



Sustainable Resource Management:

**Do policy and monitoring have an effect on
sustainability in Leisure Facilities?**

Case Study: UCD Sport & Fitness and DIT Kevin Street

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Abstract

Sustainable resource use can be achieved through strict monitoring and management. National and local policies have an important role to play on how this is implemented in the public sector. Are existing policies having a significant enough effect on these public sector bodies so that implementation of a sustainable resource management system can be established in individual industries?

A survey of two facilities within the Dublin region indicated that there are practices of both sufficient and insufficient resource management. Overviews of policies and aims for 2020 targets give an indication of work which needs to be done in the foreseeable future to drastically improve on resource management in the public sector. Surveys of personnel from facilities involved give insight into opinions on these targets proposed for the future.

‘Current policy targets appear to lack meaning due to poorly defined baselines, poor data gathering, an absence of energy reporting and a lack of operational level, results-driven programmes’ (Paul Price, 2012).

Declaration

I certify that this thesis which I now submit for examination for the award of BSc. in Environmental Management is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

This thesis has been prepared under the regulations and guidelines of Dublin Institute of Technology.

Signature:

Date:

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Although many contributed to the completion of this study I would like to state that any errors in the interpretation of data are solely mine and in no way reflect on those who gave their assistance to the research project.

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1. Introduction

1.1 Background

‘Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology’. (Our Common Future, Part 3. 27.)

The topic of sustainability interests me greatly and from day one the decision was made that I would base my dissertation around this topic. Recent issues with the production of water in Ballymore Eustace Reservoir caused water restrictions in the Dublin region. ‘Dublin will be left with no water if night-time restrictions are lifted, city engineer Michael Phillips has warned. The council last night announced the extension of nightly cuts throughout the Dublin region until at least Thursday of next week’ (Olivia Kelly, 2013). This bulletin describes the issues that many industries would have had to deal with during this period of water restrictions.

Due to this problem within the water management system in Dublin I began to question whether stricter policies should be adopted in certain industries in order to reduce the use of resources. I decided to look at the Leisure industry with regard to this question, as this industry uses large quantities of resources with little productivity towards our environment.

The use of water, energy and chemicals within Leisure Facilities are considered within this study. The reason for this consideration is to enable me to cover the whole topic of sustainability in its entirety, and to provide my study with accurate results.

1.2 Aims and Objectives

The general aim of this study is to establish whether it is necessary to implement more severe resource management policies in Leisure Facilities. In order to do this a survey will be performed amongst multiple Leisure Facilities and an examination of their resource management and monitoring is necessary.

The aim of the project in reference to scope area involved will be to compare at least two Leisure facilities so a comparison study can be achieved. Anything beyond this will be great help towards comparisons for the study. It is important in this particular study, that each facility contains contrasting aspects. This could be the age, size etc. of the facility. This will aid in investigation in order to observe how sustainable a facility might be. An old building might not be as sustainable as a newer one which might seem obvious but if best practice techniques were enforced in policy this would prevent old buildings from being less sustainable.

The general objectives of this project include establishing annual rates for water and energy use within the facilities involved. It is also aimed at examining the technologies in place to combat over-use of these resources and finally to establish whether the facilities have their own policies on use of water and energy? And finally, to compare and contrast different facilities that use sustainable techniques and non-sustainable techniques to find where resource and economic savings lie.

1.3 The Field Study

The field study involved with this project was strictly within the facilities themselves. All of the information gathering and surveying was obtained through contact with personnel from each facility so that relevant information could be established from the visits.

The results from the field study were only from relevant personnel of the facilities with figures and information from these personnel being represented as true information within the project. Observations of the facilities were also represented within the project. These observations include the state of plant rooms and equipment within.

1.4 Preview of the Organisation of the Study

There are six chapters contained within this study.

Chapter 1 contains an introduction to the study topic and gives background information on the study area. It also provides information on the purpose of the study with the aims and objectives describing how the project will be approached.

Chapter 2 contains the Literary Review and provides information on any documents, articles, journals and websites, which were seen to have a close relevance to the study.

Chapter 3 is the Methodology section. This section provides an insight into how the primary information for the study was sought and obtained. Different methodological approaches are discussed and will state whether they were successful or not.

Chapter 4 contains the results of the fieldwork that was carried out. Results of questionnaires and general observations are summarized within this section.

Chapter 5 discusses the results summarized in chapter 4. The discussion section gives opinions of facility staff and personal opinion on the results found throughout the study.

Chapter 6 outlines the conclusions of the report and also gives recommendations. These conclusions and recommendations are fueled by information from the literary review, results and discussion chapters.

1.5 Limitations

Throughout this study there were many limitations which included lack of access to certain companies and pieces of information that would have been very helpful to the study.

Ideally the study would have a broader scope with a number of participating facilities. These may have included the National Aquatic Centre and UL University of Limerick. Neither of these facilities accepted to the invitation to be included in the study. On both occasions specific personnel's contact details were provided but no response was received. If there were plans for further study on this topic ideally these facilities could be included.

In reference to access of information, it was difficult to obtain information regarding water at Killarney Sport and Leisure as the information provided was isolated to energy use. This meant it could only partially contribute to the study.

A slight lack of information also proved to be an obstacle in regards to DIT Kevin Streets statistics but this gave topic for discussion.

Throughout this study it deemed to be of great difficulty in obtaining from many leisure centres that I contacted.

2. Literary Review

2.1 Introduction to Chapter

This chapter will review and discuss relevant existing material on the topic of sustainable leisure management with regards to water, energy and chemicals. Existing documents such as the Water Framework Directive and the Energy Performance of Buildings Directive will give insight into current legislation on the topic. There will also be discussions of systems that are needed within the field of sustainable leisure centres and examples given where these systems are used currently in Ireland or in the study area of the project.

2.2 Water Management

(16) 'Further integration of protection and sustainable management of water into other Community policy areas such as energy, transport, agriculture, fisheries, regional policy and tourism is necessary. This Directive should provide a basis for a continued dialogue and for the development of strategies towards a further integration of policy areas. This Directive can also make an important contribution to other areas of cooperation between Member States; inter alia, the European spatial development perspective' (ESDP).

This extract from the European Parliament on establishing a framework for community action in the field of water policy refers to the continuation of development of strategies towards further integration of policy areas. Ireland is a member state of the European Union therefore policies amended or established will have an effect on existing policies within the country. Any policies that have relevance to sustainable resource management will be investigated and referred to in this study.

2.2.1 Water Framework Directive

As all of the leisure centres within this study contain swimming pools, this directive becomes more important. This importance is mainly towards the depository end of these facilities as it is a responsibility to know what pollutants will be put back into the environment by the polluter. The Water Framework Directive is written under the EU Commission and contains all policies concerning water. The policies within this directive that are relevant to this study are water and chemicals. These different policies will only cover the criteria of pollution of which leisure facilities would be concerned. This begs the question should policies exist that dictate how water is managed within these large facilities? Without proper management security of water resources can be hampered. It briefly refers to water management in the Irish water framework directive however it fails to contain any information on how it can be managed within infrastructure. The only policy provided is how it is to be managed in order to release it back into the environment. Sustainable water management is mentioned in the EU water initiative on the EU Commission website. This refers to water pricing and how it can help the sustainable use of water.

‘The emerging “green growth/green economy” paradigm. This should facilitate the implementation of good water resources management in at least three aspects: (a) increasing recognition of the need to protect water resources and water-related ecosystems as economic assets, (b) better allocation of water resources (in terms of economic productivity), and (c) increasing attention to investments in nature-based/green infrastructure (such as upper watershed forested lands, wetlands, aquifers and floodplains) as more efficient alternatives to hard infrastructure’(EUwater).

2.2.1.1 Water

The policies contained within the Irish Water Framework Directive do not state how water should be used. It contains policies that prevent the pollution of water from industry and the human environment. Sustainable water management is suggested throughout the EU Commission site within articles about water scarcity and the EU water initiative which talks about *'Financing the sustainable management of water resources is a major and increasing challenge'*(EUwater).

'While Europe is by large considered as having adequate water resources, water scarcity and drought is an increasingly frequent and widespread phenomenon in the European Union. The long term imbalance resulting from water demand exceeding available water resources is no longer uncommon' (EC).

In early November 2013 there were water restrictions placed during the evening hours in Dublin City. Contaminants at the Ballymore Eustace plant were the reason for the restrictions. This also led to restrictions on water quantities for leisure centers to use, even those containing pools. This national broadcast made citizens aware of shortages. *'Dublin's four local authorities have urged people to conserve water due to a serious production problem at the Ballymore Eustace treatment plant'* (RTE). During the hours of 8pm and 7am water was shut off in many places, and in other areas such as heavy industry water had to be used sustainably. The restrictions were forced upon industries around Dublin. UCD Sport & Fitness is an example of one of the facilities which had to endure water restrictions in the evening time which meant that sustainable water management throughout the period was imperative in order to keep showers and taps running.

These problems should not be a factor in water use. There should be firm policies in place declaring that water and other resources should be used sustainably within areas of Leisure to prevent mismanagement of water due to its high quantities in Ireland.

‘resource efficiency is a goal of any effective water business, as it implies minimising the use of water, energy, process chemicals and other resources to reduce costs. Water conservation initiatives involving customers also provide benefits in terms of improved water security and resource efficiency’ (David R. Marlow et al., 2013)

2.2.1.2 Chemicals

‘Chemicals are an essential component of our daily lives, but some chemicals can severely damage our health or the environment. There is an increase in health problems that can be partially explained by the use of chemicals’ (EC).

For this reason recently there has been a general outcry for reduction in chemicals used in swimming pools within leisure centers for the interest of human health but also for the environment to which this water will be received. New technologies have been developed to substitute the use of chemicals in pools such as chlorine.

UV (Ultraviolet) light is becoming increasingly popular in swimming pools and other aquatic facilities in order to sterilize water. This method of water sanitization means that there is very little need for chlorine to be used within the water.

‘Ultraviolet (UV) pool sanitizers utilize a cutting-edge, non-chemical process that uses germicidal UV light rays to sanitize water, air and surfaces that may be contaminated. Ultraviolet pool sanitizers emit a high intensity germicidal light ray that alters or disrupts the DNA or RNA of targeted organisms such as algae, bacteria, viruses, cysts and protozoa. The highly concentrated electromagnetic energy also destroys organic matter, eliminating the formation of dangerous chlorine by-products’ (Spectralight UV).

2.2.2 Rain Water Harvesting

Rain Water Harvesting is a method that can be used by industries to save on commercial water costs. It is a system that can be installed on roof -tops or other areas of high rainfall, where water that is collected is stored in a collection tank within the facility. This water can be treated and reused for any function or simply put back into the system for toilet flushing. This method of water conservation helps industries to save on the commercial cost of pumping water into the facility and also out of the facility. Any facility that wishes to establish a rainwater harvesting system has to register it with the county council.

Creative Arts Building, University of Huddersfield

Envireau collects rainwater from the university's roof, filters it and then passes it into a 45,000 litre below ground rainwater holding tank. The water is then pumped to a high level header/break tank within the building to service toilet flushing (Kingspan Water).

DEFRA Offices, Northumberland

From the outset, the aim was to construct a building with the highest possible BREEAM (Building Research Establishment Environmental Assessment Methodology) rating. This includes incorporating low energy technologies, responsibly sourced materials and reduced carbon emissions. There was also the aim of minimising mains water consumption through low-water use fittings and rainwater harvesting systems (Kingspan Water).

The example above gives successful accounts from Kingspan of rainwater harvesting being implemented successfully and providing a service to these companies that would otherwise cost commercially.

2.2.2.1 Grey Water

‘Grey Water is the term used for water that is recycled from water that has already been used in wash hand basins, showers and baths. Personal bathing habits will influence the potential quantity available for saving mains water. The most common method of re-using grey water is to carry relatively clean water used for washing or rinsing outside and use on the garden’ (DCCOCO).

There is potential for grey water to be established within all of the facilities however with commercial water being relatively cheap there is no real push factor for this technology to be installed or retro fitted which may takes a long time to get value from. This was a point made by the environmental manager of Cadburys in Coolock. (Course field trip in February)

2.3 Energy Management

2.3.1 Energy Performance of Buildings Directive

The EU Energy Performance of Buildings Directive (EPBD), transposed into Irish Law from 2006 onwards, contains a range of provisions to improve the energy performance of new and existing buildings (SEAI).

‘A building shall be designed and constructed so as to ensure that the energy performance of the building is such as to limit the amount of energy required for the operation of the building and the amount of CO₂ emissions associated with this energy use insofar as is reasonably practicable’ (BUILDING REGULATIONS, PART L AMENDMENT, 2008)

With these constraints contained in the legislation it is imperative that new buildings are built sustainably. A sustainable building will require less energy to keep it running comfortably with

regards to heat, water and lighting. This will also entail less of a cost to the bill payer on a higher rated building. Many different technologies are available to compliment sustainable buildings and this idea of sustainable buildings has been a long strung out process, resulting in a modern experience.

'the findings from the organizations in three sectors studies indicate that there are many such cost effective opportunities, in this sense, still available in most of the organisations concerned. A majority of interviewees in each of the three sectors agreed that there were many energy efficient opportunities available in their organisations that would have quite short payback periods' (FitzGerald et al., 2005, p.130).

This extract is from the book 'Aspects of Irish Energy Policy' and John FitzGerald talks in 2005 of organisations that are willing to pay for cost effective technologies. The results will see a short payback time for these technologies and will help to save money for these organisations.

'Water management decisions should consider energy use to improve the resource management. Consideration of the critical link between water and energy during water planning and policymaking can lead to significant energy saving as well as, reductions in the associated CO2 emissions. Water production requires energy and energy production contributes to the carbon footprint' (Shrestha E. et al., 2011, p.210)

2.3.2 BER – Building Energy Rating

As explained above BER is the energy performance of a building with regards to heat, ventilation and lighting. The scale runs from A-G with 'A' being the best rating and 'G' being the worst rating. Through legislation it is now imperative that a building has a BER if it is newly built and to be sold. This allows the potential buyer to be aware of costs necessary to keep the building running comfortably.

These rules of BER apply to:

New dwellings: The regulations apply to new dwellings for which planning permission was applied for on or after 1st January 2007. All new homes (even when not for sale) must have a BER certificate before they are occupied.

New Non-Domestic Buildings: The regulations apply to new non-domestic buildings for which planning permission was applied for on or after 1st July 2008.

Existing Buildings: (dwellings and other buildings) when offered for sale or letting on or after 1st January 2009. An existing building is a building which has previously been sold and/or occupied.

Large Public Service Buildings: From the 9th January 2013 publicly and privately owned buildings over 500m², frequently visited by the public, are required to exhibit a Display Energy Certificate (DEC), in a prominent place, clearly visible to the public. The DEC is intended to encourage public authorities to adopt environmentally responsible and efficient use of energy in buildings (SEAI).

2.3.3 E3 – Energy. Environment. Economy

E3 is an initiative funded by Sustainable Energy Ireland, which uses four colleges, DCU, DIT, UCD and Trinity College Dublin in an attempt to reduce energy use within their buildings. The initial goal of the project was to reduce energy use in buildings by 10% by 2012. E3 is relevant to this study as DIT Kevin Street adheres to the requirements of the E3 initiative.

The main goal of this initiative is challenging the energy use, which has been increasing in conjunction with increased research activity associated with IT infrastructure. To achieve this goal E3 identified areas within each building where energy use could be saved. Once this was completed a committee was established which contained an energy manager from each college who would make sure the initiative was being implemented and then review the energy use monthly and produce a progress report which would be made public online.(E3)

2.3.4 SEAI (Sustainable Energy Authority Ireland)

'Local Authorities are identified as having a cross-sectoral role at local level, including in partnership with local energy agencies. Local Authorities will be encouraged to adopt best international practice as developed through international network'. (NCCSI, 2000)

The Sustainable Energy Authority of Ireland was established as Ireland's national energy authority under the Sustainable Energy Act 2002. SEAI's mission is to play a leading role in transforming Ireland into a society based on sustainable energy structures, technologies and practices. To fulfill this mission SEAI aims to provide well-timed and informed advice to Government. It also aims to deliver a range of programmes efficiently and effectively, whilst engaging and motivating a wide range of stakeholders and showing continuing flexibility and innovation in all activities. SEAI's actions will help advance Ireland to the vanguard of the global green technology movement, so that Ireland is recognised as a pioneer in the move to decarbonised energy systems (SEAI).

It runs many programmes and helps businesses through consultation become more energy efficient, which will be of financial advantage to businesses in the future.

2.3.4.1 CODEMA Dublin's Energy Agency

CODEMA are an energy agency based in Dublin which have a similar purpose to SEAI, on a regional scale. They were established in 1997 as a not-for-profit limited company. They work with Dublin's local authorities to improve the energy efficiency of public buildings in order to reduce the city's CO2 emissions (CODEMA).

CODEMA currently have established a contractual agreement for four of the biggest leisure facilities run by Dublin City Council. This was in the wake of the Ireland's commitment to the NEEAP National Energy Efficiency Action Plan. This requires all of the facilities involved to meet energy requirements each year. This will hopefully set a benchmark for other leisure facilities to follow suit if not already doing so in order to become more sustainable.

2.3.5 BEMS (Building Energy Management System)

A Building Energy Management System consists of one or more self-contained computer based 'outstations' which use software to control energy consuming plant and equipment, and which can monitor and report on the plant's performance. These outstations have the ability to be linked together in a modular fashion by a network, and can communicate with each other and with an optional central operator's terminal, which is often a conventional Personal Computer (PC). BEMS provide control by using software logic and are re-programmable, whereas older controllers of the electrical or electro-mechanical type relied on purpose built hardware, which required hardware changes to change their characteristics or abilities.

Building Energy Management Systems are also referred to by various other names including:

- Energy Management System
- Building Management System

BEMS can be expected to save 20%, and occasionally more, of the energy consumption of the plant being controlled. Savings can be expected to recur year after year, leading to improved competitiveness in the market and therefore higher profit (SEAI, BEMS).

SEAI give two case studies in which BEMS has been used:

UCD campus is a good example of tried and tested use of BEMS. The first installation of this was in 1986 in the library building on campus. Compared to today the system that was installed back then has seen a complete change but even so, there were huge economical savings to be made from the system.

It was decided to install this system to control heating in the existing Agriculture building. This proved successful and made an immediate improvement in environmental conditions in the building. Following this it was decided to install a system in the Arts/Commerce building to control

the switching of lighting and plant to monitor electricity consumption through a check meter. This led to a 10% reduction in electricity consumption in the building resulting in a decision to install BEMS on a campus-wide basis. But with 100,000 square metres of buildings it was clearly seen that it was going to be a long road (BEMSUCD).

As a result of the BEMS the overall energy cost saving is estimated at £350,000 per annum. A significant part of this is the improved electrical load factor which has reduced the average unit cost for electricity by 0.5p per unit. With an annual consumption of 13 million units this reduction alone is worth £65,000 per annum. Clearly then, an investment of £100,000 per annum in BEMS at UCD has paid handsome dividends in terms of cost reductions and improved comfort and efficiency. Source (BEMSUCD).

Another example of BEMS use is in Fingal Swimming Pool which was a good practice case study carried out by Sustainable Energy Ireland (SEI). The BEMS contributes in the following ways within Fingal Swimming Pool –

Monitor external and internal conditions and control heating and ventilation systems to achieve desired internal environment within the building. Thus plant is not running at full load when not required

Control operation of mechanical plant

Control duty standby switching for all pumps, twin fans and boiler plant to maximise plant life

Monitor the building's electricity, gas and water consumption.

This is another example of how monitoring of resources can give good sustainability within industry. SEI rate energy savings within the facility as 'good' with cost savings per year estimated to be €51,000 (SEAI)

2.3.6 Economics of Energy Conservation and Generation Systems

2.3.6.1 Payback Period

‘A common method of evaluating the value of an energy generation or conservation system is to determine the time required for the system to payback the initial costs. The payback period is determined by comparing the total cost of the equipment and installation, to the annual benefit in either value of the net energy produced or the net energy saved per year times the unit cost of energy’ (Kreith F., 2013).

The time and value for this payback period will be the main reason for the installation of an energy system. It will be successfully considered sustainable if the system can pay back the expenses on it in a short space of time, in comparison to what would have been spent with the old system then it would be deemed successful. If the payback time is lengthly depending on the system installed it may be still considered sustainable due to the process involved however the economic rewards may not be seen for a long period of time.

2.3.7 NEEAP Ireland’s National Energy Efficiency Action Plan

‘An Energy Policy for Europe specified a target of saving 20% of the European Union’s energy consumption compared to projections for 2020. This has formed a key ingredient in the EU Energy and Climate Change Package agreed at the European Council in December 2008 (i.e. 20% efficiency improvement, 20% renewable energy penetration and 20% greenhouse-gas emissions reduction by 2020). This target is not currently binding and a method for calculating the national targets has not been finalised by the European Commission (EC). Ireland has reflected this commitment by adopting a national 20% target’. (SEAI, Energy Targets)

The targets stated above are all explained in Ireland's Second National Energy Efficiency Action Plan. Within this action plan the public sector has relevance to this project as the facilities involved within the study both have to meet the targets provided within the public sector section of the this action plan.

2.4 BAT (Best Available Technology)

'Our framework of action involves the identification, promotion and implementation of appropriate best practices for public bodies. We will develop a suite of information resources based on international best practices and on lessons learned from notable local success stories. We will facilitate the transfer of this knowledge to public bodies to empower them to take action'. (NEEAP, p.47)

2.4.1 CHP (Combined Heat and Power)

Combined heat and Power (CHP) is the simultaneous on-site generation of usable heat and electricity. When electricity is generated in a CHP unit, the heat by-product is recovered rather than wasted, and can therefore be used to deliver space heating, to produce hot water, or to produce steam (CES Energy).

'Combined Heat and Power is, at present, the most significant type of generation embedded in distribution systems. CHP, sometimes known as cogeneration, is the simultaneous production of electrical power and useful heat. Generally the electrical power is consumed inside the host premises or plant of the CHP facility, although any surplus or deficit is exchanged with the utility distribution system. The heat generated is either used for industrial processes and/or for space heating inside the host premises or alternatively is transported to the local area for district heating' (Fritzsche, 2005).

CHP is a process that is functioning in 2 of the 3 study areas within this project. UCD Sport and Fitness & Killarney Sport and Leisure both use combined heat and power as a method for electricity generation for their facilities. As described above this method of electricity generation is modern, sustainable and very economical with payback periods being relatively short.

The Sustainable Energy Authority of Ireland SEAI set up a CHP deployment programme which ended in April 2010. This program funded a large proportion of the installation of CHP to 52 establishments before this date.

Figure 2.1

CHP Programme – Capital Investment Grants

Completed Projects at end of April 2010

| # | Applicant | Project | Location | # CHP units | Size (kW _e) | Size (kW _{th}) |
|----|--|--|--------------|-------------|-------------------------|--------------------------|
| 1 | Bunratty Castle Hotel | Bunratty Castle Hotel - CHP unit | Co. Clare | 1 | 70 | 104 |
| 2 | IKB Energy Ltd | Shannon Shamrock Hotel ESCO | Co. Clare | 1 | 150 | 237 |
| 3 | William Savage Construction | Charleville Park Hotel | Co. Cork | 1 | 122 | 196 |
| 4 | Dunnes Stores | Dunnes Stores Cork CHP installation | Co. Cork | 1 | 150 | 231 |
| 5 | Combined Power (South) Ltd | The Maltings | Co. Cork | 2 | 350 | 554 |
| 6 | Leopardstown Park | Leopardstown Park CHP | Co. Dublin | 1 | 100 | 165 |
| 7 | Tesco Nutgrove | Tesco Nutgrove - CHP Unit | Co. Dublin | 1 | 334 | 497 |
| 8 | SuperQuinn | SuperQuinn | Co. Dublin | 1 | 173 | 270 |
| 9 | Low Carbon Solutions Ltd | Monkstown Pool CHP Project | Co. Dublin | 1 | 81 | 121 |
| 10 | Our Lady's Hospital For Sick Children Crumlin | Our Lady's Hospital For Sick Children | Co. Dublin | 1 | 228 | 358 |
| 11 | Blackrock Clinic | Blackrock Clinic CHP | Co. Dublin | 1 | 334 | 497 |
| 12 | F4energy Ltd | Days Hotel | Co. Galway | 1 | 334 | 497 |
| 13 | National University of Ireland, Galway | NUI Galway Arts & Sciences Building | Co. Galway | 1 | 350 | 422 |
| 14 | HSE West | Portiuncula Hospital CHP installation | Co. Galway | 1 | 122 | 200 |
| 15 | National University of Ireland, Galway | NUIG - 150 CHP Unit | Co. Galway | 1 | 150 | 231 |
| 16 | HSE West | Merlin Park Regional Hospital CHP Installation | Co. Galway | 1 | 228 | 358 |
| 17 | National University of Ireland, Galway | NUI Galway Orbsen Building | Co. Galway | 1 | 350 | 422 |
| 18 | Galway Clinic | Galway Clinic CHP | Co. Galway | 1 | 400 | 509 |
| 19 | National University of Ireland, Galway | NUI Galway Sciences Buildings | Co. Galway | 1 | 400 | 500 |
| 20 | Boston Scientific Ireland Ltd | Boston Scientific Galway CHP | Co. Galway | 1 | 999 | 1005 |
| 21 | Killarney Town Council | Killarney Sports & Leisure CHP Project | Co. Kerry | 1 | 103 | 212 |
| 22 | Green Isle Foods Ltd | Green Isle CHP Project | Co. Kildare | 1 | 999 | 1022 |
| 23 | Kilkenny Co-op Livestock Mart | Cillin Hill | Co. Kilkenny | 1 | 90 | 152 |
| 24 | Laois County Council | Portlaoise Leisure Centre | Co. Laois | 1 | 122 | 196 |
| 25 | PJ & Noel Noonan T/A University Business Complex | Noonan Office & Leisure Complex | Co. Limerick | 1 | 334 | 497 |
| 26 | IKB Energy Ltd | Patrick Punks Hotel ESCO | Co. Limerick | 1 | 120 | 201 |
| 27 | Milford Care Centre | Milford Care Centre | Co. Limerick | 1 | 100 | 160 |

Figure 2.2

| # | Applicant | Project | Location | # CHP units | Size (kW _e) | Size (kW _{th}) |
|----|---|---|---------------|-------------|-------------------------|--------------------------|
| 28 | Combined Power (South) Ltd | Castle-Troy Park Hotel | Co. Limerick | 1 | 122 | 196 |
| 29 | Tesco Ireland Ltd | Tesco Drogheda CHP | Co. Louth | 1 | 151 | 237 |
| 30 | Hotel Westport | Hotel Westport CHP Project | Co. Mayo | 1 | 376 | 590 |
| 31 | Triona Keating | Trim Sports and Leisure Centre | Co. Meath | 1 | 122 | 196 |
| 32 | Annyalla Chicks | Annyalla Chicks/Upgrade of Hatchery - 140P CHP Unit | Co. Monaghan | 1 | 140 | 246 |
| 33 | Tullamore Leisure Ltd | Tullamore Leisure Centre | Co. Offaly | 1 | 150 | 231 |
| 34 | Bridge House Hotel Ltd | Bridge House hotel | Co. Offaly | 1 | 150 | 231 |
| 35 | Hotel Minella Ltd | Hotel Minella | Co. Tipperary | 1 | 70 | 104 |
| 36 | Boston Scientific | Boston Scientific Clonmel CHP | Co. Tipperary | 1 | 999 | 1005 |
| 37 | Abbott Vascular Clonmel | Abbott Vascular Clonmel CHP | Co. Tipperary | 1 | 999 | 1005 |
| 38 | Tyco Healthcare Ireland Ltd | Tyco Tullamore CHP | Co. Tullamore | 1 | 255 | 320 |
| 39 | Days Hotel Waterford | Days Hotel Waterford CHP | Co. Waterford | 1 | 122 | 201 |
| 40 | Tesco Ireland Ltd | Tesco Tramore CHP | Co. Waterford | 1 | 100 | 180 |
| 41 | Prefero Ltd | Athlone Town Centre Hotel | Co. Westmeath | 1 | 122 | 196 |
| 42 | Whites Hotel Ltd | Whites Hotel | Co. Wexford | 1 | 280 | 460 |
| 43 | Obalus Hotel Company Limited | Marriott Druids Glen Hotel | Co. Wicklow | 1 | 228 | 358 |
| 44 | Bovale Developments | Charlestown Centre CHP | Dublin 11 | 1 | 228 | 358 |
| 45 | Walls Leisure Ltd | Hilton Dublin Airport CHP | Dublin 17 | 1 | 173 | 270 |
| 46 | Camden Court Hotel | Camden Court Hotel | Dublin 2 | 1 | 220 | 338 |
| 47 | HSE (Health Service Executive) | St. Mary's Hospital | Dublin 20 | 1 | 122 | 196 |
| 48 | Sportsco | Sportsco Refurbishment | Dublin 4 | 1 | 110 | 181 |
| 49 | The Royal Hospital Donnybrook | The Royal Hospital Donnybrook | Dublin 4 | 1 | 70 | 104 |
| 50 | Low Carbon Solutions Ltd | Blackrock College CHP Project | Dublin 4 | 1 | 118 | 181 |
| 51 | Dublin City Council | Rathmines Square - 150 CHP Unit | Dublin 6 | 1 | 150 | 231 |
| 52 | Sportslink- Public Services Telecom Sports Club Ltd | Sportslink- Public Services Telecom Sports Club Ltd | Dublin 9 | 1 | 122 | 196 |

Killarney Sport and Leisure is number 21 on the list. This is an example of a modern facility that uses CHP in order to save on energy costs. In the case of the proposed building, the design team planned to use a micro-turbine CHP unit to cover all base thermal loads during the summer months; this measure was designed to ensure that the CHP unit was being run for the longest time possible. The capital cost of using the CHP unit on this basis was established. Potential annual electrical and thermal energy savings were compared with the energy input required to run the CHP unit. The associated energy cost reductions were also calculated.

The results were as follows:

Additional Capital Cost – €132,327.20

Thermal Energy Input – 2,003,820 kWh

Electrical Energy Saved – 600,600 kWh

Thermal Energy Saved – 728,438 kWh

Total Energy Saved – 674,782 kWh

Annual Energy Cost Savings – €25,237.83

The projected payback period is 5.2 years. (SEAI, Killarney)

2.4.2 Retrofitting

‘To provide something with new parts that were not available when it was originally built’
(Mirriam-Webster).

‘There is an expectation in the market that older non-sustainable commercial buildings will have to be retrofitted at some point in the future to meet the market expectation and compete. Twentieth century buildings are not suitable for the twenty first century’ (Miller and Buys, 2008)

'Reusing an existing building in terms of sustainability is the most effective strategy to reduce carbon emissions within the built environment. Constructing a new building generally uses more energy, more material and generates more pollution and waste than retrofitting an existing building' (UCD, 1998)

'There is an opportunity for the Irish Government to simulate the commercial property market by introducing a sustainable retrofitting package. Whilst reading the literature it is evident that the Irish Government has introduced a number of sustainability programs within the built environment, however, there is little evidence in the office market that the schemes and programmes are having any impact' (Hughes E. 2010)

These extracts on retrofitting have relevance to the DIT Kevin Street study area. Due to its age the building is falling behind with many of the sustainable technologies that in turn are hampering its performance. The Governmental schemes that have been introduced have helped few local authority buildings however numerous public and private sector buildings are continuing to lag behind in terms of sustainability. This may be helped by strict policy being implemented countrywide. This topic will be discussed further later in the study.

2.5 Conclusion

This chapter was a review of all relevant literature involving policies, techniques and technology that can be associated with sustainable Leisure facilities. It covers the technologies needed in order to keep a swimming facility in operation and suggests the best available techniques and technologies on the market and in use in other industries. This section also contained extracts of people's opinions towards some of the subjects discussed.

There were some limitations in retrieving journals and articles on similar topics due to rare amounts of studies with this description performed. All of the sited extracts within this chapter will

have relevance to small aspects of the study and as a whole will contribute greatly towards the study.

All relevant articles, journals, books and websites that were used within this literary review are referenced and contained in the Bibliography section of this thesis.

3. Methodology

3.1 Introduction to Chapter

This section will explain the methods of obtaining data towards the study proposed. It will contain information such as responses from personnel within the facilities that were studied.

As the research question was based around sustainability in Leisure Centre's the first priority was to locate some facilities that were willing to participate in the study. With previous case studies done on similar topics of good sustainability by SEAI there was a general idea of information that was sought. This would include technologies in use and how they are contributing to sustainability. To locate and choose buildings that would be suitable for this study I did desktop research into numerous Leisure Facilities which had certain criteria to do the study. This is quite simple criteria where a swimming pool is the only aspect needed and any other facilities within the Leisure Centre will be considered.

To obtain the information necessary there would need to be contact with relevant personnel within the participant Leisure facilities. These people included plant managers and facility engineers who would be able to obtain the information about the facilities and give the techniques used in order to be more sustainable.

3.2 Facilities Involved

Choosing the facilities was a time consuming and difficult task. This is because levels of facilities that were willing to participate in the study were very low. Numerous facilities were contacted at the start of the study via email and respondents were followed up with phone calls. Here is a list of contacted facilities.

UCD Sport & Fitness (Studied)

DIT Kevin Street, Fit2Go (Studied)

Swan Leisure, Rathmines

University College Limerick Arena (Alan Ward)

UCC, Sports Facility

Guinness Storehouse Pool

Markievicz Leisure Centre

Bluepool Leisure Centre, Monkstown

UCD Sport & Fitness was one of the first facilities in the study as it was newly established in June 2012 which makes it one of the most modern Leisure Facilities in the Dublin area. The facility contains a 50m pool and gym therefore requires the use of substantial amounts of water and energy to maintain in operation. This facility is seen as an important contribution to the study as I could investigate whether a new development meant new technology and good sustainability. On contacting the facility I was put through to the facility engineer who contributed relevant information towards the study over the study period.

In stark contrast to the UCD facility, DIT's facility is one of the older examples in the Dublin area. Built in the 1960's it would be an example of an aged structure which may be unsustainable. This facility contains an 18m pool and gym which is clearly in comparison a lot smaller than the UCD example. Again this was a good facility to investigate, as due to its age the technology within the facility may not cater for good levels of sustainable management of resources. Personnel in DIT put me in contact with the Plant Room Manager of the Fit2Go who gave me the relevant information on technologies used.

The method used for getting facilities involved was not as successful at first. With two almost immediate responses it seemed that there would be plenty of facilities to work with however lack of response from the latter facilities proved to be a common occurrence throughout the study. Few facilities showed interest through the first point of call but as the study topic got to more relevant personnel increasing obstacles occurred. I would like to thank Swan Leisure Rathmines for accepting my request but unfortunately this came too late in the study and there would not have been enough time to gather and quantify results.

3.3 Research Strategy

The research question for this study is focused on sustainability techniques and whether they exist within the studied facilities. Once the techniques are identified the task is then to quantify how much savings are produced from these techniques on resources and economy. This study is important to find whether firmer policy is needed in this industry to help drive sustainability.

There are many different sources of information within these Leisure Facilities that can indicate whether this question is relevant. To get the answers to these questions, visits were mandatory as observing the technologies in use would be the only proof of sustainable implementation.

3.4 Research Methods

3.4.1 Leisure Facility Survey

Both Leisure Centre's involved a 'walk through' took place of the facilities and also a general survey of the plant rooms and the equipment inside was taken. This gave a basic indication on one hand the amount of technology implemented to ensure sustainability and on another to understand through explanation, how these technologies work towards the operations of the building.

Once the ‘walk through’ was completed this is where I gathered information from the personnel on the technologies that are in use with regards to water, energy and chemicals.

| |
|---|
| Water |
| Do you monitor water use? |
| If so, how much water is used per annum? |
| Is there any technology in place to save water? Rainwater Harvesting etc. |
| If so, how much water was saved? |
| |
| Energy |
| Is energy use monitored? |
| What energy is used in the facility? |
| Is CHP used? |
| Do you export electricity that is generated but not used? |
| If so, how much profit is generated? |
| |
| Chemicals |
| What chemicals are used in the pool? |
| How much is used per Litre? |
| Any technology to reduce chemical use? |
| Cost of this technology? |

This is the basic questionnaire that was put forward to Sean Clancy of UCD Sport & Fitness and Joe Healy of DIT Kevin Street Pool & Gym in order to obtain the information required. These questions would ensure broad answers and explanations of the management systems within these

facilities. From the results of this questionnaire I would be able to comment and discuss whether these facilities have sustainability issues with regards to best practice examples given by SEAI.

3.4.2 Online Data

Most of the data retrieved online was through case studies on the different energy Ireland sites. SEAI and CODEMA were both helpful towards retrieving data on previous similar studies. Killarney and Fingal Leisure Centre's both have energy studies done through SEAI through the local area building projects.

There was also some online data based around the two study areas within the project. That is because UCD and DIT are both a part of the e3 initiative and there are many figures with regards to energy within this site. More information was also retrieved on the various technologies that can be implemented to ensure sustainability within buildings.

Existing policies on resource management were consulted in order to see whether there were any existing policies on the topic of sustainability in leisure facilities. The findings of this research will be discussed further in the project and suggestion made for the future.

3.5 Analysis of Documentation

Analyzing the documentation and feedback from the two facilities gave me clear insight into whether stricter policy should be a requirement for leisure facilities. This analysis is discussed later in the project where conclusion and recommendations are made towards the future in the Leisure industry towards resource management.

The results of the fieldwork will also give rates of sustainability with regards to how much water and energy is saved and also technologies in place to replace chemicals. Discussions and recommendations can also be made based on these results and different techniques may be suggested for best practice.

3.5.1 Assessment of Data Quality before Consideration

A quick assessment was carried out of all data gathered throughout the project. A simple run through of the surveys that were given to facility personnel would help achieve all relevant data towards the study in regards to the facilities involved. Regarding the case studies that were used, only the relevant data was taken from these that would correlate with the data gathered in the studied facilities.

3.6 Limitations for Data Gathering

Once the information was sought it was relatively easy to access information or retrieve information from personnel within UCD Sport & Fitness, this however was not the same for DIT Kevin Street Pool & Gym. Gathering relevant information for this facility was a difficult as much of the information is not available. There are many reasons for this and it will be discussed in detail further in the project.

Much of the data for UCD Sport & Fitness exists within a program called active energy which is an online program to which login authentication is needed. Sean Clancy (Facilities Engineer) was able to give any of the information about data provided by the program although this program doesn't categorise all of the aspects that were to be studied. This required further research into the facility.

3.7 Conclusion

This chapter gave an outline of how the relevant data towards the study was gathered. It refers to the study areas involved and also the personnel involved from these facilities. Facilities that were non respondents were also mentioned in this section in order to give a rough idea of different streams approached and whether they were successful or not. It gives an idea of the limitations

towards data gathering and also which techniques seemed to be more successful than others with regards to data retrieval.

4. Fieldwork Results

4.1 Introduction to Chapter

In this chapter all of the information gathered in the field studies will be displayed. This data will be represented by graphs and tables with explanations below. All of the information within this chapter was given by personnel within the Leisure facilities and was seen to have relevance towards the study topic.

4.2 Survey Results

4.2.1 UCD Sport & Fitness – Sean Clancy

The results of this survey were recorded on separate dates- Friday March 21st and Wednesday April 23rd. These survey questions were examined by Sean Clancy (Facilities Engineer) of UCD Sport & Fitness and all relevant questions to the facility were answered orally. These answers were recorded on paper at the time of the survey.

Water

Is water use monitored in this facility? – All water in UCD Sport & Fitness is monitored and can be isolated to certain uses within the building. The mains water that is used throughout the building is monitored separately to water used in the pool, children's pool and tepidarium. The mains water would be used for the changing rooms, cafes, toilets, showers, sinks and drinking water fountains within the facility. There is also a certain amount of water that is evaporated per day as the pool hall is kept at 30 degrees Celsius.

If so, how much water is used per annum – The total water used within the facility in 2013 was 27,646,524 litres. This can be quantified into separate categories. 19,874,100 litres was mains water used. 4,820,752 litres was white water used and finally 2,951,672 litres was mains to pool water used but is included in the mains water figure. Towards the middle of 2013 when the white water system was fully established this ceased the use of mains water for the swimming pool.

Is there any technology in place to save water? – There are numerous technologies that have existed since the opening of the building or have recently been retrofitted in order to save water.

The White water system which was referred to above is a system of water harvesting. There are 3 man-made wells on UCD Campus 1 of which supplies water to UCD Sport & Fitness. These wells have been dug below the water line and gather rainwater and groundwater within the campus area. This water from one of the wells is pumped to the UCD Sport & Fitness plant room where it is treated and used for all of the pools and tepidarium. This technology doesn't save on direct water use but saves on the use of water that is supplied by Dun Laoighaire/Rathdown County Council.

Another technology was retrofitted early in 2013 when figures of water use seemed to be slightly higher than expected. This technology was a water recovery system that was installed to the chemical sampling units. These chemical sampling units sample water constantly to test the PH, chlorine and dissolved solids within the water. Before this water that was sampled was going directly to wastewater as it couldn't be pumped back into the pool. It was found that this was a total of 600litres of water per hour being dumped to waste water. The new water recovery system cost a total of €2,500 to retrofit and had a saving capacity of €33,000 in 2013.

Some technologies existed when the building was opened that contribute to water savings. These include low flow toilets and shower heads. Showers within this facility would contribute to most of the water usage within the facility aside from the pool. Finally a technique was altered slightly from the opening of the facility to now. This is the frequency of backwashing the pool which essentially

is cleaning the pool water by replacing it with new water. This system when it began had 3 backwashes per week and currently the facility only backwashes the pool once per week. As long as the components of PH, chlorine and suspended solids are within their limits it was agreed that no backwash would be required. This again saved thousands of litres of water per week within the facility.

Energy

Is energy use monitored? – Energy is monitored in the facility and can be isolated to gas, heat and electricity use.

Is CHP used in the facility? – There are 2 CHP units used within the facility. These are 400kW units and are normally running only 75% of their capacity as this is the required power needed for the facility. The units run on natural gas and generate electricity. The units are cooled by pool water that is circulated through the system. If this water is too hot to cool the units the system will run the water to pipes external to the building and bring it back to cool the units.

Do you export electricity that is generated but not used? – Most of the CHP electricity generated is used within the facility is used but any remaining electricity is offset to the UCD electricity grid where it can be used further around campus. UCD don't export any electricity as it will be used eventually and there is no financial incentive to export to any electricity companies.

Chemicals

What chemicals are used in the pool? – There are 3 chemicals used in the UCD Sport & Fitness pool, Hydrochloric Acid, Sodium Hypochlorite and Polyaluminium Chloride. All of these chemicals have different uses in the pool and are used as little as possible.

Hydrochloric Acid is used because generally water that is either pumped to the facility or collected in the UCD campus is at a PH level of approximately 8-8.2. This level of PH for pool use needs to

be between 7.2 – 7.6. In order to bring this PH down from the water pumped into the facility hydrochloric acid is used.

Sodium Hyperchloride is the chlorine used in the facility. Chlorine is used to kill all bacteria and viruses that may be present in the water. The amount of chlorine used in the pool is decided by the chemical sampling unit which will indicate when more chlorine is needed and it will use the required amount. The effectiveness of chlorine is also based on the PH of the water it's present in so the hydrochloric acid is a very important chemical to chlorine.

Polyaluminium Chloride is used to break down flocculent that may be present in the pool water. This is an important chemical as all lifeguards must be able to see the most middle part of the pool at its deepest point for safety. This chemical ensures that the water used in the pool is at its clearest level.

Is there any technology present to reduce chemical use? – UV light is used as a technology to reduce chlorine use within the pool. The UV light produced by the bulbs zaps the bacteria and viruses present in the water which has a similar use to that of chlorine in a swimming pool. It was installed in the building process of the facility. The UV lights have maintenance costs of approx. €3,500 per year. This cost is mainly due to changing the UV bulbs throughout the year. This technology means that only about 1/3 of the chlorine normally required in swimming pools is used. This technology is not only sustainable with regards to chemical use but also has a good comfort value for members as this pool has very little chlorine in comparison to others that don't use UV cleansing.

4.2.2 DIT Kevin Street Pool – Joe Healy

The results of this survey were recorded on Thursday February 27th. The survey questions were asked and the relevant questions to the facility were answered orally by Joe Healy (Plant Manager) and results were recorded on paper at the time of the survey.

Water

Is water use monitored in this facility? – Water use isn't monitored for the pool or associated toilets and showers. (Further investigation after the survey found that water is only monitored for the whole Kevin Street building which doesn't specify where the water is being used).

How much water is used per annum? – Water is used as it is needed within the facility. There are numerous backwashes done each week depending on usage of the pool. If there are swimming lessons on this will generally mean more usage which in turn means more backwashes needed per week. (Information provided by Brendan Swords of DIT showed that the use of water within Kevin Street was 8,459,528 m³ for 2013. This equals to 8,459,528 litres of water for the year which would be considered a large amount because of the facility size and capacity).

Is there any technology in place to save water? – There is no specific technology in place to save water. There is no water harvested for the building so all water that is used comes from the mains water provided by Dublin City Council.

Energy

Is Energy use monitored? – Energy use is monitored at Kevin Street and can be isolated into 3 categories. It is monitored again throughout the whole building so won't be very specific to the pool. The three different categories are electricity, Kevin Street main natural gas and Swimming Pool natural gas.

Is CHP used? – There are no CHP unit's onsite all energy is provided from natural gas and the electrical grid.

Chemicals

What chemicals are used in the pool? – Chlorine is that only chemical used in the Kevin Street pool. It is used to kill all bacteria and viruses that may be present in the water.

How much of this chemical is used? – This chemical is used as it is needed. There is a monitor that uses pool water to see how much chlorine is needed in the pool. If chlorine is needed the specific dosage will be deposited into the pump leading to the pool. Approximately one bucket of chlorine is used per week which weighs 20kg. (There may be a high use of chlorine in the pool due to the PH level as more chlorine may be needed at a higher PH).

Are there any technologies to reduce chemical use? – The only cleaning technology present is the basic sand filtration system which is usually contained in every swimming pool facility and filters all large sediment and suspended solids.

4.3 Quantitative Results

4.3.1 UCD Sport & Fitness Water

Figure 4.1

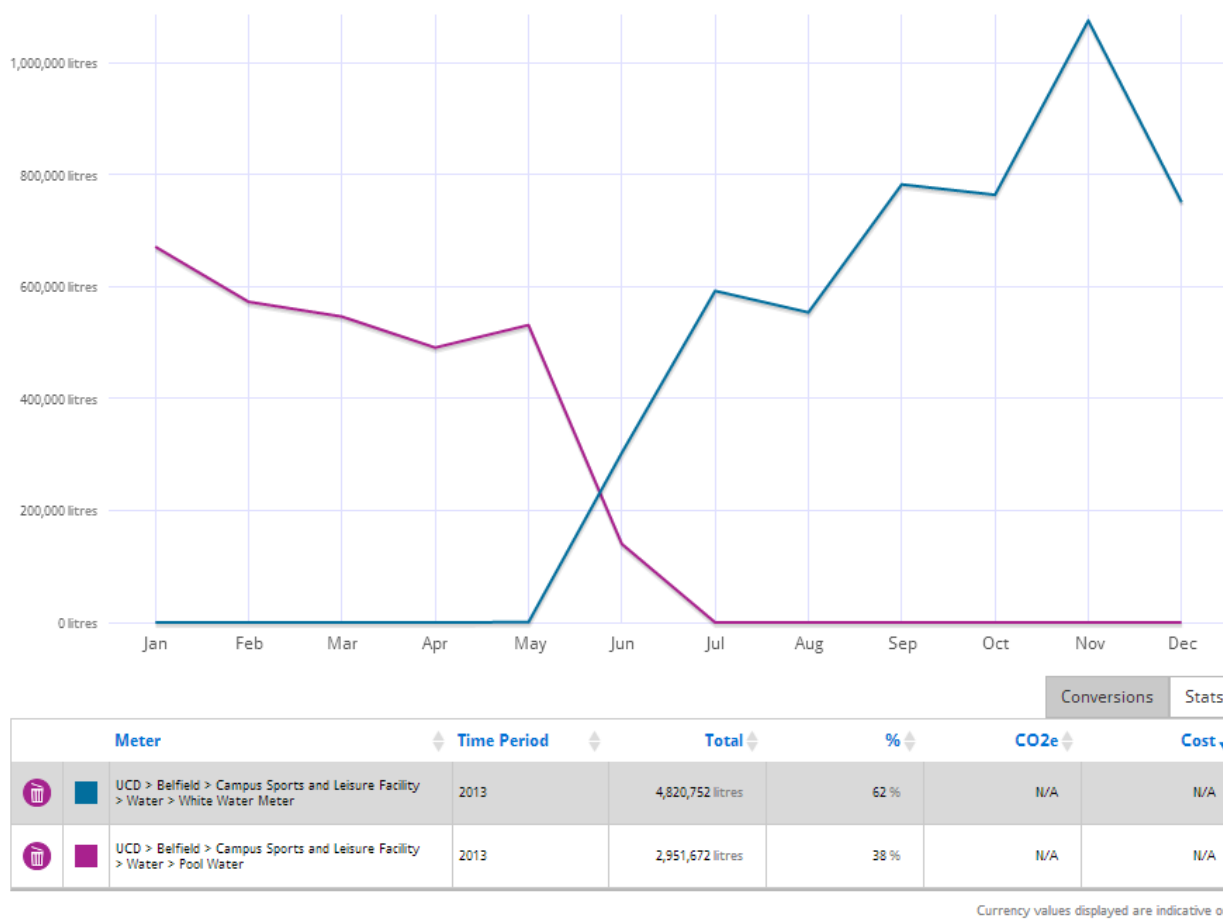
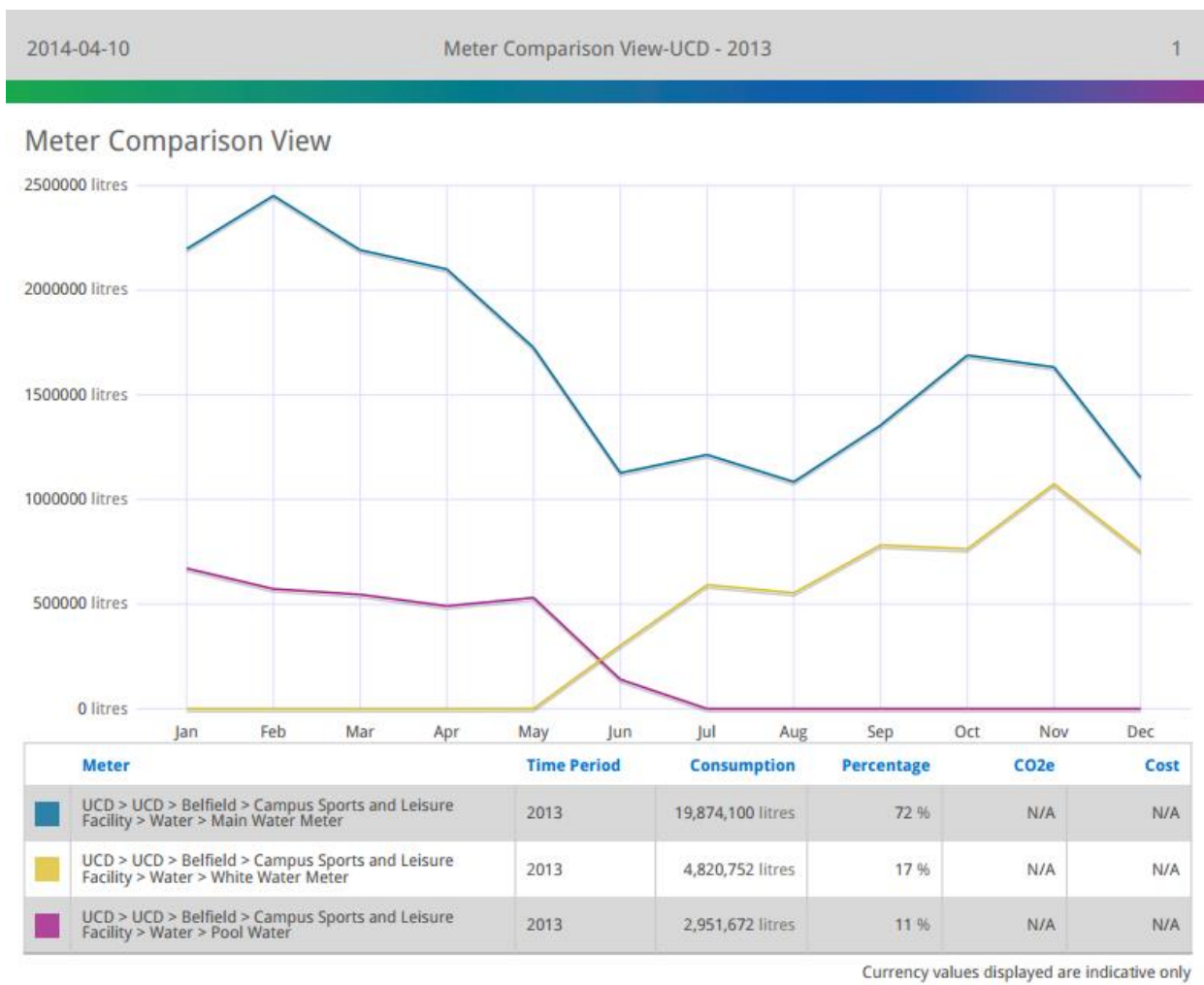


Figure 4.1(Active Energy) represents the amount of pool water used in the facility in 2013. This is an important piece of information towards the study because as was stated earlier in the thesis, there is no regulation or policy on how much water is used within a Leisure facility which could result in a very unsustainable practice.

The purple line represents pool water that was taken from the mains water supply. This is water that would have had a cost made payable to Dun Laoghaire/Rathdown County Council. The Blue line represents White water used by the facility. White water supplies water to many of the buildings on campus free of the commercial water levy.

As UCD Sport & Fitness is a very new building it took a few months to be able to implement the White water system. As shown clearly in the graph the White water system began operation in the facility in May 2013 and this significantly affected the water use within overall. The reason White water levels on the blue line are higher than the purple line is because White water became to supplement water to all parts of the building and not just the pool. It supplemented the numerous toilet facilities, showers, sinks, fountains and restaurants within the facility. Below is a graph that includes the mains water used for the rest of the building, the pool water generated from the mains supply and the White water that has been pumped from the well on campus.

Figure 4.2



As you can see by Figure 4.2(Active Energy) when the White water system wasn't in service the mains water peaked at almost 2.5 million litres of water used in February. Since the White water system was put into operation the peak level of mains water was approximately 1.7 million litres of water that came at a commercial cost. This is an approximate saving of 0.8 million litres of water that doesn't have to be pumped from the Dun Laoighaire/Rathdown water supply. This is an extremely sustainable technique for the use of water resources within Leisure facilities. The total use of water for the facility in 2013 was 24,694,852 litres. This is a large quantity of water but for the requirements of this facility this is a very sustainable figure.

4.3.2 UCD Sport & Fitness Electricity

Figure 4.3

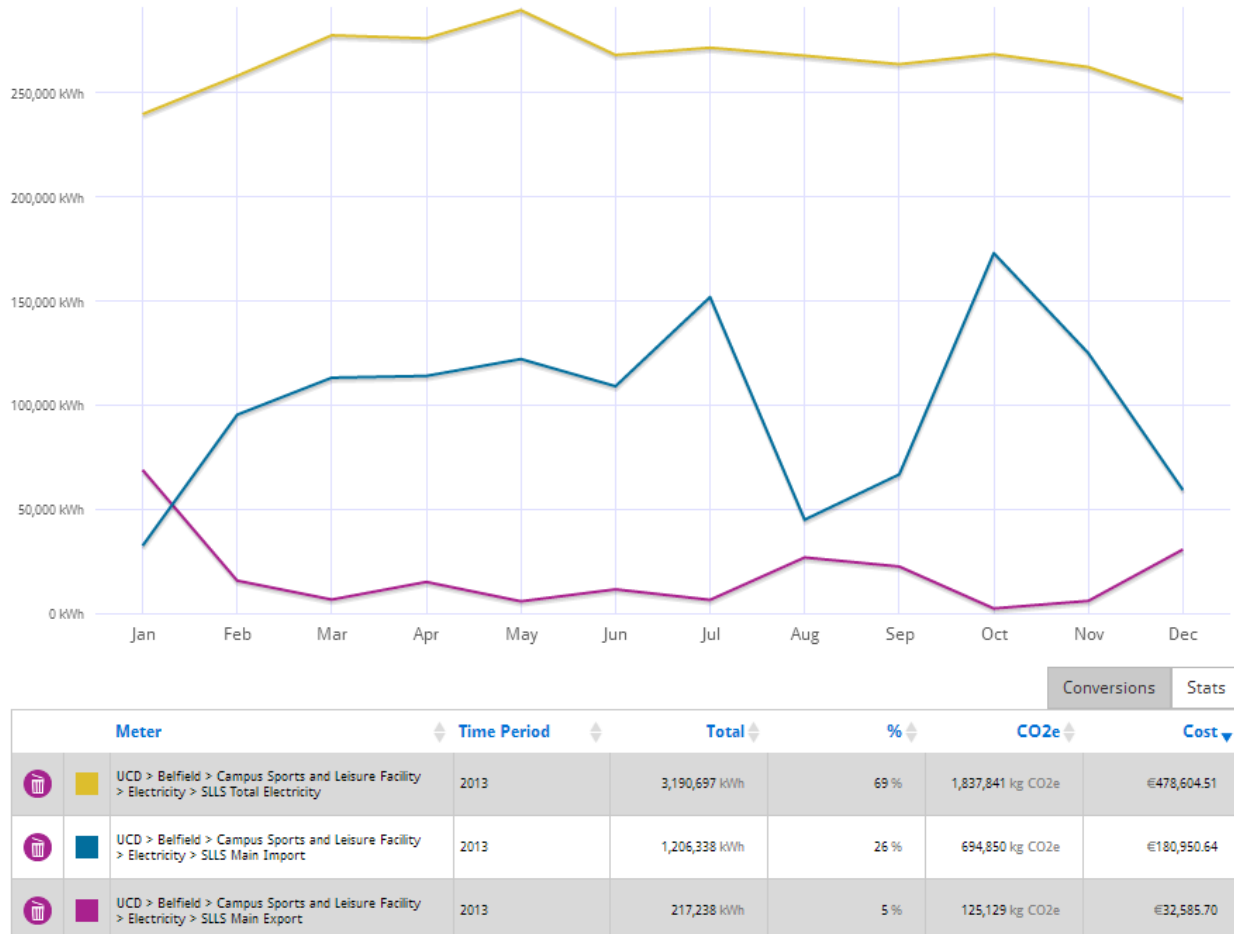


Figure 4.3(Active Energy) is a graph that represents total mains electricity used within the UCD Sport & Fitness Facility. This graph also contains stats on electricity which is imported from the UCD electricity grid and also stats on unused electricity exported to the UCD electricity grid.

As it is a large facility there is a large quantity of electricity in use to keep it operational. The majority of this energy is supplied by the UCD grid. However, UCD Sport & Fitness has 2 CHP units which generate electricity that are used to generate power for the building however there is also a large quantity is exported to the UCD grid. The statistics for these CHP units are presented below in Figures 4.4 and 4.5.

Figure 4.4

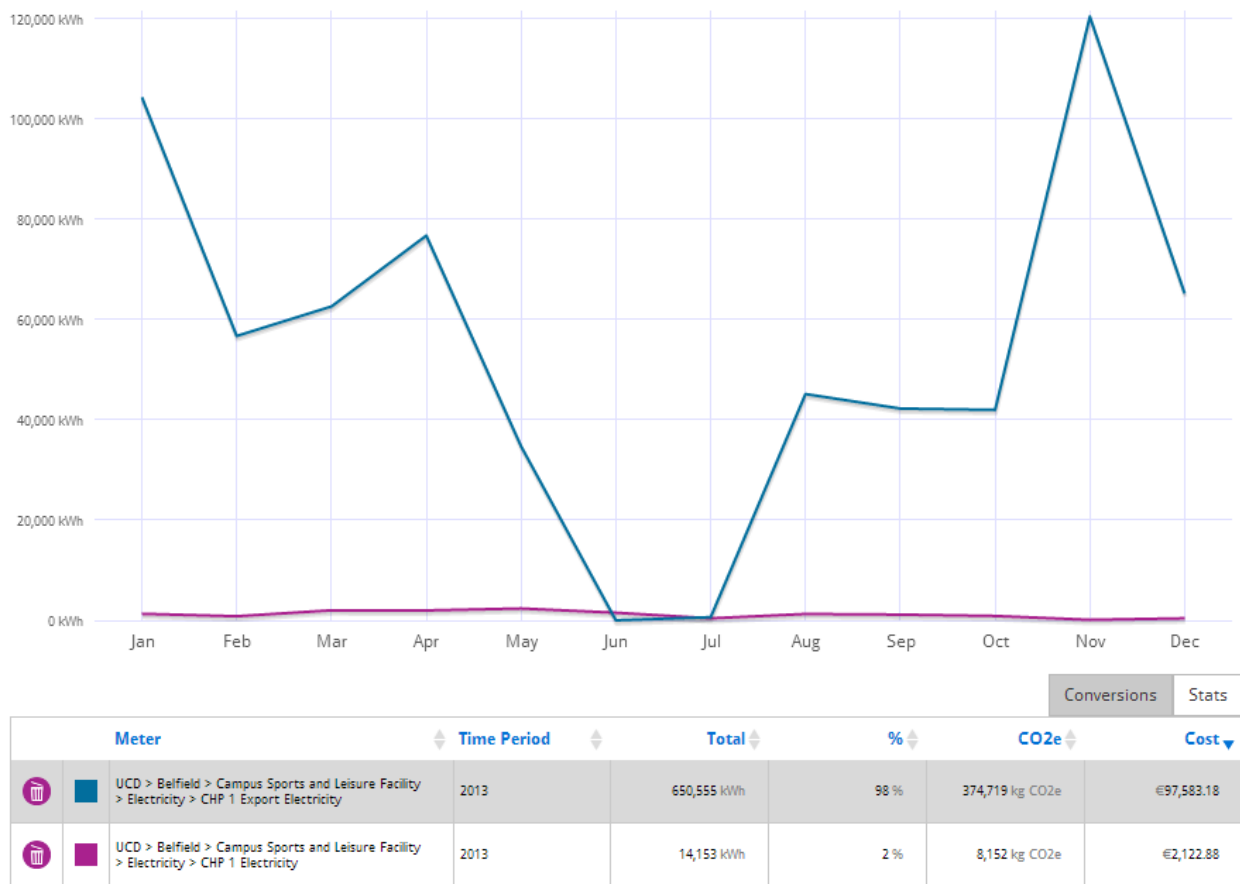


Figure 4.4(Active Energy) represents CHP unit 1 which mainly electricity used throughout the building. A small amount of electricity is exported to the UCD grid but only about 2%. A total of €97,583.18 worth of electricity is generated by this CHP unit and used within the building whilst €2,122.88 worth of electricity is given to the UCD grid and used in other buildings.

Figure 4.5

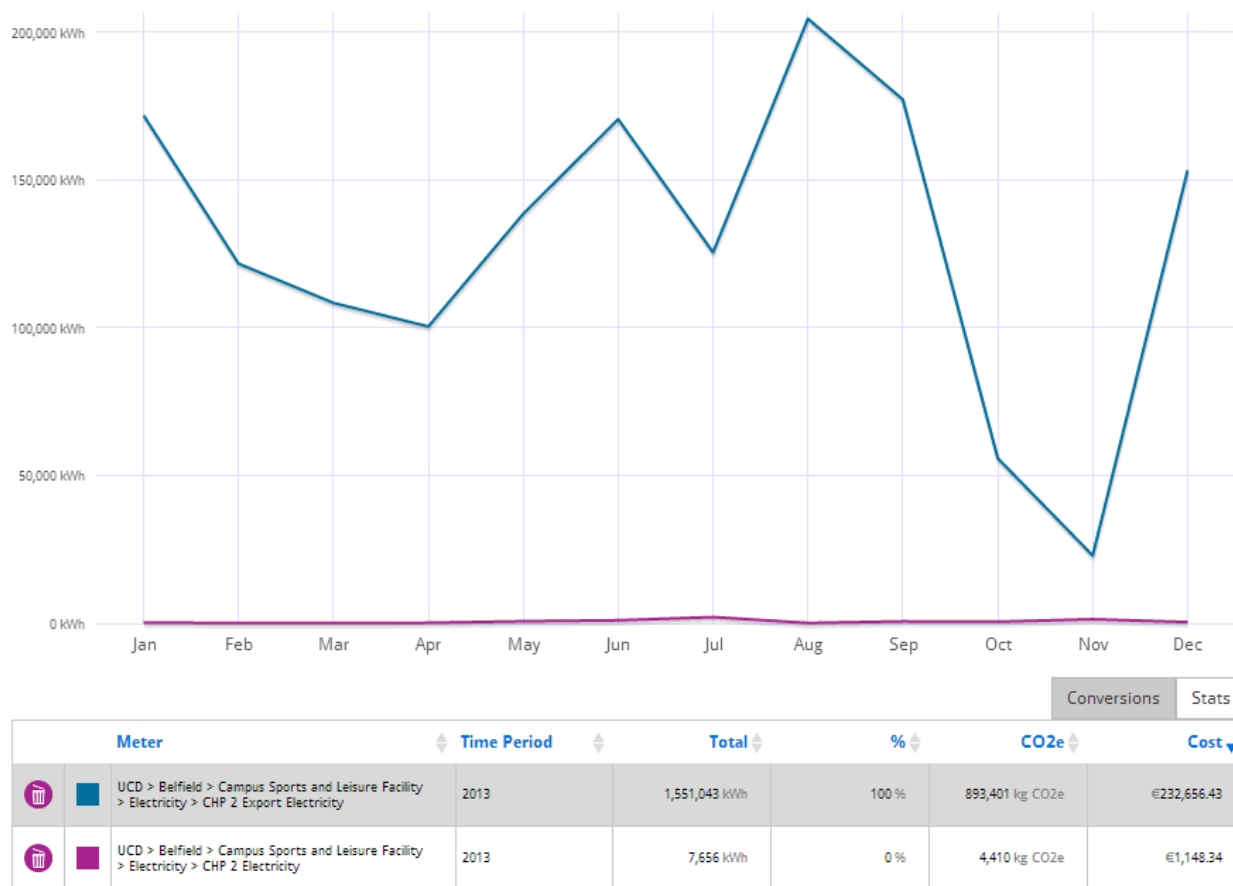


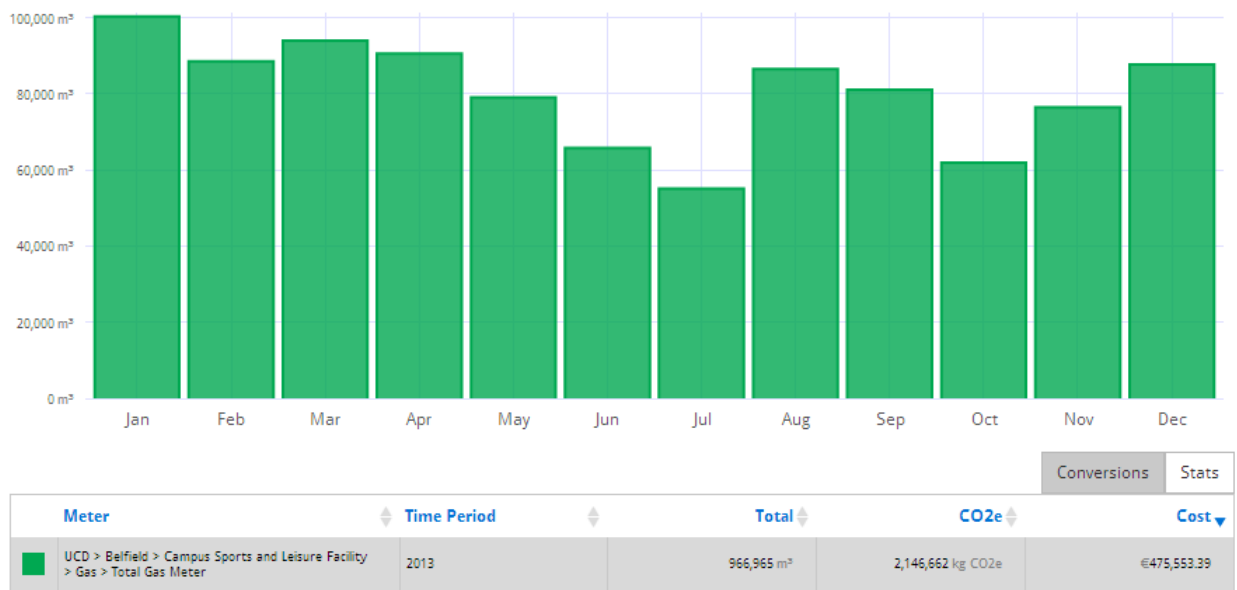
Figure 4.5(Active Energy) represents CHP unit number 2. Again as can be seen in the graph this unit actually contributes most of its energy generated to the facility in terms of electricity but contributes a small quantity of electricity to the UCD grid. This unit generated €232,656.43 worth of electricity to UCD Sport & Fitness in 2013 which is over 1.5kWh over the space of one year. The two units' combined generated a total of €330,239.61 worth of electricity towards the UCD Sport & Fitness. This is a total of 2,201,598 kWh.

The results from these CHP units show that installation would prove to be very sustainable within Leisure facilities. Payback periods would vary depending on the facilities use of energy from the unit and whether a connection to a grid is possible. These two units at UCD Sport & Fitness produced these numbers although only running at 75% capacity and still export a small amount of electricity to the campus grid. This could prove very effective to other Leisure industries that have associated buildings where unused energy that is generated could be used to save money.

4.3.3 UCD Sport & Fitness Gas

Finally below in figure 4.6 is the gas reading for UCD Sport & Fitness for 2013. This gas is used mainly to heat the large pool hall and gym areas. The pool hall is 3 stories high of open space so to maintain this at approximately 30 degrees Celsius requires a large quantity of heat to be generated. Yet again there is a slight trend between busy months and gas consumption but it's not a drastic as electricity or water because whether there are people in the pool hall and gym or not they still have to be kept at this temperature. Unfortunately this data couldn't be quantified to strictly the pool area usage.

Figure 4.6



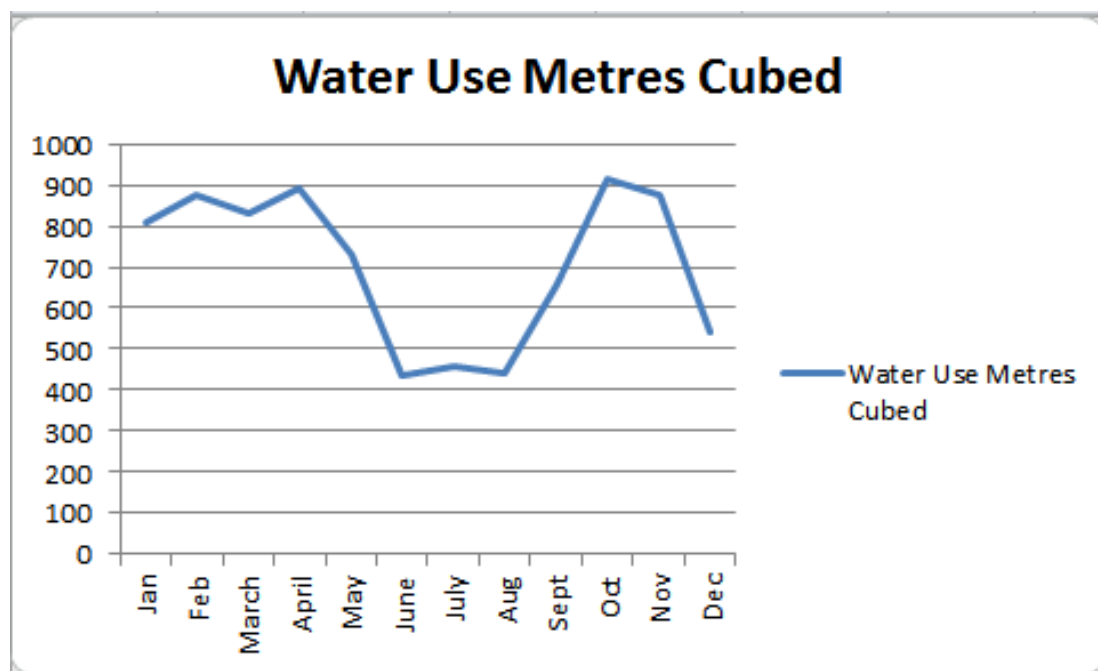
Currency values displayed are indicative only

4.3.4 DIT Kevin Street Water

There were no conclusive results for this section in regards to the Kevin Street Pool but there were figures of general water usage throughout the Kevin Street building. It was explained by the plant manager within this facility that water is not monitored for the pool. Usage of water for the pool would be dependent on the daily requirements depending on usage by facility members but this figure was not available. Water is pumped into the pool in this facility when needed, however the amount of water that is used is an unknown figure. The only figure that might indicate water usage within the facility would be the buildings use but it would be a rough estimation to quantify pool usage.

There is no water harvesting system at DIT Kevin Street so all water used within the facility comes straight from the Dublin City Council mains supply. This might have been an issue when supply was restricted in November 2013 as there was no other supply of water available to the facility.

Figure 4.7



As it can clearly be seen from Figure 4.7 there is a direct correlation between water uses when college is in term and out of term. This is similar to the UCD Sport & Fitness figures with this trend but water use figures are drastically different. The total water use throughout 2013 equals 8,459.528 metres cubed. This is equal to 8,459,528 litres which seems to be an unnecessary amount of water use to the buildings requirements. Below in figure 4.8 are the exact results of water use per month.

Figure 4.8

| | Water Use Metres Cubed |
|-------|------------------------|
| Jan | 806.124 |
| Feb | 875.688 |
| March | 830.676 |
| April | 889.328 |
| May | 731.104 |
| June | 435.116 |
| July | 459.668 |
| Aug | 441.936 |
| Sept | 658.812 |
| Oct | 915.244 |
| Nov | 875.688 |
| Dec | 540.144 |

Comparing DIT Kevin Street to UCD Sport & Fitness is where the major flaws are found. UCD Sport & Fitness uses approximately 24.6 million litres of water per year and Kevin Street uses approximately 8.5 million litres of water per year. These flaws will be discussed in the Discussion section of this study.

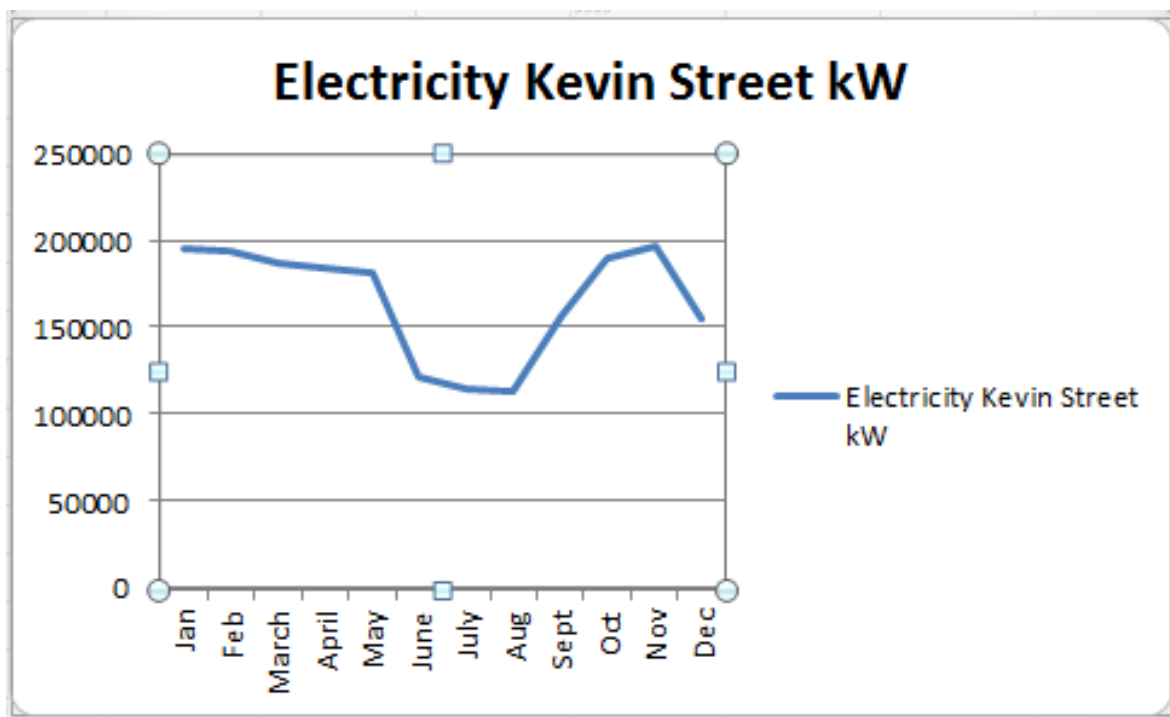
4.3.5 DIT Kevin Street Energy

There were more successful results in the energy department when it came to records of use. There were records present of how much energy was used but unfortunately this figure was not as conclusive as the figures present in UCD Sport & Fitness. The figures for energy used represented the whole DIT Kevin Street building which, includes lecture theatres, class rooms, common areas

etc. Another downside to the results that exist is that they are dated to 2010/2011/2012 when the e3 initiative was prominent. This initiative required results to be presented on a daily basis so the areas of energy savings could be focused.

The sustainability website run by DIT will give figures of the past week for electricity and oil usage but trying to find results from the past year proved to be a tougher task but was finally provided by Brendan Swords who monitors daily figures throughout the DIT buildings. Ideally the results would only be representing the pool facility and 2013 so a comparison of usage could be achieved but this wasn't so. These results and the results of water usage however have significance towards this study as this is an example of a Leisure facility which does not monitor where resources are being used. This could potentially have a huge effect on the sustainability of the facility. Examples of figures for 2013 are displayed below.

Figure 4.9



Like the figures for Kevin Street water usage Figure 4.9 shows that electricity use drops significantly outside of the college term. Although there is a drop in electricity use during these out of term periods overall use is quite high. Below are the figures of use per month in 2013.

Figure 4.10

| | Electricity Kevin Street kW |
|-------|-----------------------------|
| Jan | 194937.9 |
| Feb | 193975 |
| March | 187398.7 |
| April | 183903.4 |
| May | 180732.5 |
| June | 121605.8 |
| July | 114836.7 |
| Aug | 112879.7 |
| Sept | 156524.2 |
| Oct | 190255.7 |
| Nov | 195966.1 |
| Dec | 155257.9 |

Figure 4.10 shows electricity use per month in 2013. The overall use of electricity for the year was 1988274 kW.

4.3.6 DIT Kevin Street Gas

Finally the last section of resource use in DIT Kevin Street is natural gas. This figure is the one figure that is quantified for only the pool as there is a separate monitor. This will give an indication of how much gas is used in order to keep the pool and pool hall at the right temperature to provide a comfortable service.

Figure 4.11

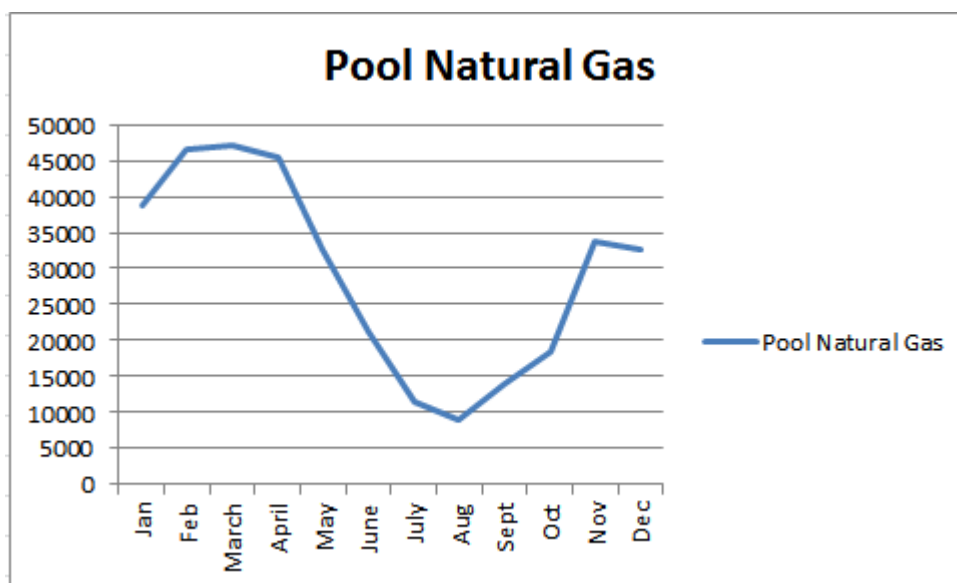


Figure 4.12

| | Pool Natural Gas |
|-------|------------------|
| Jan | 38729.46 |
| Feb | 46506.46 |
| March | 47128.62 |
| April | 45328.8 |
| May | 32730.06 |
| June | 21197.88 |
| July | 11554.4 |
| Aug | 9043.54 |
| Sept | 13976.38 |
| Oct | 18464.82 |
| Nov | 33885.5 |
| Dec | 32530.08 |

As it can be seen from figures 4.11 and 4.12 like electricity in Kevin Street there is a correlation between figures during the college terms. This is somewhat of a surprise as because usually the gas figures shouldn't have this much of a change because pool temperatures are usually to be kept the same as well as pool hall temperatures. This figure for natural gas is presented in kW which has been converted using a gas metre factor of 11.4 from metres cubed to kW. The total for the year was 351,076 kW.

4.4 Building Comparison

This section will give a brief overview on the description of each building with regards to size and space. On general observation these two buildings have very different designs which will explain some of the figures with regards to energy use. The UCD Sport & Fitness building is approximately 12,000 metres squared whilst the Kevin Street building and pool combined equal 17,230 metres squared. Although these building numerically are different in size they are quite similar in overall space taken. This is because UCD Sport & Fitness comprises of a large pool hall that contains a 50 x 25m pool. This hall is also 3 stories high and might explain a large amount of energy use to keep this hall at 30 degrees Celsius. In comparison the Kevin Street building and pool have quite small rooms in comparison with a much smaller pool hall.

UCD Sport & Fitness also contains 5 cafes, 1 public house/bar, numerous meeting rooms and seminar rooms, debating chamber, cinema, drama theatre and a hall for events that can hold up to 500 people.

Kevin Street is divided into 5 buildings which mostly contain lecture theatres and meeting rooms. These buildings also contain delis where water would be in use. The FOCAS building that is a part of this group of 5 is quite large in size but should only have basic water requirements for a building of its size.

4.5 Plant Room Comparison

In each of the facilities there is a contrast between both of the plant rooms which contain the technologies involved in the operations of the facilities. The plant room in UCD Sport & Fitness spans over 3 floors with different technologies in each one performing different tasks. All of the rooms combined would have an approximate ground floor space of 80m². This is in contrast to the DIT Kevin Street plant room which is a room with ground space of about 10m². This room contains only technology that is relevant to the pool whereas UCD S&F plant room contains the

CHP energy units, boilers and air handling units as well as water filter system pumps and all of the other pool technology.

4.6 Conclusion

This chapter gives an indication of the quantities of resource use throughout two facilities examined within the study through the figures provided. It also provides information on these facilities from personnel within the facilities through a survey presented. The results in this section are strictly from personnel of both the facilities of UCD Sport & Fitness and DIT Kevin Street.

5. Discussion

5.1 Introduction to Chapter

This chapter will discuss the results found through the surveys with facilities personnel and also figures that were obtained regarding the facilities throughout the study. It will include a personal opinion on sustainable resource management and whether I feel it is being implemented within these facilities.

5.2 Survey Observation

The survey questions that were given to the Leisure Centre personnel did reveal some resource management issues. These issues are relative to what would be seen as best practice within this industry. Of course most of these issues are in the more dated facility which is understandable.

In regards to UCD Sport & Fitness, Sean Clancy (facilities engineer) spoke strongly and subjectively when providing information about the topic of resource management. In all aspects of the survey he gave an example of where the facility could improve on its management of resources and also where the facility had already targeted problem areas and made adjustments in order to make the facility more sustainable. Examples of these adjustments came in the establishment of white water to the facility to lower the use of mains water from the local council supply and the water recovery system that retrofitted to the facility in order to reuse water that would otherwise be going to waste water from the chemical sampling units. Other sustainable systems were also mentioned in the previous section.

Similarly UCD Sport & Fitness, Joe Healy (plant room manager) from DIT Kevin Street Pool provided as much information as he could with regards to the swimming pool and the management aspects of it. Although there was not as much information provided as the other facility it

nevertheless gave a good insight into the general viewpoint on sustainable resource management. As Mr. Healy was only the plant room manager he was not aware of any future plans for the facility however he provided useful information on current technology within the plant room. The technology present in the facility seems to be quite dated and this will in turn cause the technology to be unsustainable towards resource management.

5.3 Quantitative Data Observation

The quantitative data that was provided by both facilities appeared to back up the response to the surveys that were given to the facilities personnel. In this section both electricity usage and water usage can be compared somewhat but a comparison in gas usage would be tough to quantify as the UCD Sport & Fitness gas usage rates regard the whole facility as the DIT Kevin Street rates regard just the pool gas usage.

The data provided for water use for both facilities were compared for the whole facility, as DIT Kevin Street did not have results for pool use alone. As the data collected was for the whole facility, this meant that in each case the figure would be significantly higher because of toilet, shower, sink usage etc. Sean Clancy pointed out in the survey that shower use in UCD Sport & Fitness would actually contribute most of the water usage in the building as there are approximately 50-60 shower facilities within the building. In comparison, DIT Kevin Street does not have as many shower facilities; in fact there are only approximately 10-20 showers in the whole facility. This is significant due to the size of the buildings, pool, shower facilities and number of cafes provided, there should be a much larger number for litres of water used in the facilities comparison.

The actual figure for water use in UCD Sport & Fitness is 24,694,852 litres while DIT Kevin Street's use is 8,459,528 litres. Both of these figures are consumption for 2013. When considering the water requirements for both facilities and the fact that the water capacity of the UCD Sport & Fitness pool would be over 10 times the capacity of the DIT Kevin Street pool due to length, width

and depth my personal opinion is that UCD Sport & Fitness is extremely sustainable with water use and DIT Kevin Street could do a lot better with the water management of their facilities.

Electricity usage on the other hand is where DIT Kevin Street is more sustainable in comparison to their water usage. The total usage for UCD Sport & Fitness in 2013 for electricity was 3,190,697 kW whilst DIT Kevin Street used 1,988,274 kW for 2013. Generally electricity use should be an easier area to improve facilities sustainability because equipment can be directly replaceable for newer more sustainable equipment, whereas to improve water use sustainability it requires retrofitting very expensive equipment and maintenance which can also come at a high cost. With regards to these results for electricity use I believe that sustainable measures have taken place in both facilities to ensure that usage is lowered. There can always be improvements made but these results are promising.

Data for gas usage unfortunately cannot be compared between the two facilities but with regards to pool usage for gas there are requirements for water to be a certain temperature. This will require a large consumption of gas throughout the year especially in a large facility such as UCD Sport & Fitness. This facility also would use a large quantity of gas to heat the pool hall. This is not a requirement but is seen to maintain high customer satisfaction which is worth more to the facility in terms of economic importance.

5.4 Survey and Data Limitations

There were numerous limitations throughout the project in different areas but with regards to data retrieval and surveying there were only a small number of obstacles once the facilities agreed to participate in the study.

UCD Sport & Fitness provided conclusive data for the facility but there was such a large quantity of data on every aspect that it was hard to choose what data would be most relevant to the study topic. Every piece of technology within the facility had a monitoring capacity and these sections of data were made available which at the beginning of the project seemed daunting. Once I was advised by Sean Clancy where to look for the relevant information it became easier to gather the results that were needed to complete the study.

Most of the limitations within this study came with DIT Kevin Street. Data retrieval was a long and difficult process as it seemed that little was known about information on resources used within the facility. At the time I got the impression that data was not recorded on resource use for the facility because Joe Healy (plant manager) was not aware of any DIT personnel that took this information. Eventually I was referred back to the buildings manager for the DIT campus however again this person proved difficult to contact due to the job description rarely was this person in the office. Further investigation proved decisive as eventually I found that DIT resource management was run by an external company. Once I got in contact with this company Brendan Swords was very helpful and provided as much information and data that he could. Although a large amount of this data was very general to DIT Kevin Street and not the Leisure Facility a comparison could still be made due to the similarity in facility size.

Although contact was made with Brendan Swords, this was in the final few weeks of the project so it was not possible to organise a survey with him however a survey was partly completed by Joe Healy. Individually the survey and data would not have provided the information needed for the study but together all relevant information was gathered as well as insight into the management at this facility.

5.5 Conclusion

This chapter provided a personal opinion on the results gathered for this study. These opinions are my own and other opinions may be generated from the results section of this thesis.

6. Conclusions and Recommendations

6.1 Introduction to Chapter

This chapter will conclude the thesis by giving recommendations about the topic that are felt to be relevant. These recommendations will be towards possible policy adjustments, monitoring, resource management within the facilities involved and also different ways the study could have been approached.

6.2 Policy

Current relevant policies in my opinion are not having a strong enough effect on use of resource in the Leisure facilities sector. The reason for this opinion is due to the study performed. Current water policy is a major issue in my opinion that should be addressed. There is a large amount of targets and confinements in regards to energy usage that originate from the Kyoto Protocol which will concern public sector leisure facilities but water policy in Ireland only seems to strive on reducing pollution and very limited confines on reducing usage. Commercial water charges in my opinion are very cheap and for this reason Leisure facilities that have an income from members can easily afford them.

In 2014 Dun Laoighaire/Rathdown County Council charge €1.04 per metre cubed pumped into a facility and €1.24 per metre cubed pumped out. This is a total cost of €2.28 for 1000 litres of water to be processed through a facility. The cost is different depending on the local authority and in Dublin City where DIT Kevin Street is situated this is the case. In 2013 in this authority it costs €1.99 to pump 1000 litres of water into a commercial facility. I could not retrieve the cost to export it from the facility to wastewater but it is usually more expensive. (DCCOCO, DLRCOCO). These costs are actually quite high when Ireland's climate is considered and there is a large amount of rainfall but these costs are also contributing to the unsustainable use of water within these

industries. I believe that these costs should be increased in conjunction with the domestic water charges so that people in Ireland can be aware of the importance of water management in the future.

The European Commission has not yet finalised national targets for energy use but Ireland have committed to a 20% reduction by 2020. This reduction will help the push for sustainability in Ireland but I question whether this is plausible. During my survey with Sean Clancy of UCD Sport & Fitness he mentioned that UCD as a public body would have to reduce energy rates and water rates. There has been no consideration for the recently developed buildings on campus that includes UCD Sport & Fitness. Sean mentioned that the targets set for the college would be impossible unless these new buildings are considered because they produce large amounts of resource use and the figure to be achieved has to be lower than the figure set before these buildings were developed.

I would recommend a reevaluation of some of the relevant policies that Ireland use in order to make energy saving targets more plausible and water use more sustainable.

6.3 Monitoring

Monitoring in both of the facilities within this study was very different. UCD Sport & Fitness had a monitoring system that took each technology into account and each resource. There was data for energy and water use for every technology in the facility. This meant that any overuse of a resource by any technology could be identified and corrected which is the most sustainable way to run a facility.

DIT Kevin Street has a monitoring system that takes the use of the whole building into account for all resources. This is an unsustainable way of monitoring a facility because unlike UCD Sport & Fitness, DIT Kevin Street can't identify any technologies or areas within the facility that might be using more resources than required. This could potentially mean that leaks may go missed which could cost an industry heavily economically and in achieving goals or targets.

I would recommend that DIT Kevin Street establish a monitoring system similar to UCD Sport & Fitness so that all resources used can be quantified properly and a decision can be made whether the resources are being used as sustainable as possible which I wouldn't suspect is happening.

6.4 Management

There were contrasting management approaches at both facilities within this study. These management approaches in my opinion reflect on the sustainability of each facility. In UCD Sport & Fitness internal personnel are in charge of operations at the facility. The same personnel keep all of the data with regards to these operations so that they can monitor the performance and make adjustments or changes if needed.

DIT Kevin Street has a management system that is separated. There is one internal office that manages the operations of the facility whilst another external organisation keeps the data which is directly related to how the facility is operated. I am unsure of the relationship of these parties and whether they liaise between one another but during the survey with Joe Healy (Plant Manager) this did not seem apparent.

I would recommend that the same company or organisation manages a facility and keeps its own records. This is important as there should not be a breakdown in communication this way. It would be extremely positive for a facility when its personnel can see data and change management techniques with regards to how the current techniques are performing. This type of management would ensure a sustainable future for an industry.

6.5 Study Approach

There is potential for further study in this field as there were only two examples of Leisure facilities in this project. Albeit numerous other facilities were contacted and little response was achieved as this may be a sensitive area to some of these industries. At the beginning of the year this project

seemed to have a reasonable workload. As the projected progressed data gathering became tougher as facilities failed to respond to requests for the study.

Some facilities responded but these responses came too late in the study and could not be pursued. If the study was to be performed again of course a different approach would be taken in order to secure these facilities earlier. Possible site visits may have secured more facilities for the study.

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Appendices

A. Facilities Survey

Water

Is water use monitored within this facility?

What is the consumption of water for the facility per annum?

Are there any technologies/techniques present in the facility that help save water usage?

How much water was saved per annum from this technology or technique?

Energy

Is energy use monitored within the facility?

What types of energy are monitored within the facility?

Are there any Combined Heat and Power units in the facility?

If so, is energy that isn't used exported for further use?

Is any economy generated from exporting unused energy?

Chemicals

What chemicals are used in the pool at this facility?

What purpose does this chemical have?

Do any technologies exist within the facility to reduce the use of chemicals in the pool?

What is the cost of this technology to be installed and maintained?