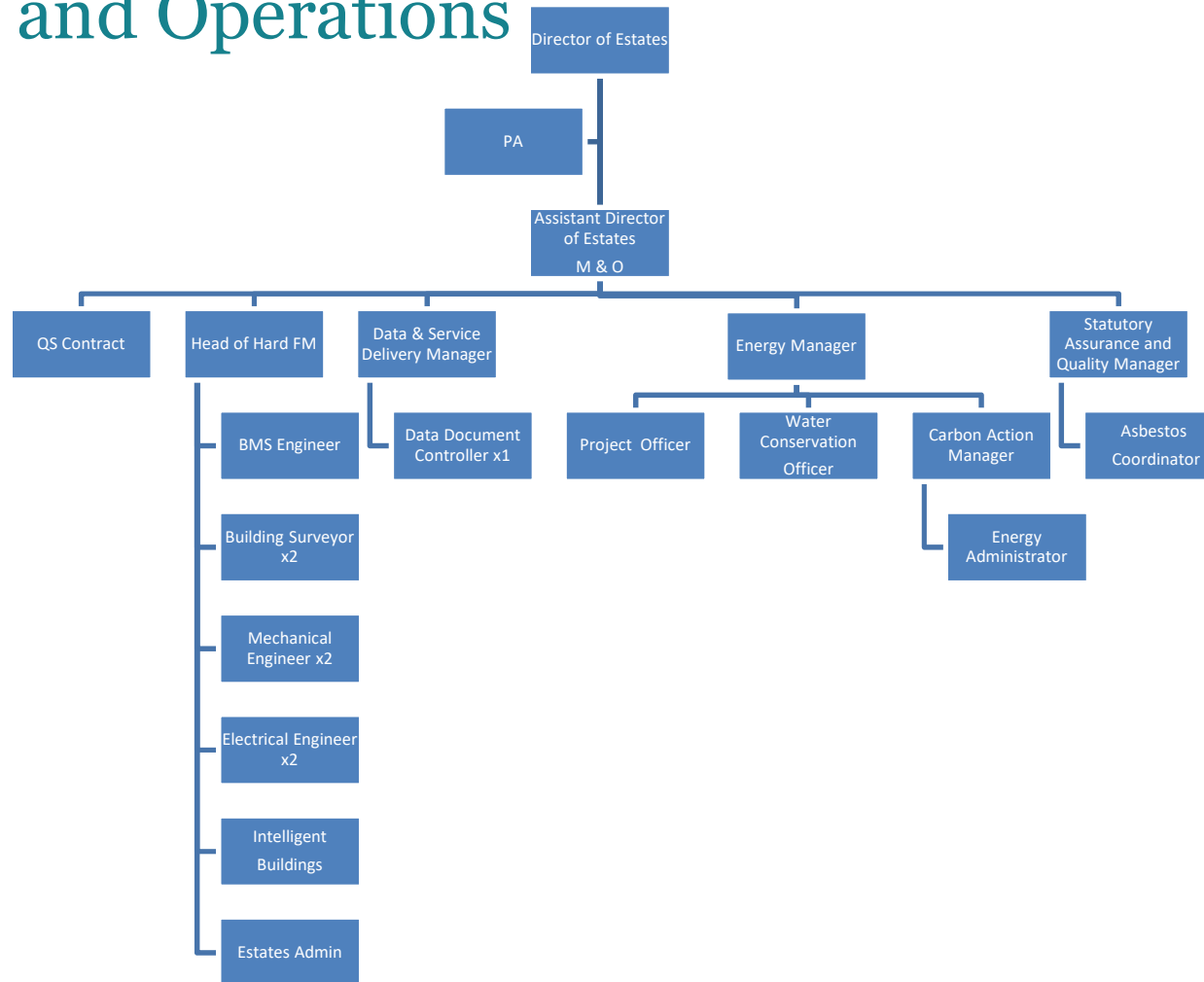
procedures by way of introducing and standardisation energy consumptions indicators and targets.

11.0 References & Bibliography

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2. British Standards Institution (2012) BS EN ISO 16247-1 *Energy Audits Part 1 – General Requirements*. British Standards Online. London: British Standards Institution. Available at <https://bsol.bsigroup.com> (Accessed 16th November 2019).
3. British Standards Institution (2014) BS EN ISO 16247-2 *Energy Audits Part 2 – Buildings*. British Standards Online. London: British Standards Institution. Available at <https://bsol.bsigroup.com> (Accessed 16th November 2019).
4. British Standards Institution (2014) BS EN ISO 16247-3 *Energy Audits Part 3 – Processes*. British Standards Online. London: British Standards Institution. Available at <https://bsol.bsigroup.com> (Accessed 16th November 2019).
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7. Poveda-Orjuela, P., Garcia-Diaz, J.C., Pulido-Rojano, A., Cannon-Zabala, G. (2019) *ISO 50001: 2018 and its application in a Comprehensive Management System with an Energy –Performance Focus*. Whole article: *Energies* **2019**, 12(24), 4700; <https://doi.org/10.3390/en12244700> Available at: <https://www.mdpi.com/1996-1073/12/24/4700> (Accessed 16th November 2019).

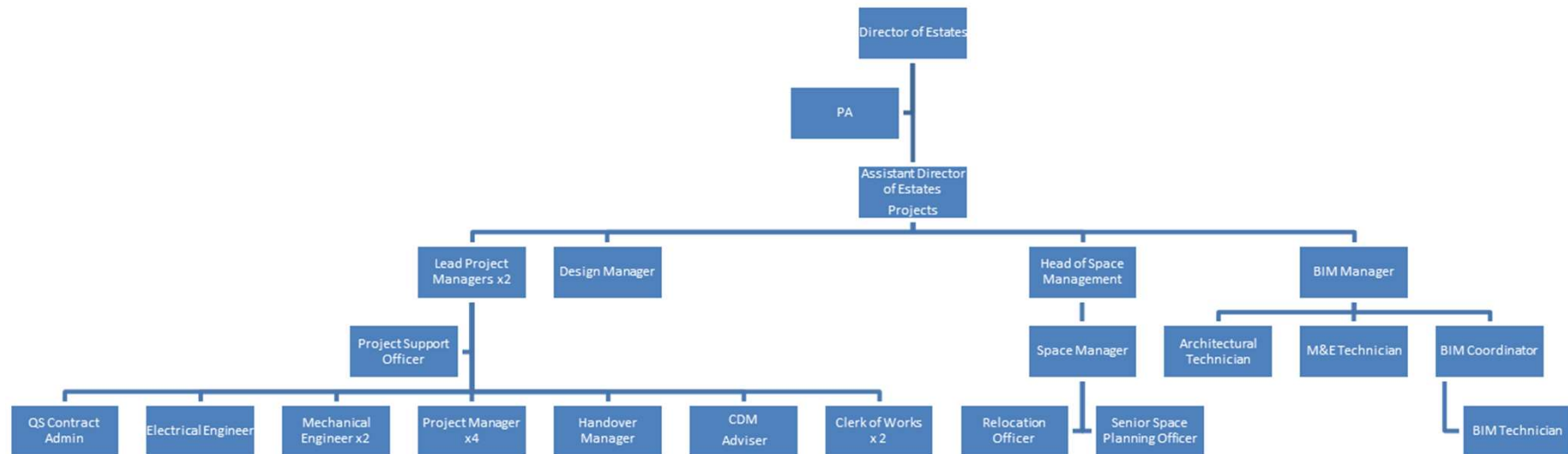
12.0 Appendix 1 – Operations and Maintenance Organisational structure for Energy Management system.

Maintenance and Operations



13.0 Appendix 2 – Project Organisational structure for Energy Management system.

Projects



14.0 Appendix 3 – Further Recommendations for continual improvement.

Ref	Recommendations/comments	Anticipated Benefits	Action Date
1.	A Widespread improvement in good housekeeping practices amongst staff with regard to lighting and small power should be instigated. Lights in unoccupied building during weekend and evenings appeared to be on.	Quick no cost, allowing savings per year to be made from lighting and small power being identified as being on for unnecessary hours each day. Switch off Campaigns and out of hours walk rounds.	TBC
2.	Green impact strategies being employed or staff campaigns to encourage ownership whereby individuals or departments get, measured on energy usage.	Engages the staff to take some responsibility and encourages optimum energy efficiency processes within the building. Use of colour coded labels to indicate which items of equipment and plant that can be switched off or left on	TBC
3.	Ensure appropriate time and seasonal control of buildings heating/cooling zones.	Improve comfort, save excessive heating/cooling GSHP operation and energy from circulating pump requirements.	TBC
4.	A complete review of any maintenance regimes, control settings, providing free cooling, simple fabric upgrades, shading to prevent overheating and or led lighting upgrades	Energy management matrix and development of an action plan in conjunction with a more comprehensive energy audit.	TBC
5.	Use LED in place of T12 and T8 Fluorescent type light fittings throughout building.	This simple but effective upgrade Can offer the client good energy savings, with less maintenance constraints	TBC
6.	Carry out control upgrades/modification to ensure all plant items are managed and operated to suit the buildings usage and zonal needs.	Effective upgrades Can offer the client great energy savings, optimising plant efficiencies, management and operation. Life expectancies for BMS strategies is unfortunately low 6-8 years so should be constantly monitored under a life cycle process.	TBC
7.	Supplement building with PV Array to assist the offsetting of high electricity consumptions within building.	Utilised upon other local university buildings and perhaps could be included as part of the re-fit program.	TBC
8.			

Key;

	Low or no cost investment
	Medium cost investment
	Business case requiring cost investment

15.0 Appendix 4 – Airdale system information for Bldg 640 and Life expectancy.

Assuming that both units are run together as “hot” standbys to meet an overall cooling load of 60kW. So 30kW per unit.

So $30\text{kW} \times 365 \text{ days} \times 24 \text{ hours} = 262,800.00 \text{ kWh}$ of cooling (Value1).

“Predicted” Energy consumption (per unit) p.a. = 60,864.3kWh p.a. per unit (Value 2) and predicted energy cost £6,086.40 p.a. (10p per kWh) per unit.

Further consideration is required to estimate the original running costs of old unit/s to find out the saving and then any calculation of payback.

An annualised EER (value 1/value 2) of 4.32 results from running both units together to share the load across the whole of the year.

A similar calculation for running the unit stand alone at 60kW with strict standby rotation would result in $(262,800 \times 2) \text{ kWh} / 136,896.2\text{kWh}$ an annualised EER of 3.84.

So running units together represents most efficient mode of operation.

Regarding longevity the SmartCool range has been out for about 7 or 8 years now and the inverter version about 4 to 5 years. If maintained correctly, the lifetime of the unit can be greatly extended.

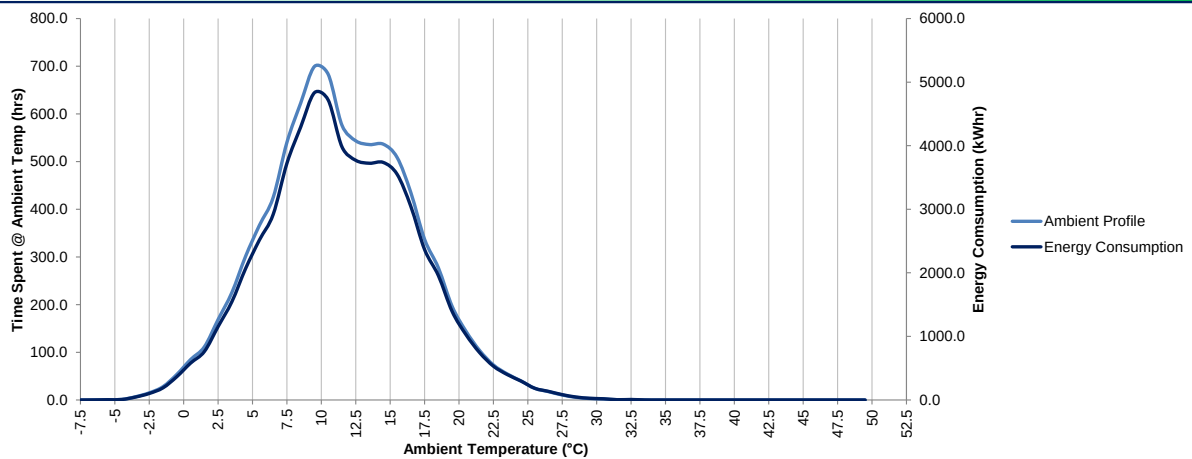
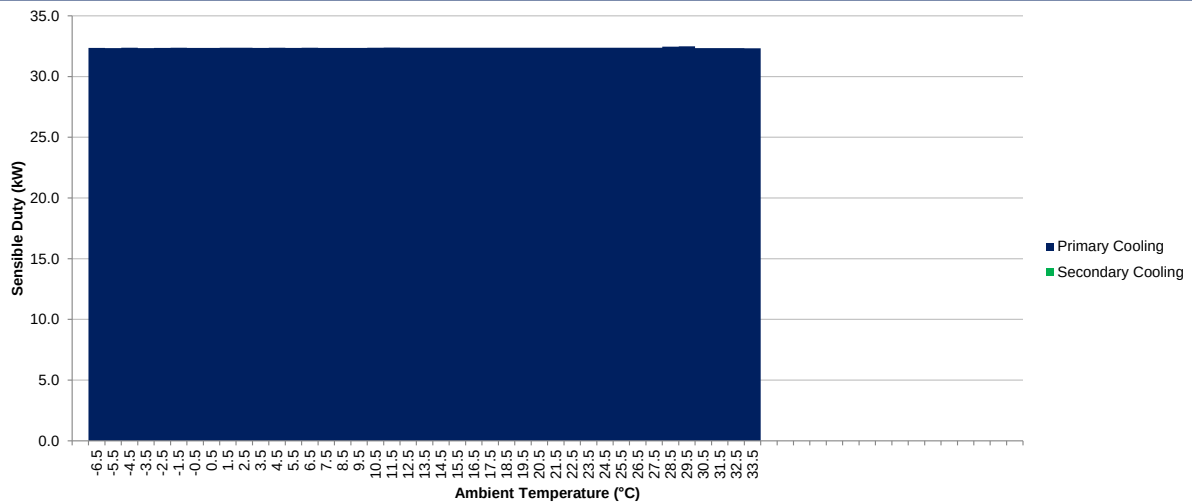
ENERGY ANALYSIS SUMMARY

UNIT CONFIGURATION

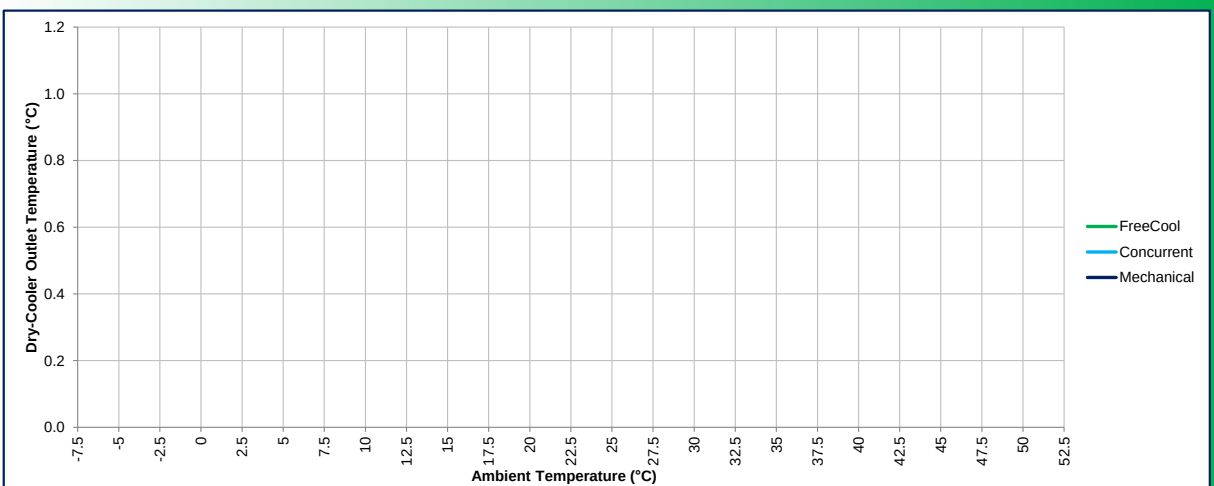
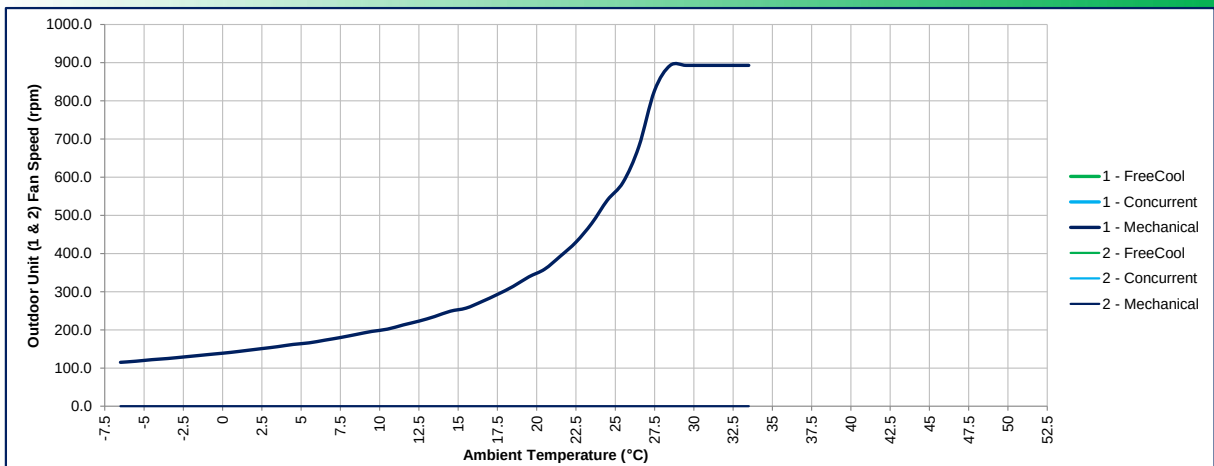
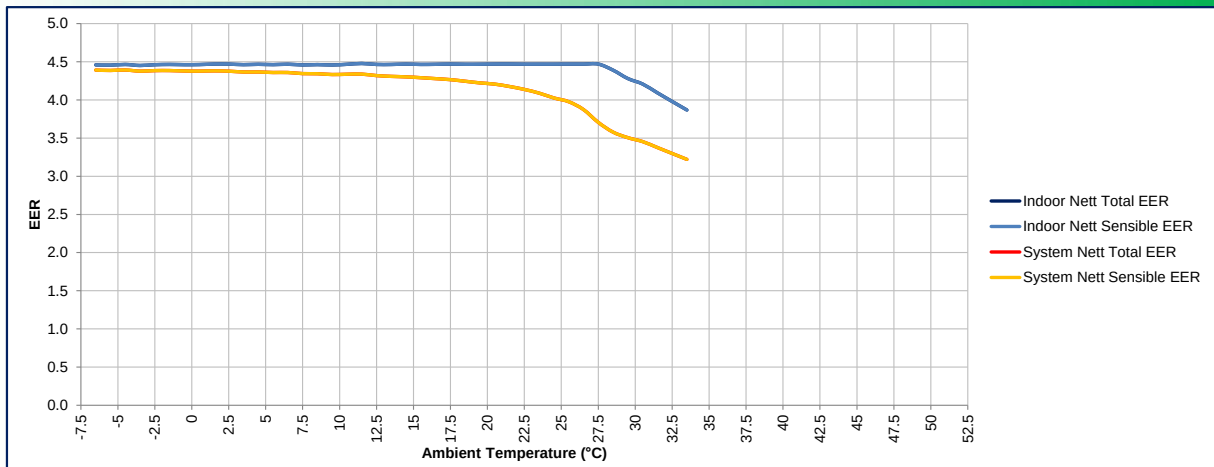
Design Ambient Temperature :	35.0 °C	Head Pressure Setpoint :	34.0 °C
Air On Temperature :	24.0 °C	Head Pressure Control :	Standard
Air On Relative Humidity :	45.0 %	Primary Heat Exchanger :	CR105-0
Air Off Temperature :	Variable °C	Primary Heat Exchanger Type :	Air-Cooled Condenser
Plate Condenser Inlet Fluid Temperature :	N/A	Outdoor Unit Fan Type :	AC
Plate Condenser ΔT :	N/A	Secondary Heat Exchanger :	N/A
Fluid Type :	N/A	Secondary Heat Exchanger Type :	N/A
Glycol Concentration :	N/A	Secondary Heat Exchanger Quantity :	N/A
Airflow :	4.11 m³/s		
Additional External Static :	25.0 Pa		
Indoor Fan :	Standard		
Filtration :	G4		

RESULTS SUMMARY

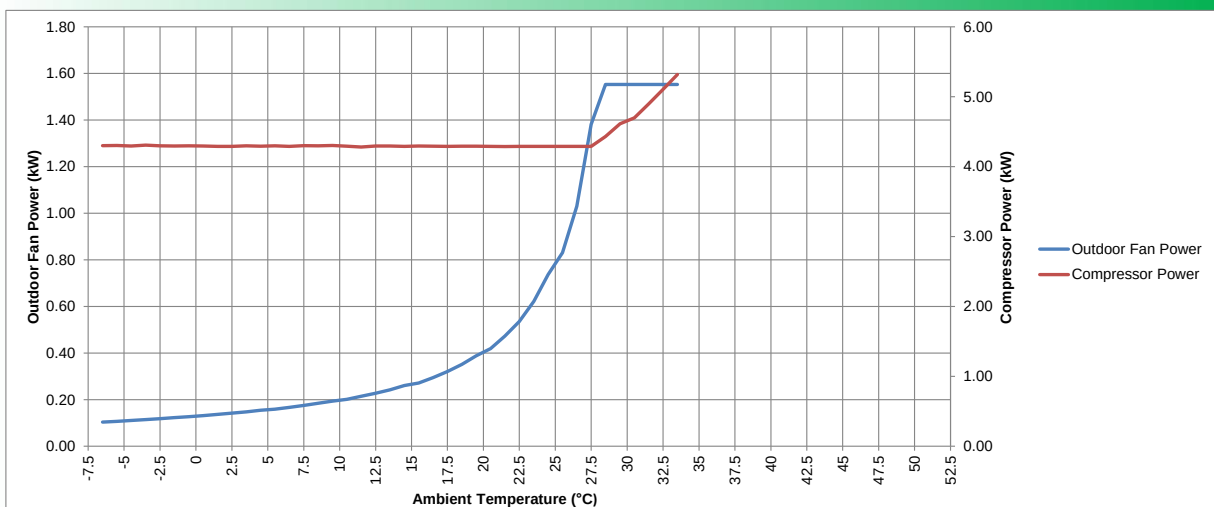
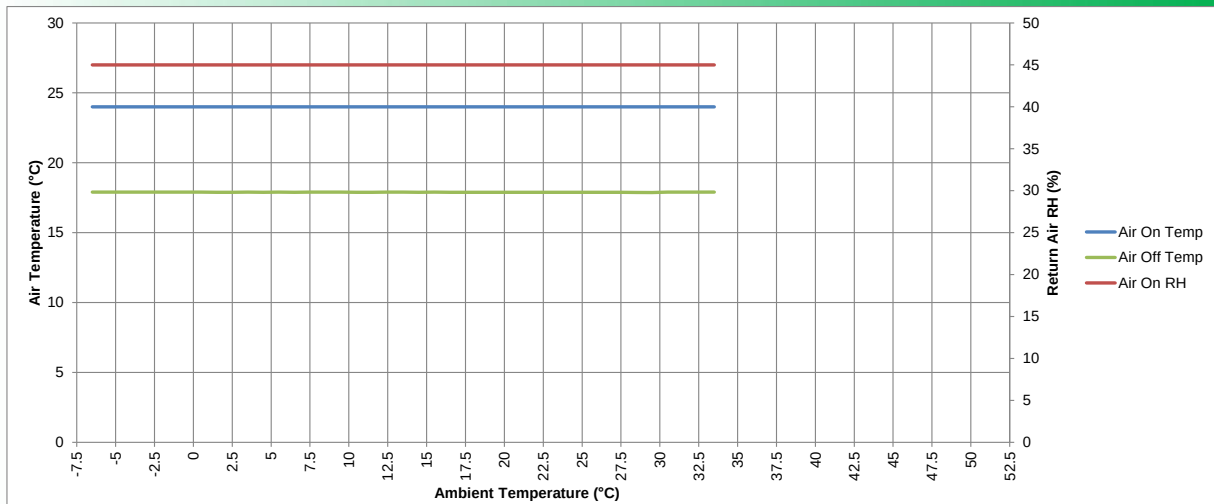
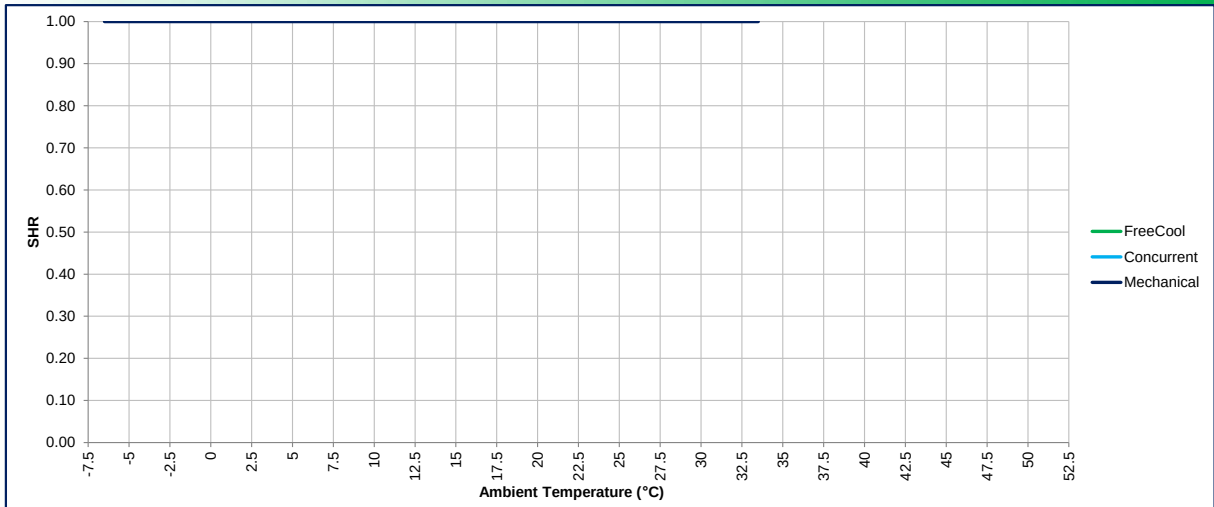
Location :	Cardiff	Total Energy Consumption :	60864.3 kWhr
Base Load :	30.0 kW	Annual Running Cost :	£ 6,086.43
Variable Load :	0.0 kW		
Days Per Week :	7.0		
Hours Per Day :	24.0		
Cost Of Electricity :	£ 0.100 /kWhr		



ENERGY ANALYSIS SUMMARY



ENERGY ANALYSIS SUMMARY





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£ 5,876.20