INTERREG IVB Atlantic Area Programme

CLIMATLANTIC Project

Pilot Action – Assessment and demonstration of measures to reduce electricity consumption by Local Authorities

Report prepared by Carlow Kilkenny Energy Agency to South-East Regional Authority

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Executive Summary

Carlow County Council, with the support of Carlow Kilkenny Energy Agency, has made a commitment to reducing their energy consumption by 3% per annum from 2009 to 2020. The Climatlantic project contributed to approximately a 1.5% reduction in energy consumption through its activities in 2012. Very importantly, though, these initiatives will continue to deliver savings throughout their life cycle.

As part of the Climatlantic project the reporting, monitoring and verification of new and existing initiatives was a key part of the project objectives. Energy savings were achieved in a number of initiatives. In other initiatives, the monitoring has led to a number of key recommendations being made to Carlow County Council.

Based on preliminary assessments, the expected energy saving results was calculated prior to commencing monitoring. As shown in the table on the following page, these were compared with actual energy savings from results obtained during the monitoring period.

As part of the initiatives, energy efficiency training was also provided to caretakers of water treatment and wastewater treatment plants. This will ensure that energy monitoring and verification will continue into the future. It is hoped that these initiatives will provide best practice to local authorities across Ireland and the EU in terms of achieving reductions in public sector energy consumption.

The Carlow Kilkenny Energy Agency would like to thank its partners, Carlow County Council and the South East Regional Authority, for their inputs both organisationally and financially in delivering this excellent demonstration project that may be circulated and disseminated as best practice across the local authority bodies nationally and internationally. It acts as a demonstration project to verify that actions do deliver savings, but more importantly through monitoring the savings are measured and verified for projects.

Initiative Name	Location	Expected Annual Energy Savings	Actual Annual Energy Savings & Comments	Estimated Annual Cost Savings
Server Room Cooling – Virtual Server with New Air-Conditioning Unit	Carlow County Hall	50%	New air-conditioning unit was undersized	Further monitoring required
Efficient Lighting Retrofit (T8 to T5 Fluorescent Tubes)	Carlow County Hall	31%	48% or 10,000kWhs	€1,800 for 420 individual fluorescent tubes
Pano Zero Client Computers	Carlow County Hall	96%	95% or 10,875kWhs	€9,772 for 300 units
Wastewater Treatment / Aeration Comparisons	Old Leighlin / Fenagh / Rathoe	40%	86% difference between best and worst practice	Not calculated
Automatic Pumping Control - Installation of MultiSmart Pump Station Manager (MPSM)	Abbeywells Pumping Station	15%	MPSM not functioning properly	Further monitoring required
Pump Replacement & Controls	Royal Oak Water Treatment Plant	60%	43% or 29,476kWhs	€4,730 (2 x 7.5kW replaced 2 x 18kW pumps)
Dehumidification in Water Treatment Plants – Dehumidifiers vs Storage Heaters	Rathvilly Water Treatment Plant	60%	39% or 72,275kWhs	€5,490
Water Pumping – Speed Control in a Reservoir System using Variable Speed Drives (VSDs)	Bagenalstown Water Treatment Plant	16%	VSDs did not reduce energy consumption	Further monitoring required
Water Pumping – Night Time Pressure Reduction	Oak Park Water Treatment Plant	15%	8% or 15,768kWhs	€1,260 Reduced MIC: savings of €3,500

Key Recommendations

Server Room Cooling @ Carlow County Hall

- Use the new inverter air-con unit as a backup for the larger air-con unit until additional servers have been replaced.
- Once new servers have been replaced, investigate if the 6kW air-con unit is sufficient to meet peak demand.
- Reduce the solar gains in the room by installing black out blinds on both external windows.
- Reduce solar gains by reducing the amount of lighting in the room from 4 lamps to 2 lamps.

Efficient Lighting Retrofit @ Carlow County Hall

- Implement a replacement strategy in Carlow County Council buildings where all T12 / T8 fluorescent tubes are replaced with their energy efficient equivalent – T5.
- Implement a replacement strategy for all lighting in council buildings.
- Review lighting with intermittent usage and investigate the installation of motion / daylight sensors where possible.
- Complete staff awareness campaign on training to switch off.
- Consider installing automatic control to switch out lighting outside office hours using simple time clocks inserted in circuit panel.

Pano Zero Client Computers @ Carlow County Hall

- Replace any desktops over 6 years old with Pano Logic Zero Client.
- Replace faulty desktops with Pano Logic Zero Client.
- Roll out this type of technology in any organisation using a central server. The ideal application is large organisations such as third level colleges, office blocks and Local Authorities.

Wastewater Treatment / Aeration Comparisons @ Old Leighlin WTTP / Fenagh WWTP & Rathoe WTTP

- Advise caretakers to assess and monitor daily energy (kWh) and flow (m^3) data usage at each plant.
- Calculate KPIs (kWh/m^3) for all wastewater treatment plants in Carlow County Council.
- Compare KPIs between WWTP.
- Investigate the energy efficiency of plants with higher than average KPIs.

Automatic Pumping Control - Installation of MultiSmart Pump Station Manager @ Abbeywells Pumping Station

- Construct an inlet screen before the inlet to Abbeywells to segregate the larger volumes of debris coming into the pump station. The MultiSmart can then carry out a well clear at set times of the day or week.
- Investigate pumping at night time electricity rate.
- When data / results / energy savings have been quantified consider the installation of a MSPSM programmable controller at other pumping stations in County Carlow.

Pump Replacement & Controls @ Royal Oak Wastewater Treatment Plant

- Identify pumps, which were installed to meet a greater demand and investigate the potential for replacement.
- Carry out similar pump efficiency tests on large pumps operating in water treatment or pumping sites operated by Carlow County Council.
- Identify pumps operating at reduced efficiency and investigate the potential for replacement.
- Fit the old variable speed drives to another water treatment plant or pumping station in County Carlow.

Dehumidification in Water Treatment Plants – Dehumidifiers vs Storage Heaters @ Rathvilly Water Treatment Plant

- Carry out feasibility studies into the installation of dehumidifiers in some other water and waste treatment facilities in County Carlow.

Water Pumping – Speed Control in a Reservoir System using Variable Speed Drives @ Bagenalstown Water Treatment Plant

- Carry out an assessment of the condition of the pipe lining supplying the reservoir in order to assess the actual friction losses in the pipe.
- Replace pumps with higher efficiency pumps operating with the new VSDs.
- Carry out a detailed feasibility study on the use of VSDs in booster pumping and / or water supplying a reservoir as a method of both reducing energy and leakage through pressure reduction.

Water Pumping – Night Time Pressure Reduction @ Oak Park Water Treatment Plant

- Investigate the potential for night time pressure reduction in all suitable sites operated by Carlow County Council with the potential for pressure reduction.
- Assess all maximum import capacity on bills to ensure sites are not exceeding their limit.
- The local authority should stipulate that it is the responsibility of the developer, residential or commercial, to install booster pump on their sites for new developments at grant of planning stage. This would facilitate the further reduction of pressures across the system in problem areas where historically pressure drops led to complaints through water services department.
- Investigate transferring the old 12kW pumps from the Royal Oak Upgrade to Oak Park Water Treatment Plant.

1. Introduction

The aim of the Climaltantic project was to develop strategies at regional and local level towards the reduction of the carbon footprint in the European Atlantic Area. The strategies were related to four basic pillars: mobility, energy, management territory and social behaviour. To achieve these strategies the project developed the following actions:

1. Constitution of four think tanks with experts from all partners;
2. Validation of the strategies through a set of joint transnational pilot initiatives;
3. Promotion of an Atlantic debate with regional and local authorities;
4. Final congress and joint approval of a Strategic Atlantic Agenda for Sustainable Urban Development for the reduction of carbon footprint aiming at increasing cohesion, competitiveness and sustainable development;
5. Dissemination of the Agenda to National Authorities in the Atlantic Area and the European Commission.

The Climatlantic project partnership comprised nine partners from five countries in the Atlantic Area:

- PORTUGAL: The lead partner of the project, Eixo Atlântico, north region in Portugal, and the Agência Portuguesa do Ambiente (APA), Lisbon.
- SPAIN: There were three Spanish partners from the Galician region, North-West of Spain: Dirección Xeral de Desenvolvimento Sostenible (Xunta de Galicia), Deputación de Ourense and Eixo Atlántico España.
- FRANCE: COMAGA in Angoulême and the Municipality of Quimper (in Bretagne).
- UK: Merseytravel, North West region of England, UK.
- IRELAND: South-East Regional Authority

1.1. Climatlantic Project Aim & Objectives

The South-East Regional Authority was the lead partner on the energy pillar of the Climaltantic project. The aim of the energy pilot initiatives was to identify and demonstrate best class energy efficiency measures in each of a Local Authority's main internal electricity consuming activities, namely water supply (4 initiatives), wastewater (2 initiatives) and buildings (3 initiatives).

This aim was achieved by meeting the following vertical and horizontal objectives:

Vertical

1. Identify and demonstrate energy efficient alternatives to accepted equipment types to achieve the same or better end results;
2. Identify and demonstrate high efficiency vs. current technologies;
3. Identify and demonstrate best practice control systems;
4. Demonstrate appropriate equipment sizing/selection.

Horizontal

5. Install energy monitoring systems to evaluate the effectiveness of the efficiency measures;
6. Develop standard procurement documents and technical specifications;
7. Improve the awareness and knowledge of site caretakers and building managers.

1.2. The Energy Efficiency Pilot Initiatives

The South-East Regional Authority partnered with Carlow County Council (one of its constituent Local Authorities) to identify and demonstrate best class energy efficiency measures for local authorities.

Carlow County Council currently consumes approximately 8 million kWh/yr of electricity with a total electricity bill of €1.25m/yr. The main energy consuming activities of the local authority are water supply & treatment, wastewater treatment, building usage and public lighting, broken down as follows;

- Water supply 42% (pumping, facility dehumidification & treatment);
- Waste water 36% (treatment/aeration and pumping);
- Offices and other buildings 10% (lighting and information technology including air-conditioning);
- Public Lighting 10%;
- Landfill 2%.

Carlow County Council identified a number of demonstration initiatives for implementation.

Initiative	**Location**	**Type**	**Description**
Server Room Cooling	Carlow County Hall	Monitoring	Virtual Server system and an inverter controlled air conditioning unit
Efficient Lighting Retrofit	Carlow County Hall	Monitoring	Replacement of T8 with T5 lamps
Zero Client Computers	Carlow County Hall	Equipment & Monitoring	Ten desktop computers with Pano Logic VDI systems
Wastewater Treatment / Aeration Comparisons	Old Leighlin / Fenagh / Rathoe	Monitoring	Surface Aeration Venturi / Rotating Drum / Diffuse Aeration
Automatic pumping control	Abbeywells pumping station	Equipment & Monitoring	MultiSmart Pump Station Manager

Pump Replacement & Controls	Royal Oak Water Treatment Plant	Equipment & Monitoring	Replace pumps and install controls
Dehumidification in Water Treatment Plants	Rathvilly Water Treatment Plant	Equipment & Monitoring	Dehumidifier / storage heaters
Water Pumping	Bagenalstown Water Treatment Plant	Equipment & Monitoring	Speed Control in a Reservoir System using Variable Speed Drives to identify most efficient flow rate
Water Pumping – Night Time Pressure Reduction	Oak Park Water Treatment Plant	Monitoring	Monitor the variations in energy consumption against flows and pressures
Caretaker training	Carlow	Training	Energy efficiency training in water & wastewater treatment sites

2. Monitoring & Verification

Each site was monitored using the equipment purchased through the Climatlantic Project in order to track the energy usage and to verify the energy savings.

The SINERGY E-Tracker energy monitor was used to monitor energy consumption of the single and three phase sites. The e-tracker has capacity to monitor both single phase and three phase supplies. For single phase, one current transformer clamp is used. For three phases, three current transformer clamps are used.

The Enistic software and hardware was used to monitor power consumption of electrical appliances. Appliances were plugged into a 5-way smart socket, which sends a signal to the Smart Energy Controller that is directly linked to the laptop. The software on the laptop allows the user to see instantaneous energy consumption of any item being monitored. The software then stores this information and allows the user to generate a report.

Lascar Easy Log data loggers were used to measure temperature / humidity / flow / pressure / pulse output. The loggers were connected to a laptop by inserting them into the USB slot and set up with the Easy Log software to monitor the above. The software made it easy to create graphs and/or export the data to excel spreadsheets.

As part of the pilot initiatives, caretakers operating water and wastewater treatment plants were given training in operational energy efficiency. Training took place in Carlow Town on 19th September 2012. A total of 16 caretakers were trained.

When energy saving initiatives are implemented in any organisation in the public or private sector, the importance of monitoring and verifying of the savings cannot be under estimated.

3. Initiatives Monitoring Descriptions

There were 9 initiatives identified by Carlow County Council to be included on the Climatlantic project. Each one had a monitoring element with 5 of the projects requiring capital expenditure to achieve energy savings. Each site was monitored using the equipment purchased through the Climatlantic project in order to track the energy usage and to verify the energy savings.

3.1. Server Room Cooling

Location

Carlow County Hall Buildings

Description

Carlow County Hall accommodates 200 employees and has a serviced floor area of 2,442m². The building has an electrical energy consumption of approx. 300 MWh/yr.

In early 2011, a Virtual Server system and an inverter controlled air-conditioning unit were installed in the main server room of the building. The virtual system reduced the number of physical servers from 30 to 4. As a result, there was a reduction in the air-conditioning load based on a lesser number of servers and the higher temperature tolerance of the new servers.

Project Aim

The aim of this initiative was to monitor the energy use of the new air-con unit in comparison with the known energy use of the previous system, which is still in place as an emergency back-up.

Old / New Air-Con System

The existing air-con system unit is a four-way cassette with a power rating of 13kW and operating constantly for 24 hours per day with no back up (Figure 1 – Old 13kW fan coil air-conditioning unit).

Figure 1 – Old 13kW fan coil air-conditioning unit

An inverter controlled 6kW air-con system was installed to replace the old system. It is wall mounted and located in front of the existing servers (Figure 2 – New 6kW air-conditioning unit).

Figure 2 – New 6kW air-conditioning unit

Monitoring Methodology

The SINERGY E-tracker was used to monitor the energy consumption of the new air conditioning unit for 10 days on a one-minute interval (Figure 3 – E-tracker monitoring the air conditioning load). This information was stored on the e-tracker and downloaded onto a USB memory stick.

Figure 3 – E-tracker monitoring the air conditioning load

Temperature and humidity sensors were installed to monitor the internal and external temperatures in the room (Figure 4 – Temperature / humidity sensors).

Figure 4 – Temperature / humidity sensors

Results

Air-con unit

Energy usage loads were recorded for the new air-con unit (Table 1 – New air-conditioning energy usage).

The coefficient of performance (COP) dictates the actual amount of cooling obtained. For example, the COP of the new unit is 3.21, therefore the actual cooling on Monday is 0.69 * 3.21 = 2.2kW of cooling.

Table 1 – New air-conditioning energy usage

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Average recorded daily kW usage	0.69	0.71	0.73	0.75	0.73	0.58	0.67
Actual kW usage	2.2	2.28	2.34	2.4	2.34	1.86	2.15

When monitoring was carried out it was noted that the air-con unit was not working at full capacity. This was due to the older unit carrying out the work of the new unit. On further investigation, it was also found that the room had a total cooling load of approximately 7kW in comparison to the new installed capacity of 6kW. Therefore, the new system was undersized.

Temperature, humidity and dew point

The temperature, humidity and dew point were monitored in the server room after the new system was installed. The monitoring period was from 11th October 2011 to 2nd November 2011 (Figure 5 – Internal Temperature/Humidity Sensor). During this period, the temperature in the room rose significantly due to a failure of the new air-con unit. This triggered an alarm but failed to bring in the second unit. When this was investigated it was established that there was no link between the new unit and the old unit. The installers were contacted straight away and a link was made between the two units in order to make sure if one is not operating effectively then the other would start up and cool the room.

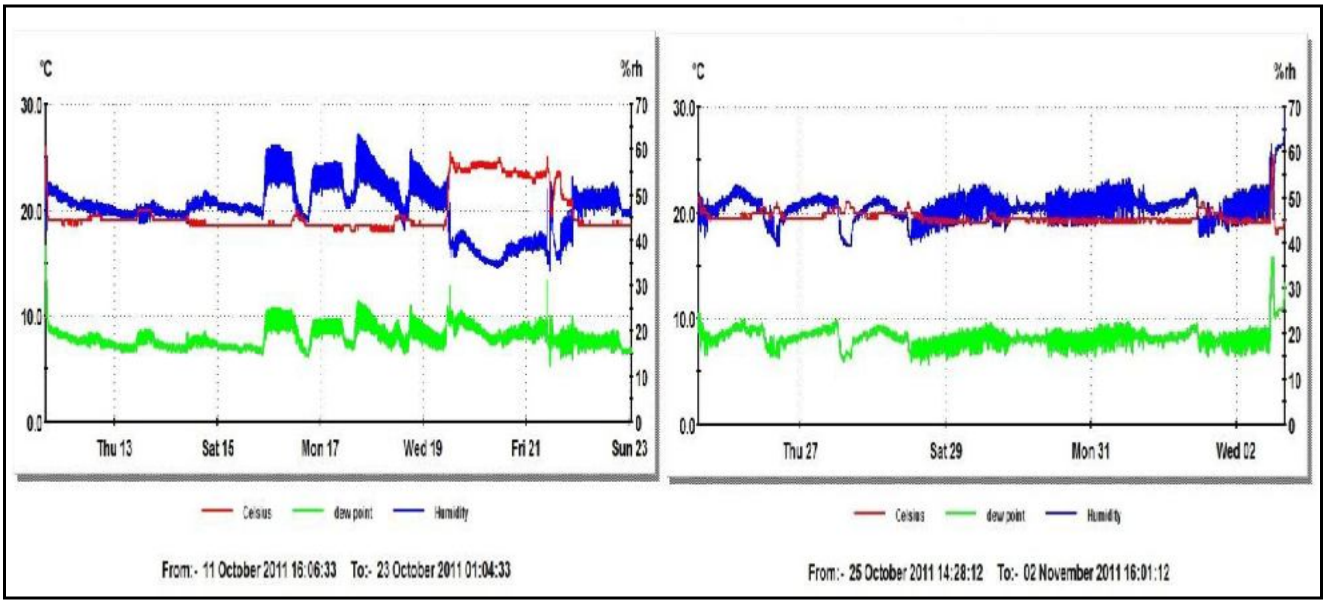

Figure 5 – Internal Temperature/Humidity Sensor

External Temperature

The external temperature was also monitored over the same period (Figure 6 – External Temperature/Humidity Sensor). The purpose of this was to see if there was any correlation between the rise in internal temperature of the server room and external conditions.

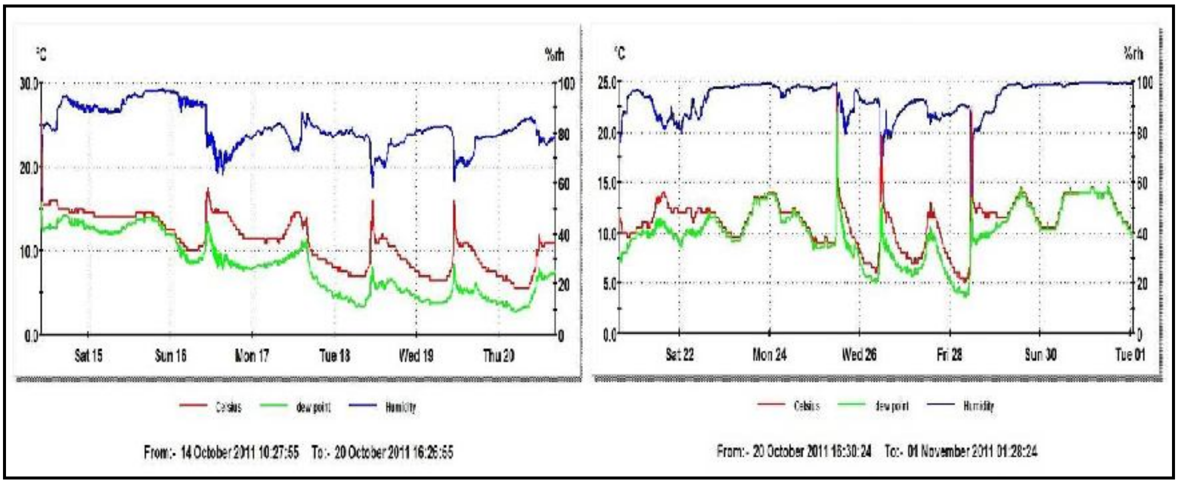

Figure 6 – External Temperature/Humidity Sensor

There was no obvious significant correlation between internal and external temperature.

Conclusion

The peak-cooling load of the server room was estimated to be around 7kW. The 6kW air-con unit was therefore undersized to meet the peak cooling demand of room.

Currently, the IT Section in Carlow County Council is waiting for additional servers to be replaced. This should reduce the cooling load so the 6kW unit may be sufficient to meet the peak demand. A revised load may be calculated on completion of further server reduction. The original option of using the new air-con unit as the lead and the old air-con unit as the back-up will be re-assessed based on the new loads in the server room.

Recommendations

- Use the new inverter air-con unit as a backup for the larger air-con unit until additional servers have been replaced.
- Once new servers have been replaced, investigate if the 6kW air-con unit is sufficient to meet peak demand.
- Reduce the solar gains in the room by installing black out blinds on both external windows.
- Reduce solar gains by reducing the amount of lighting in the room from 4 lamps to 2 lamps.

3.2. Efficient Lighting Retrofit

Location

Carlow County Hall Buildings

Description

Carlow County Hall building currently has 198 luminaries holding 420 individual fluorescent tubes (FT) with a total electrical capacity of 17kW. These luminaries operate for approximately 2,000h/year and consume approx. 34,000kWh/yr. These luminaries were recently upgraded from T8 FTs to the more energy efficient T5 FTs.

Project aim

The aim of this initiative was to monitor the energy savings made by replacing T8 with T5 fluorescent tubes (FT).

T12 vs T8 vs T5 lamp

T12 FTs were commonly replaced with the more energy efficient T8 FTs. Now T8s are replaced with the higher efficiency T5. The T5 lamp is 16mm in diameter and has a rated capacity of 28W in comparison to the T8 lamp which is 25mm in diameter and has an energy consumption of 58W. T5s can be retrofitted onto the T8 fitting with an electronic adapter conversion kit.

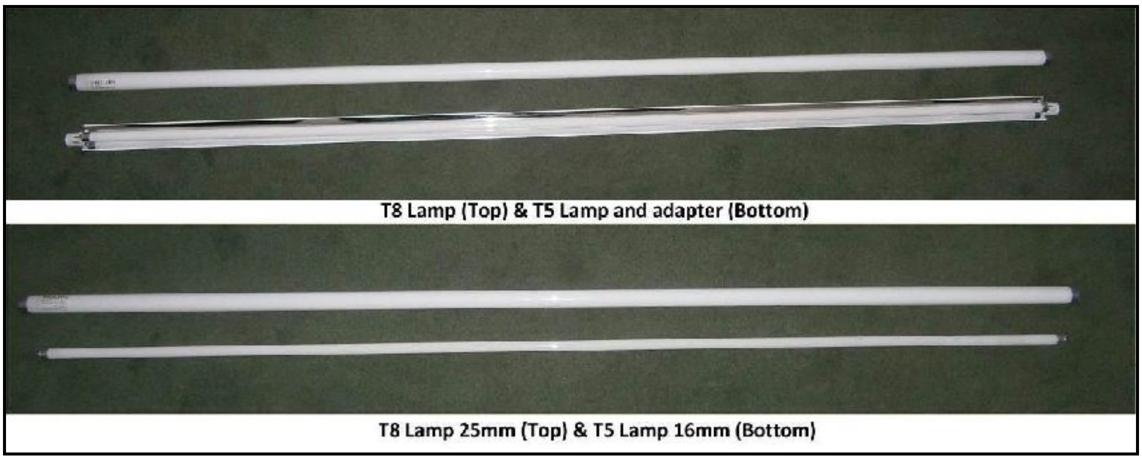

Figure 7 – T8 versus T5 comparison

To change from T8s to T5s the starter is taken out of the original fitting and replaced with an adapter and a new 16mm T5 lamp (Figure 8 – Luminaire with T5 adapters and lamps).

Figure 8 – Luminaire with T5 adapters and lamps

Monitoring Methodology

The Enistic hardware and software (Figure 9 – Enistic Energy Monitoring Equipment) was used to monitor the lighting electrical consumption before and after the replacement. Lighting monitoring was carried out in an individual Community & Enterprise office of Carlow County Council.

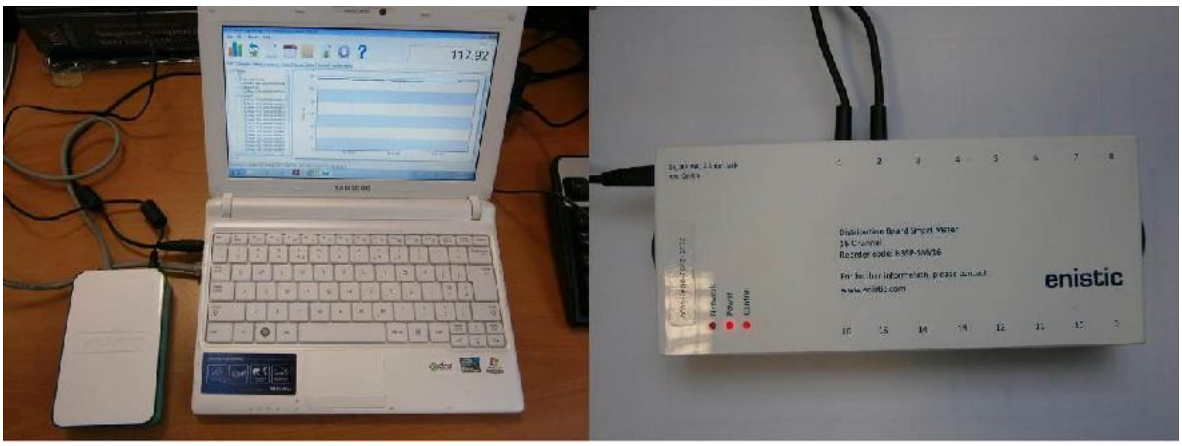

Figure 9 – Enistic Energy Monitoring Equipment

Miniature current transformer clamps were placed on the live feed for the lighting circuit for the individual office (Figure 10 – Lighting Distribution Board with Enistic CT clamps). The 16-channel logger sent a signal from the circuit board to the router, which was connected directly to the laptop giving an instant reading. This information was recorded to the laptop.

Figure 10 – Lighting Distribution Board with Enistic CT clamps

Energy Savings

Changing from T8s to T5s reduces the wattage in a standard 5ft fitting from 58W to 28W per lamp with a higher Lux Level output. Electricity consumption for T8 FTs was approximately 130 watts per hour between 9am and 5pm in a cellular office in Carlow County Hall (Figure 11 – Cellular Office with T8 FTs).

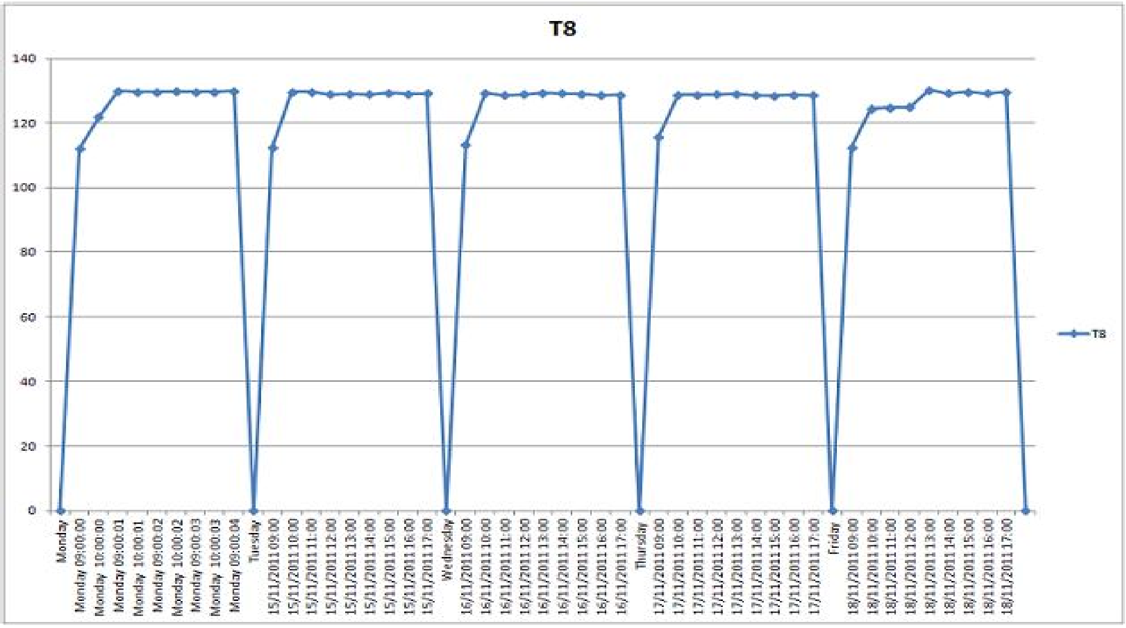

Figure 11 – Cellular Office with T8 FTs

Electricity consumption was approximately 63 watts per hour between 9am and 5pm in a cellular office in Carlow County Hall with the T5 fittings. As part of the lighting retrofit an emphasis was put on turning off lights during low occupancy times especially around lunch time (Figure 12 – Cellular Office with T5 fittings).

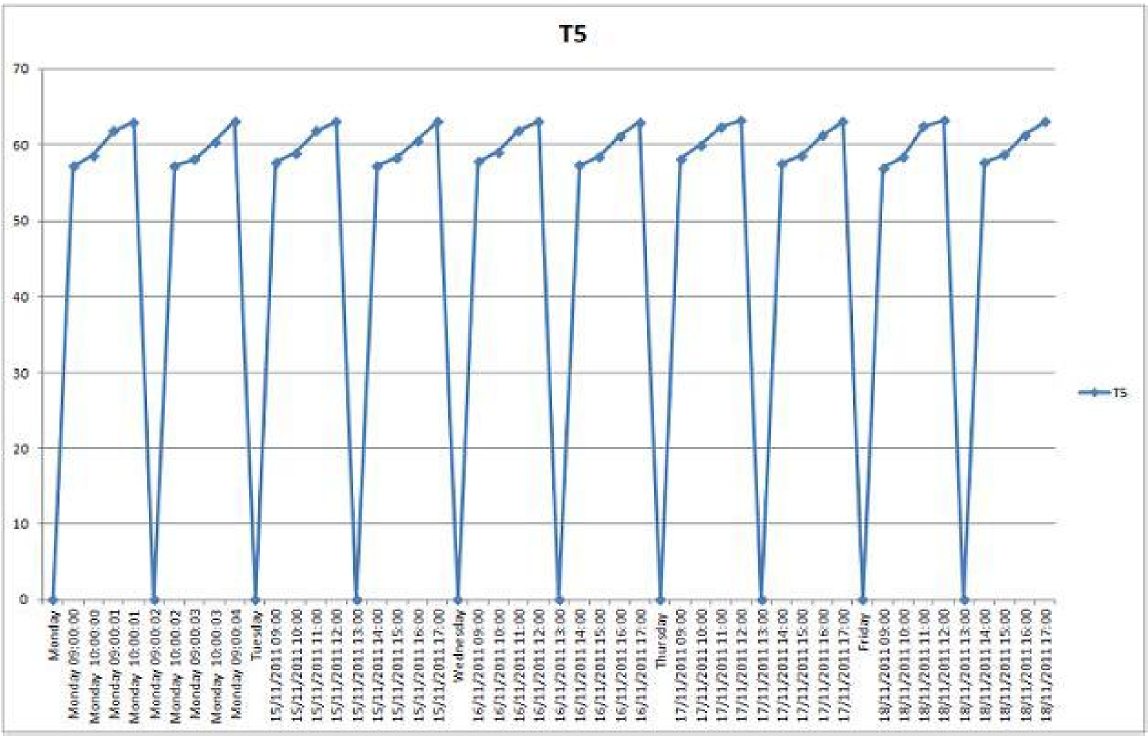

Figure 12 – Cellular Office with T5 fittings

It can be clearly seen that switching from T8 FTs to T5 FTs reduces power consumption. In the situation monitored, electricity consumption was reduced by approx. 48%. Based on the number of lamps in the county hall, the net energy savings of 10,000kWh/yr and cost savings of €1,800 was achieved (Table 2 – Energy & Cost Savings).

Table 2 – Energy & Cost Savings

Lamp	Power rating (W)	Total capacity (kW)	kWh's	Cost (€)
T8	58	17	34,000	6,120
T5	28	12	24,000	4,320
Savings		**5**	**10,000**	**1,800**

The cost to replace the T8 FTs with T5 FTs was €7,000 which included labour, adapters, commissioning and installation. This gives a simple payback of 3.9 years.

Conclusion

It can be clearly seen that replacing T8 FTs with T5 FTs saves energy, as power output is lower.

Recommendations

- Implement a replacement strategy in Carlow County Council buildings where all T12 / T8 fluorescent tubes are replaced with their energy efficient equivalent – T5.
- Implement a replacement strategy for all lighting in council buildings.
- Review lighting with intermittent usage and investigate the installation of motion / daylight sensors where possible.
- Complete staff awareness campaign on training to switch off.
- Consider installing automatic control to switch out lighting outside office hours using simple time clocks inserted in circuit panel.

3.3. Pano Logic Zero Client Computers

Location

Carlow County Hall Buildings

Description

Carlow County Hall currently has 300 standard desktop computers with flat screen displays. These standard desktops (excl. monitor) have a power rating of 60 - 85W and operate approximately 2,250 hours per year consuming approx. 191kWh/yr. It was proposed to replace 10 of these desktops with a more energy efficient model; the Pano Logic VDI systems. This will be one of the first instances of the Pano Logic being used in Europe.

Project Aim

The aim of this initiative was to examine the effectiveness of replacing ten desktop computers being used by staff of Carlow County Council with Pano Logic VDI systems (aka 'Zero Clients') and monitor energy reduction.

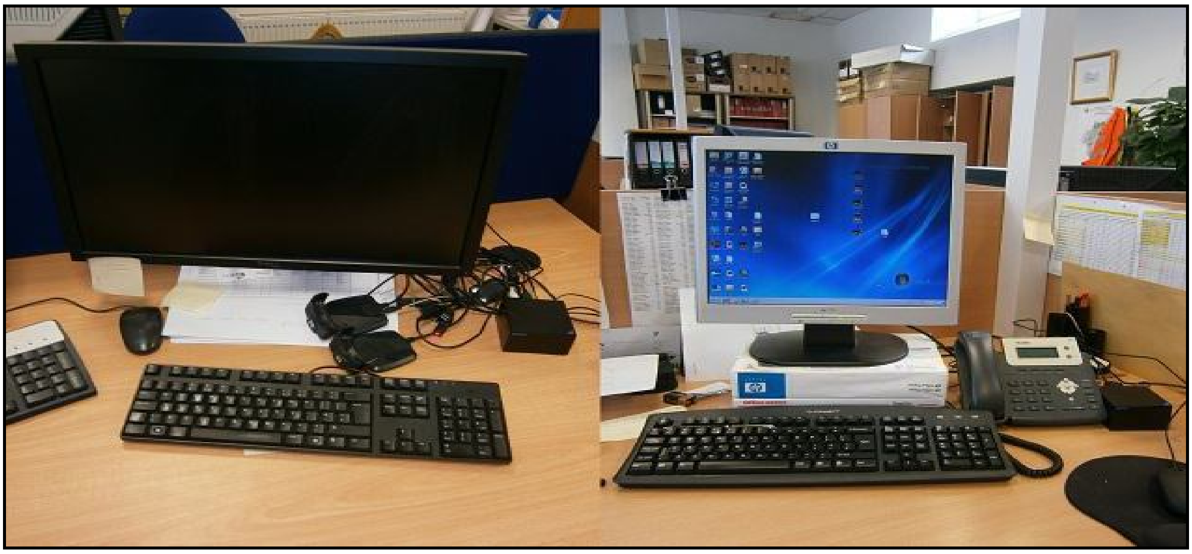

Figure 13 – Pano Logic Zero Clients

Pano Zero Client Computers

The Zero Client computers operate on a similar principle to more commonly used Thin Clients, whereby; a shared central server in an office environment does the majority of the processing. The Thin Clients use approx. 25% of the energy of a standard desktop, the proposed Zero Clients use approx. 5% of the energy of a standard desktop. The Zero Clients operate with power consumption of 4.5W (including mouse and keyboard) in comparison to 85W for a standard desktop.

Monitoring Methodology

The Enistic software and hardware was used for monitoring (Figure 14 – Netbook and Enistic Hardware). 5-way wireless (smart) sockets recorded the energy usage of desktops, monitors and the Pano Logic Zero Client while operating.

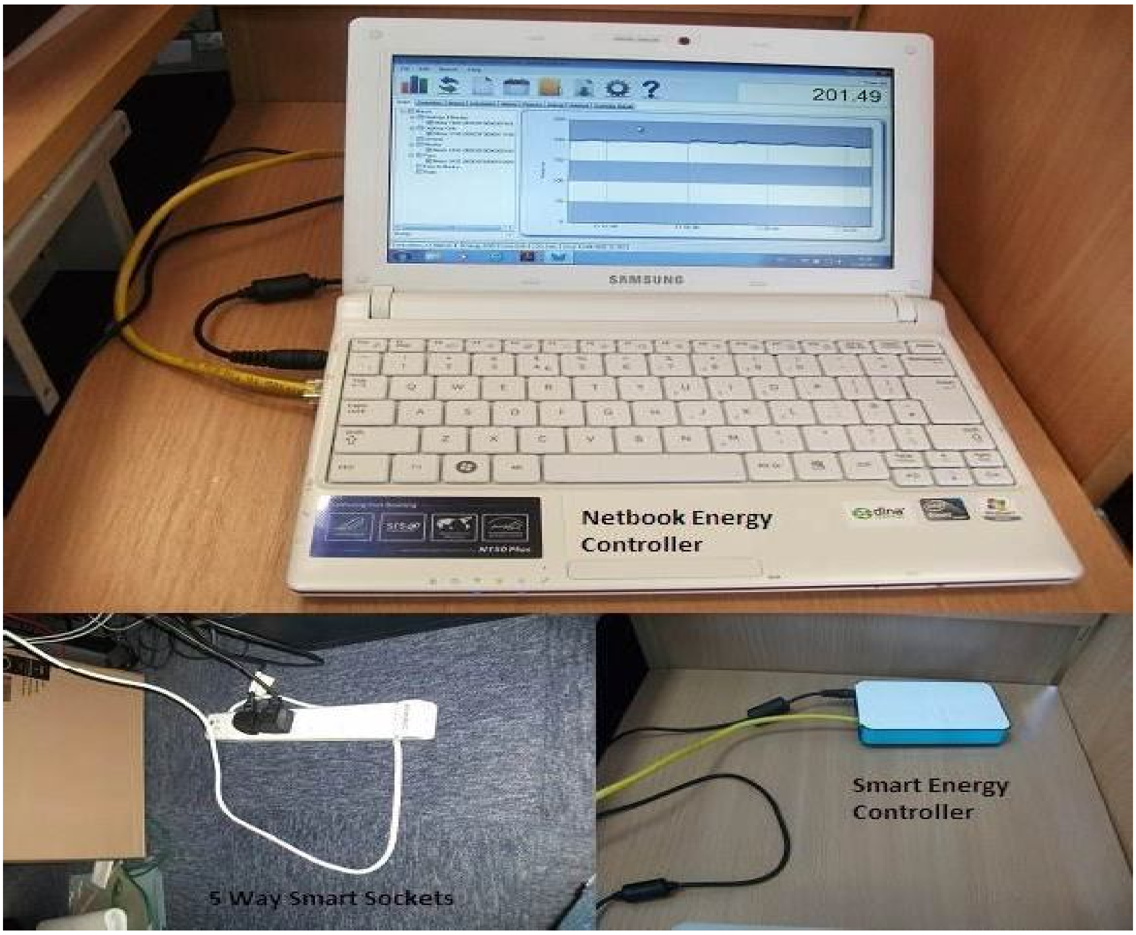

Figure 14 – Netbook and Enistic Hardware

Energy Monitoring

The first set of energy monitoring readings took place in 2011. The following scenarios were monitored;

1. Pano Logic Zero Client – used by a technician in the Water Services department.
2. Desktop Only – Standard Dell desktop used by one of the clerical staff.
3. Desktop and Monitor – HP Compaq Pentium 4 desktop and 17 inch monitor used by the energy engineer in the Water Services Department.
4. Pano Logic Zero Client & Monitor – Pano & HP 19 inch monitor used by the Environmental Awareness Officer in the Environment Section.

Results from 2011 showed that the desktop used in scenario 3 was old and highly inefficient. A Pano Logic Zero Client replaced the desktop in early 2012.

In 2012, a second set of readings were taken with the following changes:

1. Pano Logic Zero Client – used by a technician in the Water Services Section (*remained the same*).
2. Pano & Monitor – Pano & HP 17 inch monitor used by an Engineer the Water Services Section (*desktop replaced with Pano Logic, same monitor was used*).
3. Desktop Only – Standard Dell desktop used by one of the clerical staff (*remained the same*).
4. Desktop & monitor -- Dell Optiplex 380 desktop and 24" monitor used by an Executive Engineer in the Water Services Department (*changed for monitoring purposes*).

Results

Monitoring periods – 2011 & 2012

The Enistic software monitored power consumption recording hourly data for reporting purposes using 4 x 5-way wireless sockets. Results were taken in 2011 (Figure 15 – Pano Logic Comparison 2011) and 2012 (Figure 16 – Pano Logic Comparison 2012).

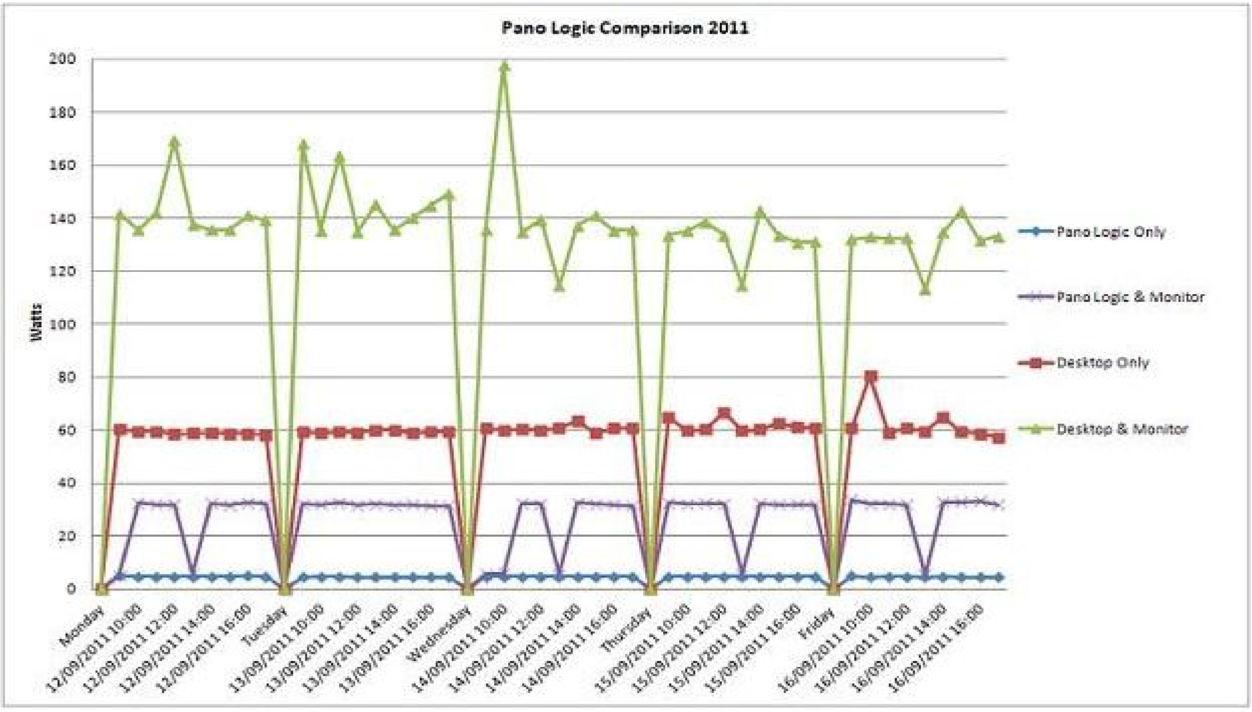

Figure 15 – Pano Logic Comparison 2011

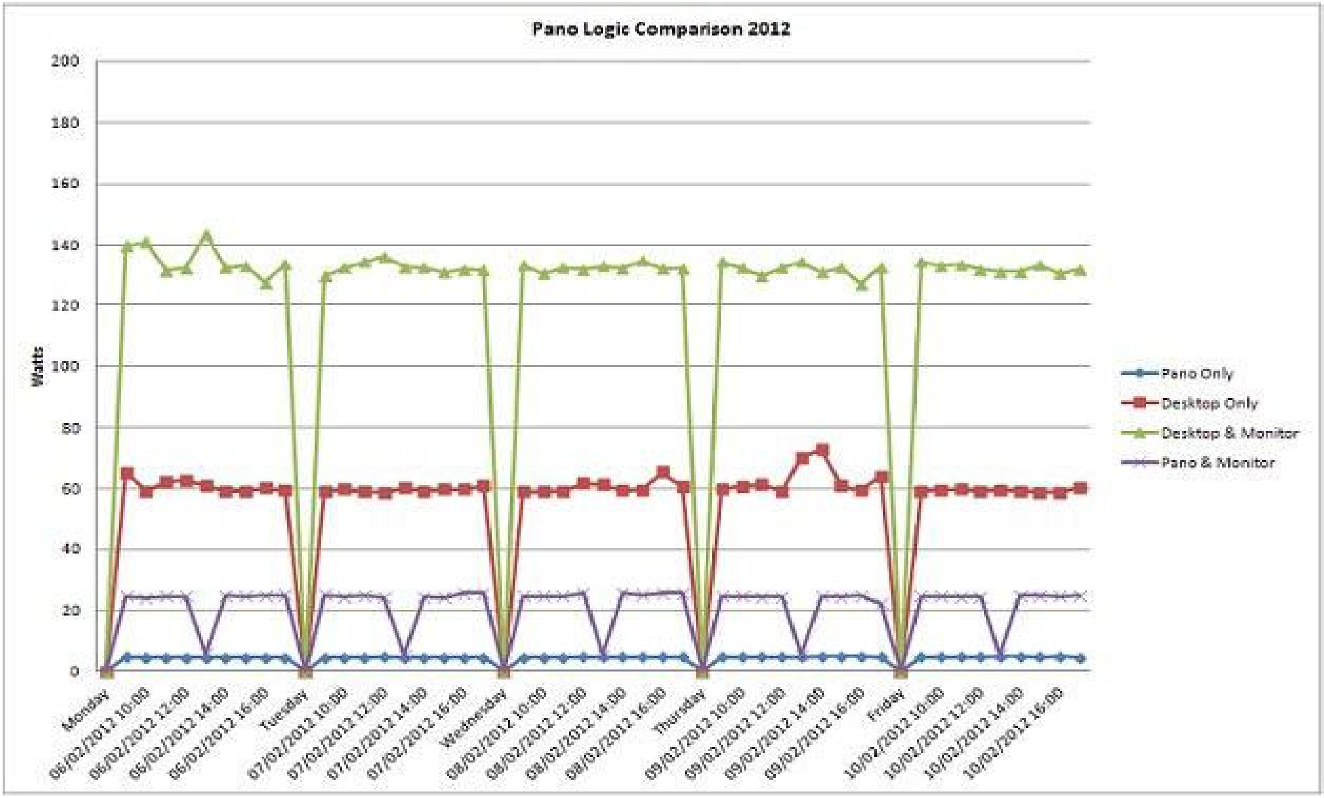

Figure 16 – Pano Logic Comparison 2012

Actual Energy Savings Comparison

A comparison was made between both energy-monitoring periods. In 2011, the average consumption of the old desktop and monitor (blue) over a week was 139W (Figure 15 – Pano Logic Comparison 2011). Energy consumption: 139W x 2,250hrs = 313kWh/yr.

In 2012, the desktop was replaced with a Pano Logic Zero Client. The average usage of the new Pano Logic Zero Client including monitor (red) was 22.5W (Figure 16 – Pano Logic Comparison 2012). Energy consumption: 22.5W x 2,250hrs = 51kWh/yr.

This resulted in an average energy reduction of 116.5W or 262kWh/yr for this computer alone. The cost saving for replacing this one desktop was €47/yr.

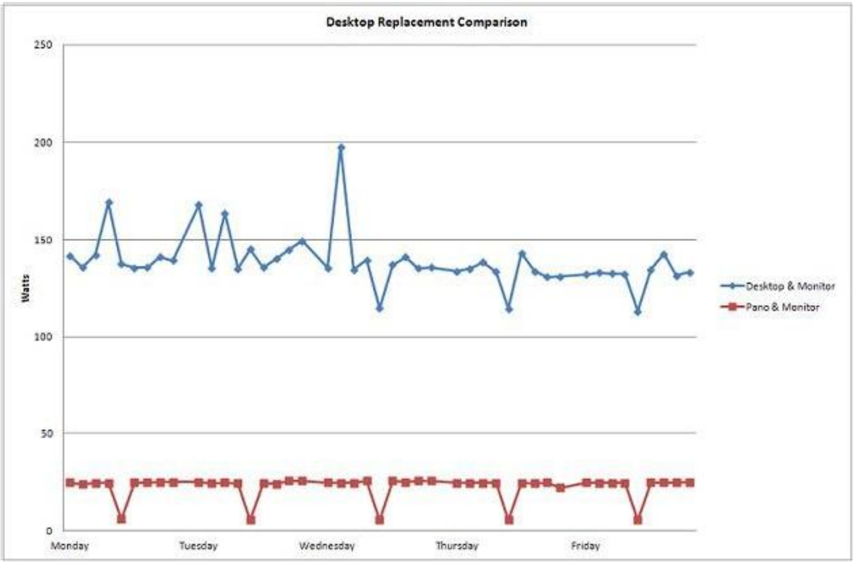

Figure 17 – Desktop Replacement Example

A cost analysis was done to show the potential savings that can be achieved by implementing the roll out of the Pano Logic Zero Logic for the entire 300 personal computers used by Carlow County Council (Table 3 – Replacing 300 Desktop Computers with Pano Computers).

The Pano unit is expected to have a lifetime of 8 years so replacing 300 units will give a lifetime savings of around €78,192 (or annual savings of €9,772) with an upfront cost of €207,600. The expected simple payback would be around 21years.

Table 3 – Replacing 300 Desktop Computers with Pano Computers

	Electrical Rating (kW)	Operating (hrs)	Electricity Consumption (kWh)	No. of Units	Total Consumption (kWh)
Desktop Computer	0.085	2,250	191	300	57,300
Pano Computer	0.0045	2,250	10	300	3,000
Total Energy Savings					**54,300 kWh**
Total Cost Savings				@~0.18c/kWh	**€9,774**

For unscheduled replacement of desktops, the cost per pano unit is approx. €692 with an 8 year lifetime savings of €260.64 in 8 years.

Conclusion

The success of the pilot project was easily seen as the Pano Logic Zero Client has been rolled out to a number of different sections and departments within the council. Recently the County Library has converted its desktops to Zero Client computers.

During the course of this trial a lot of interest was gained from other Local Authorities and Third Level Colleges. A student in IT Carlow is currently completing a dissertation on the viability of replacing some of the desktops in the college with the Pano Logic Zero Client. This shows the replicability of the pilot project for any organisation with a virtual system that has the capacity to install the Pano Client Zero Client system.

Recommendations

- Replace any desktops over 6 years old with Pano Logic Zero Client.
- Replace faulty desktops with Pano Logic Zero Client.
- Roll out this type of technology in any organisation using a central server. The ideal application is large organisations such as third level colleges, office blocks and Local Authorities.

3.4. Wastewater Treatment / Aeration Comparisons

Location

Old Leighlin of Waste Water Treatment Plants (WWTP), Fenagh WWTP & Rathoe WWTP.

Description

Surface aeration treatment has been primarily used in the treatment of wastewater. However, there are now 2 primary new technologies available to replace surface aeration; diffused aeration and rotating drum aeration. Both have recently been commissioned in Carlow County Council wastewater treatment plants.

Project Aim

The aim of this initiative was to compare three different types of Waste Water Treatment Plants (WWTP) being operated by Carlow County Council. The three plants selected were Old Leighlin (Surface Aeration Venturi), Fenagh (Rotating Drum) and Rathoe (Diffuse Aeration).

Treatment Plants

Old Leighlin WWTP uses surface aeration (venturi injection). The venturi requires a pump to move the material through a specially designed pipe that allows oxygen in by way of a vacuum because of the differential pressure created across the venturi.

Figure 18 – Surface Aeration Venturi at Old Leighlin WWTP

Fenagh WWTP uses a rotating drum (stahler wheel). The rotating drum rotates above the water level powered by a low powered motor, surface air is captured by the fixed film and consequently the microorganisms in the basin are supplied with oxygen.

Figure 19 – Rotating Drum at Fenagh WWTP

Rathoe WWTP uses diffused aeration (fine bubble). Oxygen is supplied through a series of diffusers from a low speed variable speed output blower coupled to a high efficiency motor.

Figure 20 – Rathoe WWTP

Figure 21 – Diffused Aeration at Rathoe WWTP

Monitoring Methodology

An e-Tracker Energy Monitor was used to monitor the energy consumption of each plant. The three phase power of each treatment type were monitored; the Stahler Wheel in Fenagh (Figure 22 – Energy monitoring at Fenagh WWTP), the Aeration Blower in Rathoe (Figure 23 – Energy Monitoring at Rathoe WWTP) and the Venturi in Old Leighlin.

Figure 22 – Energy monitoring at Fenagh WWTP

Figure 23 – Energy Monitoring at Rathoe WWTP

The *Easy Log* USB data logger was used to monitor the flow on the inlet and outlet of the plant. The cover for the flow meter was removed and the cables were attached to slot 56 & 57 (Figure 24 – USB Data Logger on Siemens Magflow).

Figure 24 – USB Data Logger on Siemens Magflow

Results

The energy performance of the three plants was compared using key performance indicators (KPI) – the energy consumption (kWh) per inlet flow of wastewater into the plant (m^3) (Table 4 – Wastewater Treatment Comparison). This meant that the energy usage for each treatment type was compared with the amount of wastewater being treated.

Table 4 – Wastewater Treatment Comparison

Location	Treatment Type	Power Consumption (kW)	Litres	m^3	kWh/m^3
Fenagh	Rotating Drum	2.89	147,692	147.69	0.0197
Rathoe	Diffused Aeration	9.14	73,230	78.23	0.1168
Old Leighlin	Venturi	5.38	39,060	39.06	0.1377

The rotating drum at Fenagh WWTP was the most energy efficient method for wastewater treatment. It has a KPI of 0.0197kWh/m^3 that was far lower than the KPI for diffuse aeration and surface aeration.

Conclusion

Key performance indicators (KPIs) were used to compare the 3 different types of wastewater treatment plants. The rotating drum in Fenagh WWTP is the most energy efficient form of wastewater treatment. Surface aeration venturi in Old Leighlin is the least efficient.

Recommendations

- Advise caretakers to assess and monitor daily energy (kWh) and flow (m^3) data usage at each plant.
- Calculate KPIs (kWh/m^3) for all wastewater treatment plants in Carlow County Council.
- Compare KPIs between WWTP.
- Investigate the energy efficiency of plants with higher than average KPIs.

3.5. Automatic Pumping Control - Installation of MultiSmart Pump Station Manager

Location

Abbeywells Wastewater Pumping Station (PS)

Description

Abbeywells Wastewater Pumping Station (PS) in Tullow deals with a wide range of flow rates (dry weather, rainfall, flooding etc.) under specific flow regimes necessary to limit pipe clogging, pipe wear and solids deposition.

Abbeywells has 2 x oversized duty/standby pumps, both sized to meet flood time requirements. Under normal circumstances, these pumps operate well below their best operating efficiency point in frequent stop/start mode. A MultiSmart Pump Station Manager was installed to minimise energy use of the duty/standby/assist pumps.

Figure 25 – Abbeywells Pump Station

The MultiSmart Pump Station Manager (MSPSM) is a programmable logic controller and can be used to modify and operate the pumps at the correct parameters depending on the load involved.

Project Aim

The aim of this initiative was to monitor the operation of the MultiSmart Pump Station Manager (MSPSM) which was installed and assess its impact on energy savings.

MultiSmart Pump Station Manager

The installation of the proposed MultiSmart Pump Station Manager (MSPSM) will facilitate automatic selection of different sized duty/assist pumps and operate these at the optimum parameters. This replaces manual selection of pumps and parameters by the site caretaker.

Figure 26 – MultiSmart and Internal Control Panel

The MultiSmart unit has user friendly interface (Figure 26 – MultiSmart and Internal Control Panel) that makes it easy to set parameters and make changes to the pump and site operations. It allows the caretaker or technician to download information on pumping volumes, pumping times, electrical faults etc. onto a compact flash memory card. This information can then be uploaded onto a computer and used to monitor the efficiency of pumps etc.

Figure 27 – Close up of MultiSmart User Display

The snapshot in figure 27 shows Pump 2 running in automatic mode. Pump 1 is activated to run in automatic mode next when the levels reach a certain limit. The level can be seen on the right of the display. The caretaker as required can adjust settings.

Results

Unfortunately due to an issue with logging data of the MultiSmart in Abbeywells it is not possible to comment on any results at this stage.

Initially during monitoring, it was found that the MultiSmart was returning false data due to the ultrasonic level sensor returning errors in the level. The total daily volume was being downloaded on the memory card but was returning unstable data. This had a massive knock on effect on energy data efficiencies etc. as the volume pumped was calculated by level. In order to resolve this issue the installers were contacted and the level sensor was replaced with a new Siemens standalone unit. The level and volume data on the MultiSmart was then checked and recalibrated.

Once this problem was rectified a further set of readings were taken. This in turn led to a new problem with the data logging from the MultiSmart. The logging intervals reverted to 1-day data, which meant that the logging was being recorded for the previous day. This issue is still unresolved. Carlow County Council is waiting for the installer and the manufacturer to propose a solution to fix this problem.

The use of night time tariff electricity for pumping should be looked at. This would mean switching pump profiles before and after the high day tariff period. Before the high tariff the station operates on low set points and during high tariff the station operates on higher set points so that pumping is kept to a minimum during high day tariff. After high tariff the pump profile returns to normal set points.

Conclusion

The benefit of the MultiSmart will be re-examined once the data logging issues have been resolved in Abbeywells.

Recommendations

- Construct an inlet screen before the inlet to Abbeywells to segregate the larger volumes of debris coming into the pump station. The MultiSmart can then carry out a well clear at set times of the day or week.
- Investigate pumping at night time electricity rate.
- When data / results / energy savings have been quantified consider the installation of a MSPSM programmable controller at other pumping stations in County Carlow.

3.6. Pump Replacement & Controls

Location

Royal Oak Water Treatment Plant

Description

In a pressurised water supply system, it is necessary for the pumps to be correctly sized and controlled to meet a range of instantaneous changes in flow conditions. At the Royal Oak Water Treatment Plant (WTP), the pumps installed were oversized to deal with an expected flow based on the proposed development of the Royal Oak area which did not occur and which is unlikely to occur.

The water supply system in the Royal Oak WTP operates under a pressurised system at 2.6 bar normal pressure and supplying approximately 600m^3/day. There were 2 x 18.5kW pumps operating at an efficiency of less than 30%.

It was proposed to replace these pumps with 2 x 4kW pumps to match the actual demand range of 18 – 40m^3/hour at an efficiency of between 60 – 70%. While carrying out the review on the site it was found that 2 x 4kW would be unable to cope with the demand in the Royal Oak. Therefore, a revised plan proposed the installation of 2 x 7.5kW pumps working under the same operating efficiencies.

The new pumps have built in variable speed controls to allow finer control and reduced night time pressure during low demand times resulting in energy savings and reduced wear on the pumps and pipe network.

Project Aim

The aim of this initiative was to monitor and demonstrate the correct sizing and control of pumps to meet the various demands of a pressurised water system.

Pump Replacement

To date, the 2 x 18.5kW pumps with variable speed have performed the required task of maintaining pressure to the distribution network, but at an efficiency of less than 30% (Figure 28 – Old 2 x 18.5kW Pumps - Royal Oak WTP).

Figure 28 – Old 2 x 18.5kW Pumps - Royal Oak WTP

Two new 7.5kW pumps operating at approximately 65% efficiency were installed to replace the existing pumps. These will deliver 65% of the absorbed power with only 35% within the pump as opposed to 70% within the pump for the old system.

The new pumps have built in variable speed controls, which reduce energy by allowing the motor to operate at different speeds. They also have a soft start arrangement incorporated in the system. This allows the pump to have a slower ramp up rate on startup and reduces its initial power demand on the plant. This helps reduce the mechanical wear during start up and stopping. Other advantages of variable speed drives include reduced leakage, reduced water hammer and less frictional wear, all of which prolong the life cycle of both the pumps and fittings.

Monitoring Methodology

The e-Tracker Energy Monitor and flow/pressure logger were used to monitor the power/flow/pressure of the pumps in Royal Oak. When installing the e-tracker onto the pumps the plant was shut down for a set period of time and a water interruption notice was issued to the affected area.

The main isolator switch was switched off and the cabinet was then opened after a couple of minutes while all the components were shut down. Energy monitoring of the pumps was then carried out using three current transformers on each of the three phases of the pump. The cabinet was then closed and the energy monitor was switched on (Figure 29 – Energy Monitoring Royal Oak WTP).

Figure 29 – Energy Monitoring Royal Oak WTP

A data logger was used to monitor the flow and pressure of the plant. To get a connection for the logger a T-junction was installed onto the pressure/flow line (Figure 30 – Logging equipment Royal Oak WTP).

Figure 30 – Logging equipment Royal Oak WTP

Two new 7.5kW pumps with variable speed drives replaced the older pumps in the pump house of the Royal Oak WTP. A safety step was installed in order to make it easier to access the expansion vessel in the corner of the room (Figure 31 – New 2 x 7.5kW Pumps with VSD – Royal Oak WTP).

Figure 31 – New 2 x 7.5kW Pumps with VSD – Royal Oak WTP

Results

The information gathered from the energy monitoring equipment was draw onto the pump curve (Figure 32 – Pump Curve excluding variable speed drives). An example of a typical flow was used and inserted into the pump curve. The pump flow at 10am was 25m^3/h. This gives an overall efficiency of 56% and a shaft power of 6.2kW. The measured power consumption from the energy monitor was 6.95kW. This gives a motor efficiency of 89%.

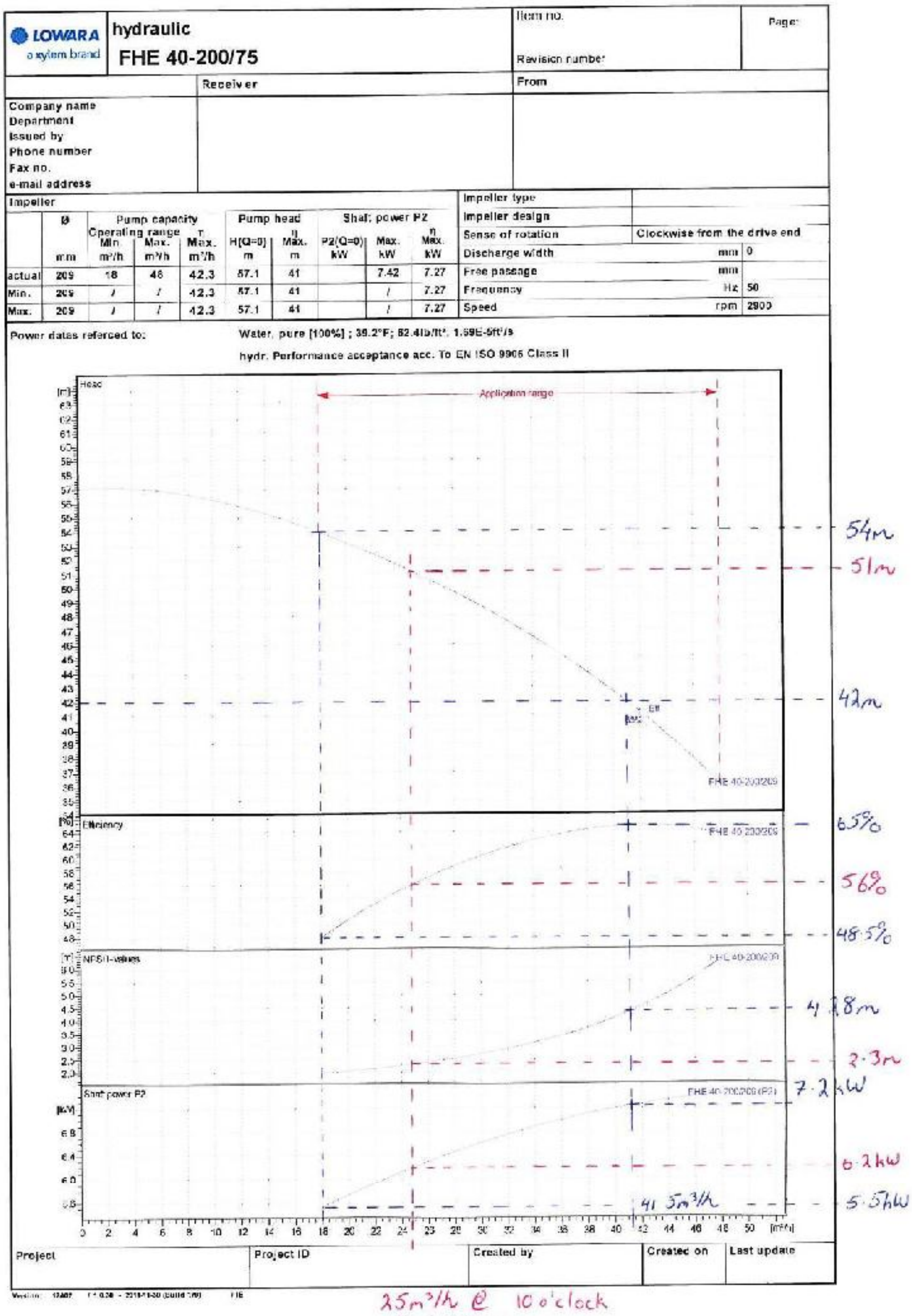

Figure 32 – Pump Curve excluding variable speed drives

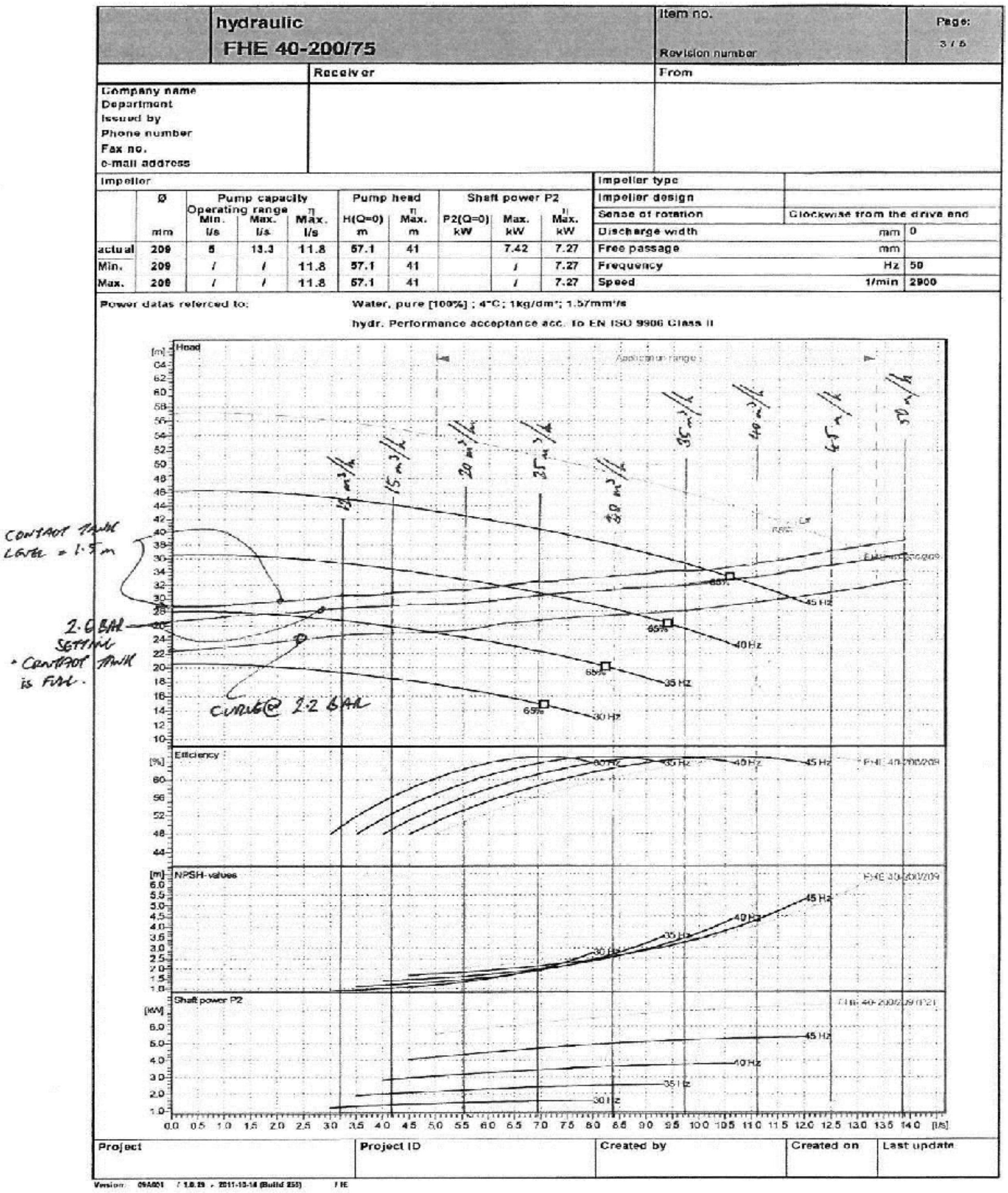

Figure 33 – Pump Curve with variable speed drives

By using the variable speed drives on the pumps the same desired flow/pressure can be obtained by reducing the speed of the pumps to 40Hz. This will operate the pump at the better operating efficiency of 65% while still maintaining the desired pressure in the line of 2.6bar.

Energy savings can be seen from an improved efficiency and a change to the operation of the plant. The new pumps work at the original set point with a change in flow from 25m^3/h to 35m^3/h over a shorter period of time. Savings can also be expected due to better ability to control the pressure/flow at different flows.

Table 5 – Pump Comparison

		Old Pump	New Pump
Rated Power	kW	18	7.5
Pump speed	Hz	38	43
Pressure	m	26.3	26.3
Flow (avg)	m3/h	25	35
Motor efficiency	%	90%	90%
Pump efficiency		31%	65%
Power absorbed	kW_e	6.15	5.42
kWhrs/day	Current 18hrs Proposed 13hrs	111	70.5
Saving	kWh/day		40.5
Saving	kWh/yr		14,783
Saving €/yr	~0.16c/kWh		**€2,365**
Capital cost			**€6,171**
Simple payback			**2.6 years**
450m3/day @ 25m3/hour = 18hours/day (38Hz)			
450m3/day @ 35m3/hour = 13hours/day (43Hz)			

Since 2 x 7.5kW pumps were installed, energy and cost save can be doubled for the Royal Oak WTP, i.e. 29,476kWhs and €4,730. This results in a 43% energy savings per annum.

Conclusion

The correct sizing of pumps is critical for water services in the supply and distribution of water. In this case the original pumps were sized for the continued development of the Royal Oak area of Bagenalstown. Due to the downturn in the economy, the area surrounding the Royal Oak was not developed and the pumping system in the Royal Oak was oversized. In order to account for the reduction in demand the size of the pumps were reduced. In this instance the pumps went from operating at an efficiency of less than 30% to an approximate efficiency of 65% depending on the demand.

Recommendations

- Identify pumps, which were installed to meet a greater demand and investigate the potential for replacement.
- Carry out similar pump efficiency tests on large pumps operating in water treatment or pumping sites operated by Carlow County Council.
- Identify pumps operating at reduced efficiency and investigate the potential for replacement.
- Fit the old variable speed drives to another water treatment plant or pumping station in County Carlow.

3.7. Dehumidification in Water Treatment Plants – Dehumidifiers vs Storage Heaters

Location

Rathvilly Water Treatment Plant

Description

Rathvilly Water Treatment Plant (WTP) treats and pumps 9,000m^3 of water per day supplying the vicinity of Carlow Town. The plant has an annual energy consumption of approx. 1,600MWh/yr mainly from high lift (755MWh/yr) and low lift (200MWh/yr) pumps. In addition, a significant proportion of the electricity consumption is used for storage heating (186MWh/yr) to keep the building at the appropriate humidity level.

In water treatment plants, it is vital to maintain the facilities at a relative humidity (RH) below 40 – 50% to maintain the integrity of the building itself and the electric and mechanical controls within. In Rathvilly WTP, the gallery area is heated with 50kW of storage heating consuming approximately 110MWh per year.

The use of storage heating is an inefficient means of dehumidification. A desiccant dehumidifier with heat recovery was installed as a replacement to storage heaters (Figure 34 – Gallery Area Rathvilly WTP & Dehumidifier).

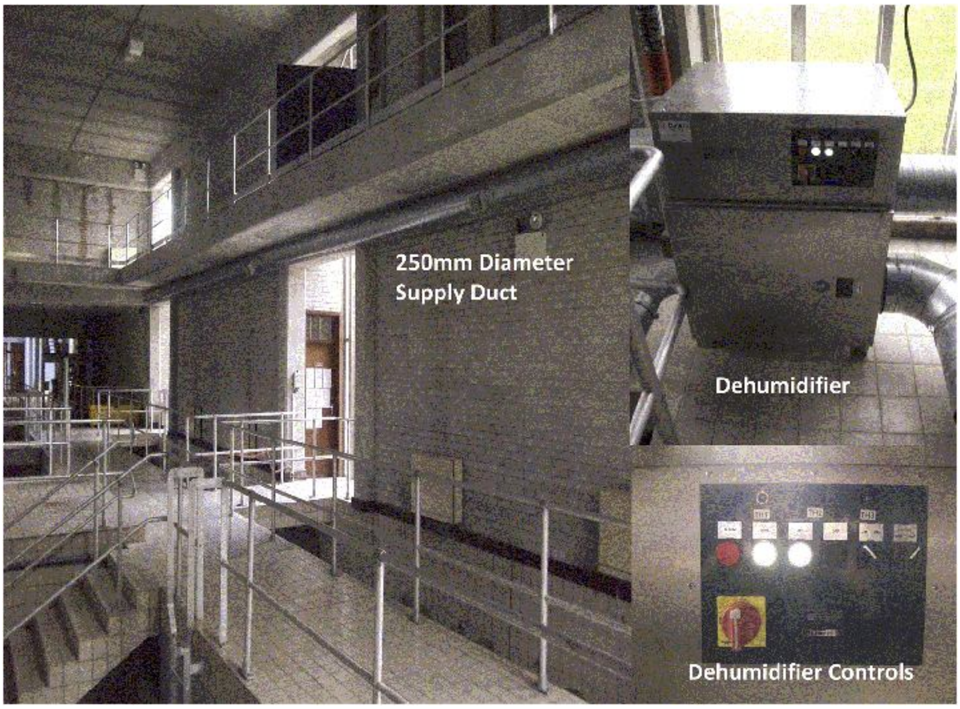

Figure 34 – Gallery Area Rathvilly WTP & Dehumidifier

Project Aim

The aim of this initiative was to compare the energy consumption of the dehumidifier compared to the storage heaters.

Dehumidifier

The dehumidifier continuously exchanges two air streams of different flow rates, the *Process Air* and *Regeneration Air*, normally having a flow ratio of approximately 3 to 1 (Figure 35 – Dehumidifier Process). The process air has a greater flow rate and is dried as it passes through the dehumidifier. The regeneration air has a smaller flow rate and is used to heat the rotor material to drive the absorbed moisture vapour from the desiccant. The moisture, which is removed from the process air, is transferred over to the regeneration air as the rotor turns slowly. The water vapour is effectively absorbed from the treated air in the silica gel rotor.

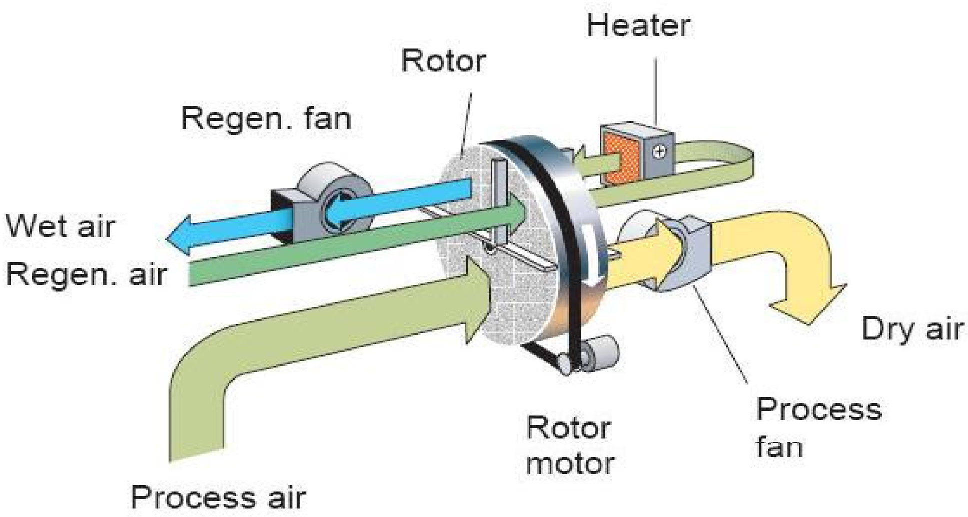

Figure 35 – Dehumidifier Process

The wall mounted humidity sensor and display are used to monitor the humidity of the gallery (Figure 36 – Humidity Display and Sensor). During commissioning the humidity of the space was set to 45 – 50% with a +/- 2°C variation. However, the caretaker found the humidity to be too low for working conditions so the band was raised to 50 – 55% with a +/- 2°C variation on this.

Figure 36 – Humidity Display and Sensor

The humidity display has the ability to show the 2-step process of the dehumidifier. In Figure 36, the dehumidifier was carrying out stage 2 of the cycle.

Monitoring Methodology

An e-Tracker Energy Monitor was used to monitor the energy consumption of the dehumidifier. The e-tracker allows the user to track the energy usage of items of plant or building and gives real time data and consumption figures. It was set to log data on a 15-minute interval (Figure 37 – e-Tracker monitoring power consumption of dehumidifier).

Figure 37 – e-Tracker monitoring power consumption of dehumidifier

Three *Easy Log USB* wireless temperature and humidity data loggers recorded conditions in different areas of the plant before and after the installation of the dehumidifier.

Results

The dehumidifier was monitored for a number of weeks using the e-Tracker monitor. The power consumption of the dehumidifier showed the two-step process of the dehumidifier (Figure 38 – Dehumidifier power consumption on 18th November 2011).

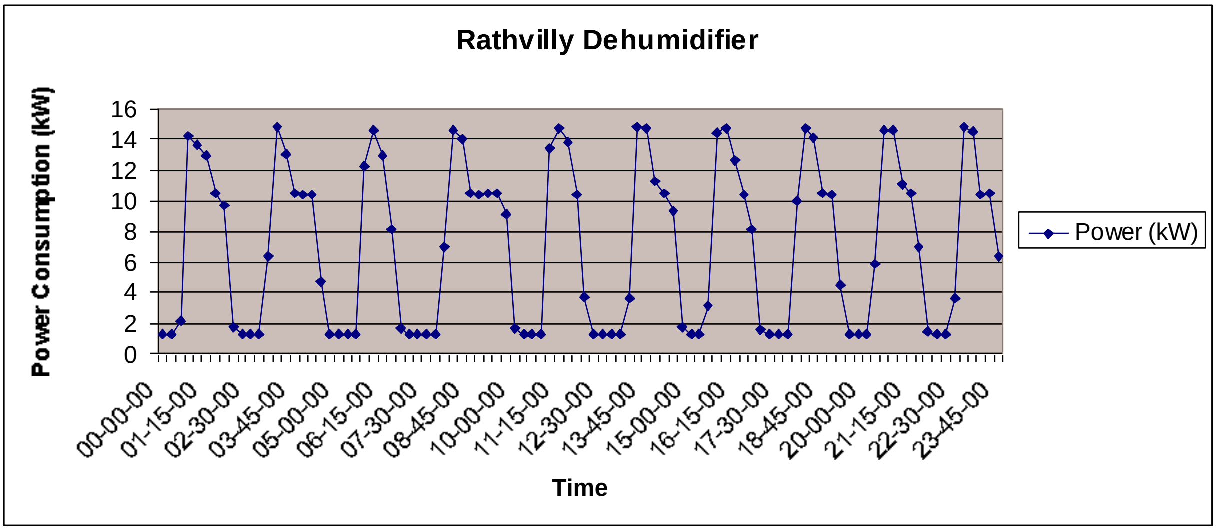

Figure 38 – Dehumidifier power consumption on 18th November 2011

The temperature/humidity/dew point for Rathvilly WTP was monitored before and after the installation of the dehumidifier.

The first *Easy Log* USB data logger was placed in the gallery area of Rathvilly Water Treatment Plant. The humidity in the plant varied from 68.5% to 91%, the dew point temperature varied from 6.6°C to 14°C and the ambient temperature varied from 11°C to 16°C before the installation of the dehumidifier (Figure 39 – Temperature/Humidity Sensor Rathvilly WTP *before installation*).

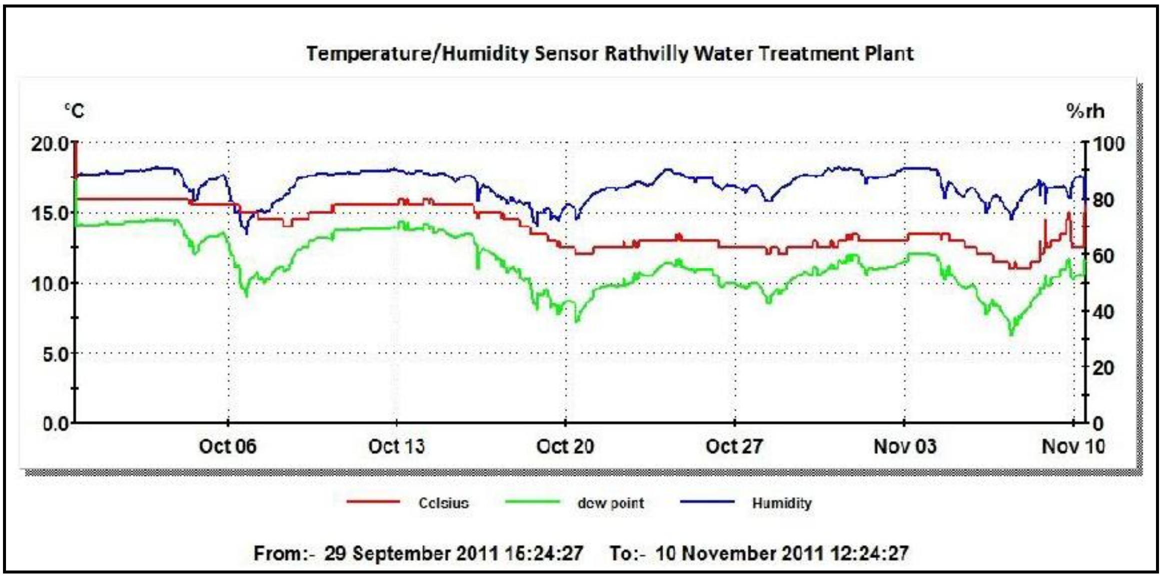

Figure 39 – Temperature/Humidity Sensor Rathvilly WTP *before installation*

After the installation of the dehumidifier, the humidity in the plant varied in a much smaller band 50% to 57%, the dew point temperature varied from 3.2°C to 6.3°C and the ambient temperature varied from 11.5°C to 16°C (Figure 40 – Temperature/Humidity Sensor Rathvilly WTP *after installation*). This is a clear indication of the work being done by the dehumidifier.

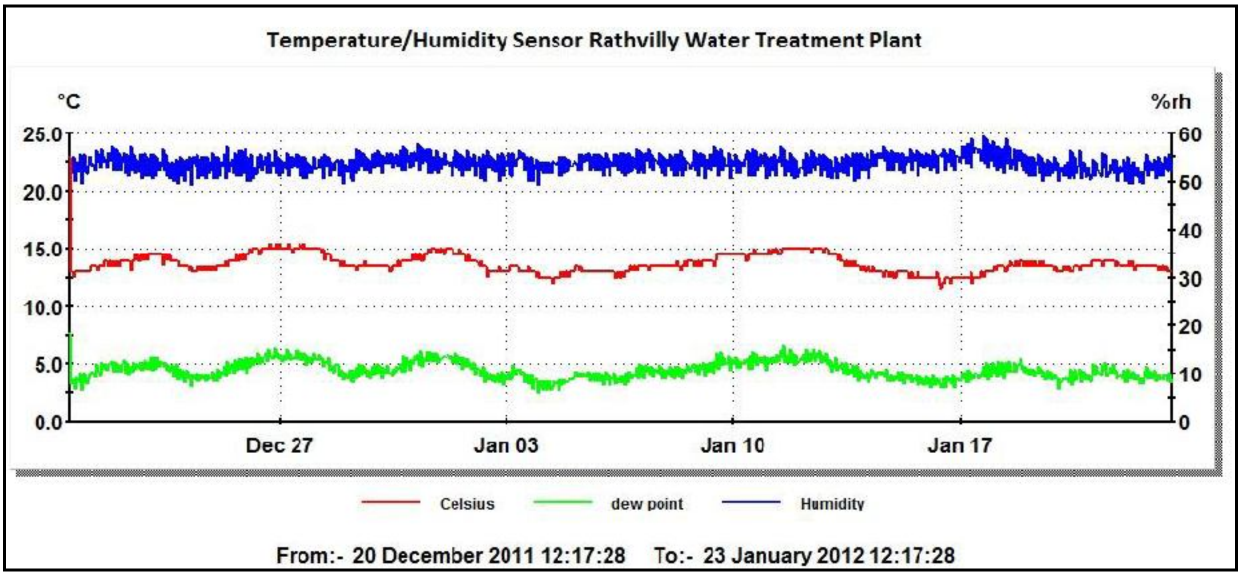

Figure 40 – Temperature/Humidity Sensor Rathvilly WTP *after installation*

With the installation of the dehumidifier, the RH varied between 53% and 57% in comparison to a variation of between 70% and 95% in an un-controlled environment.

Energy Savings

The dehumidifier has a rated capacity of 9kW or 13.5kW depending on the load and is estimated to consume 31,225kWh/yr operating over the different loads (Table 6 – Energy Use and Payback Period). Storage heating will still be required in winter to keep the gallery above freezing point (approx. energy consumption: 6,000kWh/yr).

The total annual storage heating consumption load for Rathvilly WTP is estimated at 186,000kWh. With the installation of the dehumidifier a reduction in energy consumption of 39% was achieved.

Table 6 – Energy Use and Payback Period

		Power (kW)	hrs/yr	Energy consumption (kWh/yr)	Cost (€)
Old Load	Storage heating (Gallery Area only)	50	2,190	**109,500**	**9,381**
New Load	Load 1	13.5	1,300	17,550	1,931
	Load 2	9	950	8,550	941
	Steady State Cycle	2.5	2.050	5,125	564
	Total (new load)			**31,225**	**3,435**
	Winter heating			6,000	456
Energy & cost savings (old load – new load)				**72,275**	**€5,490**

The installed cost for the dehumidifier system was €26,990. Cost savings are estimated to be approximately €5,490 (Table 6 – Energy Use and Payback Period). This gives a simple payback of 4.9 years.

Conclusions

The dehumidifier used in Rathvilly WTP is commonly used where a dry environment is required for storage of moisture sensitive products and raw materials. It uses air-drying technology, which provides great flexibility in solving humidity problems.

In the past, the most convenient way of heating this type of plant was using storage heating. At that time the price of electricity was low which made it economically viable to install storage heaters as a method of heating.

This pilot project in Rathvilly WTP has shown that the installation of a dehumidifier can make it easier to control the relative humidity and reduce the energy consumption in the plant.

Recommendations

- Carry out feasibility studies into the installation of dehumidifiers in some other water and waste treatment facilities in County Carlow.

3.8. Water Pumping – Speed Control in a Reservoir System using Variable Speed Drives

Description

Bagenalstown Water Treatment Plant (WTP) pumps approximately 1,100m^3/day of water to supply the town of Bagenalstown in County Carlow. The plant has an energy consumption of approx. 130MWh/yr mainly from fixed speed high lift pumps (115MWh/yr).

It has been determined from on-site efficiency testing and flow calculations that the existing water pump could pump the same amount of water to the reservoir using 16% less power by operating the pump at a slower speed over a slightly longer period of time. Two new variable speed drives for the high lift pumps were installed in the Bagenalstown WTP to reduce energy consumption.

Project Aim

The aim of this initiative was to identify the most efficient flow rate based on the pumping, the height of the reservoir and the type/diameter of the pipe. To achieve this, variable speed drives was installed.

Variable Speed Drive (VSD)

A VSD operates the pump at the lower speed from a combination of lowering pipe friction losses and operating the pump at closer to its best efficiency point. VSDs also reduce leakage, reduce water hammer and cause less frictional wear. This prolongs the life cycle of both the pumps and fittings.

VSDs have a soft start arrangement incorporated in the system. This allows the pump to have a slower ramp up rate on startup and reduces its initial power demand on the plant. This helps reduce the mechanical wear during start up and stopping.

Two variable speed drives were installed in Bagenalstown WTP on high lift pumps (Figure 41 – VSDs for High Lift Pumps 1 & 2).

Figure 41 – VSDs for High Lift Pumps 1 & 2

The image on the right in Figure 41 shows the controller display for the VSD for high lift pump 1. Adjusting the dial in the anticlockwise direction can manually turn down the speed of the pump. This was done in increments of 0.5Hertz (Hz) from 50Hz down.

Energy Monitoring

An e-Tracker Energy Monitor was used to monitor the energy consumption of the high lift pump. Transformer clamps were placed on the three phases of the pump (Figure 42 – E-tracker monitoring High Lift Pump 1).

Figure 42 – E-tracker monitoring High Lift Pump 1

The *Easy Log* pressure/flow data loggers were used to monitor the pressure and flow of the high lift pumps (Figure 43 – Pressure Logger connected to laptop).

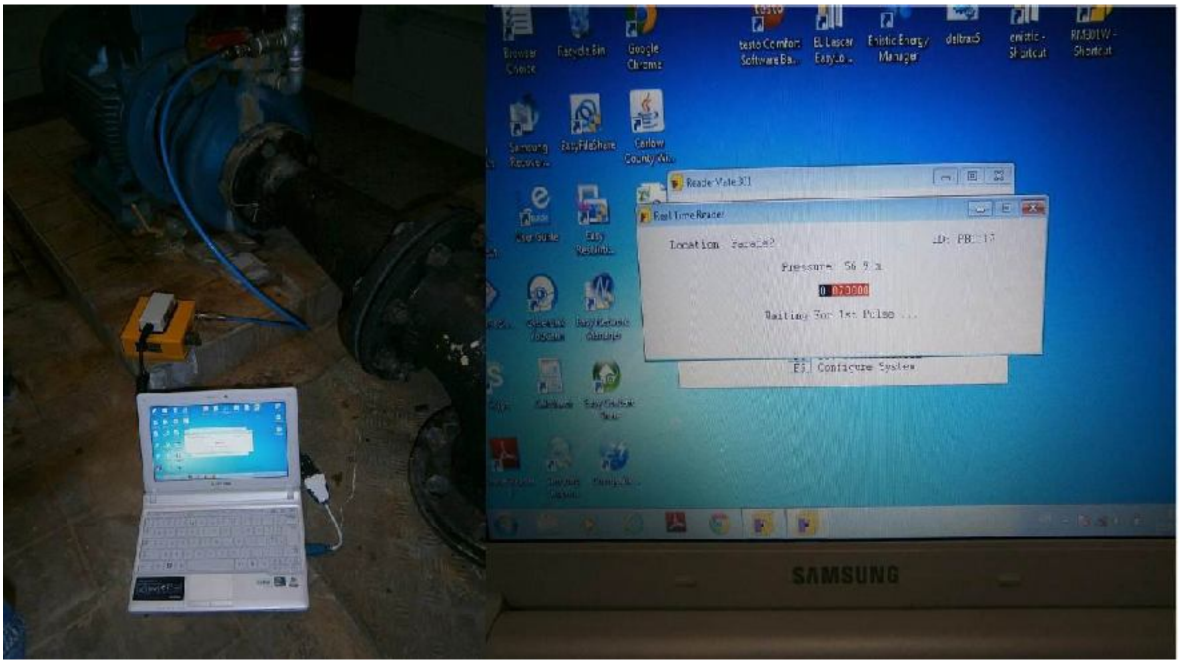

Figure 43 – Pressure Logger connected to laptop

Results

The speed of the high lift pump was varied form 50Hz down to 47Hzin increments of 0.5Hz. Pump parameters were recorded (Table 7 – High Lift Pump 1).

Table 7 – High Lift Pump 1

Power (kW)	26	25	23	22	21	19	18
Speed (Hz)	50	49.5	49	48.5	48	47.5	47
Flow (m^3/h)	83.3	78.9	73.5	67.5	62.2	55.6	49
Volts (V)	398	396	391	387	384	380	375
Amps (A)	37.5	35.8	34	32.3	30.7	29.3	27.5
Pressure (m)	57.8	57.4	56.8	56.4	56	55.7	55.1

Based on the recorded data (Table 7 – High Lift Pump 1) an energy analysis was done to investigate the energy reduction from using VSDs (Table 8 – VSD: Energy & Cost Analysis).

Table 8 – VSD: Energy & Cost Analysis

Speed	**Hz**	**50**		**47**
Daily requirement	m^3/day	1,100		1,100
Run hours	hours/day	13.25		22.45
Flow rate	m^3/hour	83		49
Hours per year	h/yr	4,837		8,194
Annual Water Requirement	m^3/yr	401,500		401,500
Annual Electricity Requirement	kWh/yr	125,771.08		147,489.8
€/kWh avg day	0.14917	€11,726		€13,751
€/kWh avg night	0.0764	€3,603		€4,226
Cost/year (€)	€	€15,329.14		€17,976.24

The use of a VSD doesn't have the desired effect of reducing the energy consumption in the Bagenalstown WTP as was envisaged. Reducing the speed of the pump reduces the flow to 49m^3/h to the reservoir. The reduced flow rate means that the pump has to do a lot more work over a longer period of time and therefore uses more energy to pump the same amount water to the reservoir. The desired result would have been to use less energy to pump less water over a longer period of time at a reduced speed.

During the initial monitoring of the site, assumptions were made on friction losses in the pipe to the reservoir. This figure may have been underestimated. An assessment of the condition of the pipe lining should be investigated in order to assess the actual friction losses in the pipe.

Another advantage of VSDs is that they can operate both pumps together at a lower speed. So in the event of a borehole pump failing, this arrange would allow pumping of up to 112m^3/h up to the reservoir at a speed of 47.5Hz. This would mean that the reservoir could be filled quickly in the event of a failure in the plant.

Conclusions

Carlow County Council has seen the benefit of using VSDs in booster pumping. However, in the sump to reservoir system in Bagenalstown WTP the use of VSDs seems to be not feasible. It seems that the pump is unable to operate at a lower speed than 47Hz due to the pump not being able to pump an adequate amount of water to the reservoir. This may have to do with the age of the pumps as VSDs were installed on old pumps.

Recommendations

- Carry out an assessment of the condition of the pipe lining supplying the reservoir in order to assess the actual friction losses in the pipe.
- Replace pumps with higher efficiency pumps operating with the new VSDs.
- Carry out a detailed feasibility study on the use of VSDs in booster pumping and / or water supplying a reservoir as a method of both reducing energy and leakage through pressure reduction.

3.9. Water Pumping – Night Time Pressure Reduction

Description

Oak Park Water Treatment Plant pumps 1,300m^3/day water from a wellfield into a reservoir where it is mixed with 2,400m^3/day water, which is gravity, fed from another reservoir. From here, the 3,700m^3/day is fed into a pressurised mains network supplying Carlow Town.

Figure 44 – Oak Park Water Treatment Plant Storage Reservoir

In a pressurised water supply system, it may be possible to reduce the system pressure during low demand periods without negatively affecting public supply. The benefit of reducing system pressure is primarily to reduce leakages in the pipe network. An additional benefit is the reduction in the pump power required to maintain the lower pressure.

Project Aim

The aim of this initiative was to monitor the variations in energy consumption against flows and pressures, and to establish the energy effectiveness of night pressure reduction level.

Booster Pumps

There are two booster pumps in Oak Park, operating on a duty standby arrangement. Both booster pumps are fitted with variable speed drives (VSDs). The booster pumps operate on a pressure Proportional Integral Derivative (PID) control. The required pressure set point of the booster pump can be adjusted from the Human Machine Interface (HMI) on the main panel.

Figure 45 – Booster Pump 1 & 2 Control Panel

The booster pump control has two different set points:

1) Desired Day Time Pressure

This value is the desired day time operating pressure required in the rising main between the hours of 06:00hours and 24:00hours.

2) Desired Night Time Pressure

This value is the desired night time operating pressure required in the rising main between the hours of 24:00hours and 06:00hours.

The HMI in Oak Park Reservoir shows the main incoming line feeding the reservoir along with the 3 borehole pumps also feeding the reservoir. The booster pumps are displayed on right hand side of the HMI (Figure 46 - HMI Oak Park Reservoir).

Figure 46 - HMI Oak Park Reservoir

Both booster pumps are controlled via the Programmable Logic Controller (PLC). The PLC receives feedback from all sensor and controllers. All set points on the booster pumps can be adjusted from the HMI.

The Variable Speed Drives (VSD) varies the speed of the pump as required. The VSD receives a signal from the PLC to increase or decrease the speed of the pump.

Energy Monitoring

The pressure sensor was fitted to the common delivery line from the booster pumps. The pressure sensor gave a pressure feed back to the PLC giving the live pressure in the delivery line. The desired day and night time pressure set point was set from the HMI.

Figure 47 – Flow Gauge at Oak Park

The water pressure in Oak Park Reservoir was monitored between 23rd April and 29th April 2012. There was a reduction in water pressure between the hours of 24:00hours and 06:00hours (Figure 48 – Pressure graph from data logger).

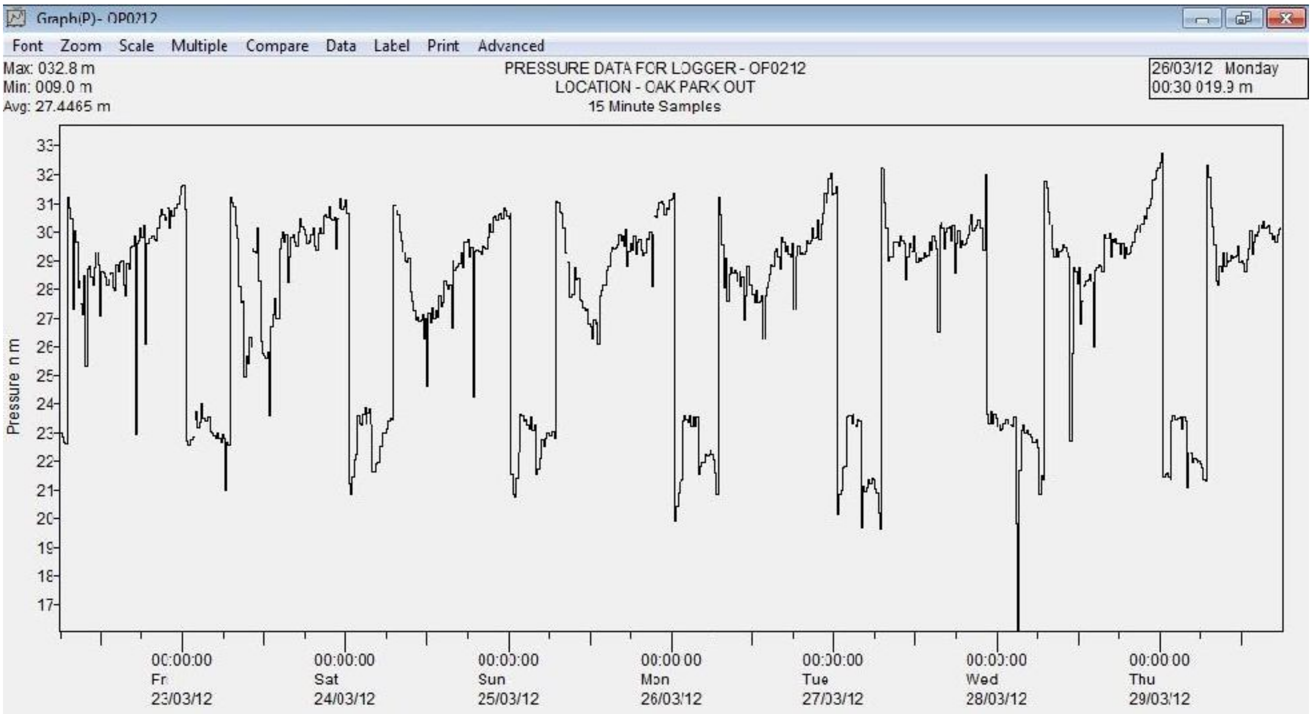

Figure 48 – Pressure graph from data logger

Results

An analysis was done on the cost savings that can be made by implementing night time pressure reduction over a 24-hour period (Table 9 – Pressure Reduction).

Table 9 – Pressure Reduction

14/11/2011	Day	Night	Difference
Pressure (m)	30.46	23.69	6.77
Power (kW)	22.5	15.3	7.2
Flow (m^3/h)	30.4	26.8	3.6

Daily energy savings: 7.2kW x 6hours = 43.2kWh

Daily cost savings: 43.2kWh x 0.08c/kWh = €3.46/day

Annual energy savings: 15,768kWh

Annual cost savings: approx. €1,260

Oak Park WTP has an annual electricity consumption of approx. 200,000kWhs per year. Night time pressure reduction resulted in an 8% energy reduction per annum.

While carrying out the monitoring for this report it was noted that the maximum import capacity (MIC) for Oak Park far exceeded the load. A recommendation was made to reduce the MIC from 180kVa to 50kVa. This resulted in a saving of approximately €3,500/yr.

Conclusion

The use of night time pressure in energy reduction has proven successful in Oak Park. Previously, night time pressure was reduced to improve leakage now it can be concluded it is successful in reducing energy and cost in booster pumping.

Recommendations

- Investigate the potential for night time pressure reduction in all suitable sites operated by Carlow County Council with the potential for pressure reduction.
- Assess all maximum import capacity on bills to ensure sites are not exceeding their limit.
- The On new developments at grant of planning stage the local authority should stipulate that it is the responsibility of the developer, residential or commercial, responsibility to install booster pump on their sites for new developments at grant of planning stage. This would facilitate the further reduction of pressures across the system in problem areas where historically pressure drops led to complaints through water services department.

From this analysis, it was found that the pumps at Oak Park Reservoir were oversized and not operating at their optimum efficiency. A recommendation was made to look at using the old 12kW pumps from the Royal Oak Upgrade and transfer them to Oak Park Water Treatment Plant. The feasibility of such an operation would depend on cost of transport and installation, future demand, and the ability to use those pumps on a duty standby or duty assist arrangement in Oak Park.

4. Conclusion

Energy monitoring and verifying of energy savings is essential when energy initiatives are implemented by any company, business or public/private sector organisation. A recent report from the Sustainable Energy Authority of Ireland (SEAI) states that as part of the annual reporting process, there will be a stronger requirement to measure and verify energy savings.

As part of the Climatlantic Project, Carlow County Council with the support of Carlow Kilkenny Energy Agency has engaged in this process. Monitoring and verification was carried out on new initiatives implemented as part of the Climatlantic project and existing initiatives. This shed considerable light on the feasibility of these initiatives. Energy savings were achieved in some of the initiatives, for example, Pano Logic, Dehumidifier, and Correctly Sized and Controlled Pumps. In other initiatives where estimated energy savings were not achieved, the monitoring has led to a number of key recommendations being made. These recommendations would not have been possible without the monitoring being carried out.

Initiative	Location	Annual Energy Savings	Estimated Annual Cost Savings
Server Room Cooling	Carlow County Hall	New air-conditioning unit was undersized. Further monitoring required.	
Efficient Lighting Retrofit	Carlow County Hall	10,000kWhs	€1,800 for 420 individual fluorescent tubes. Simple payback: 3.9yrs
Zero Client Computers	Carlow County Hall	10,875kWhs	€9,772 for 300 units. Simple payback: 21yrs
Wastewater Treatment / Aeration Comparisons	Old Leighlin / Fenagh / Rathoe	86% difference between best and worst practice	
Automatic pumping control	Abbeywells pumping station	MPSM not functioning properly. Installer contacted.	

Pump Replacement & Controls	Royal Oak WTP	29,476kWhs	€4,730 (2 x 7.5kW replacing 2 x 18kW pumps). Simple payback: 2.6yrs
Dehumidification in Water Treatment Plants	Rathvilly WTP	39% or 72,275kWhs	€5,490. Simple payback: 4.9yrs
Water Pumping – speed control using VSDs	Bagenalstown WTP	VSDs did not reduce energy consumption. Further monitoring & analysis required.	
Water Pumping – Night Time Pressure Reduction	Oak Park WTP	8% or 15,768kWhs	€1,260 Reduced MIC: savings of €3,500
Caretaker training	Carlow	Energy efficiency training in water & wastewater treatment sites	

The table listing the summary of conclusions dictates that the most effective initiative monitored was that of pump replacement. Second was the lighting upgrade at county hall. These are both capital projects. The low cost initiative was pumping less at night to reduce pressure in the line, and hence, saving energy and reducing leakage in the line. On this basis the CKEA will identify all potential opportunities to replicate these measures across Local Authority stock.

The least effective measure was that of replacing the desktops with payback of 21 years. However, when one compares the cost of replacement of a standard desktop PC it is paramount that for a replacement strategy only low energy PANO systems or equivalent are incorporated into hardware resulting in reduced operating cost of overall system.

There was a substantial difference in energy consumption between the three methods of wastewater treatment and aeration. Rotating drum aeration was 86% more efficient the older method of surface aeration treatment. This method should be considered for all new or replacement wastewater aeration treatments in LA.

The Dehumidification unit resulted in considerable savings and should be considered in plants where there are a large number of storage heaters being used to keep the building at the required relative humidity.

There were unsatisfactory results obtained from the installation of the Multismart Pump Station Manager (MPSM). The unit installed did not functionally operate and the installer has been contacted to rectify the problem. The installation of VSDs on the older pumps in Bagenalstown WTP did not produce the desired effect of reducing energy consumption at the plant. There were a number of assumptions made at the beginning of this initiative and these are being investigated further.

Carlow County Council will soon be implementing the SEAI Energy Map as part of their on-going energy policy. The lessons learned through the Climatlantic project have given Carlow County Council the competencies needed to report, monitor and verify energy savings.

All local authorities engage in the same practices; management of buildings, water treatment and wastewater treatment sites. All of these are significant energy users. Therefore, all initiatives undertaken in the Climaltantic Project can be replicated and implemented in other local authorities across Ireland and the EU. This would lead to significant energy savings across the EU public sector. It is expected that this report will benefit local authorities interested in engaging in any of these energy saving initiatives and monitoring which were undertaken in Carlow County Council through the Climatlantic project.