



powerPerfector

CASE STUDY

Grimsby Institute of Further and Higher Education

Installation 10th August 2008

Report November 2008



*“The **powerPerfector** technology will now be strongly considered for our programme of new builds, which forms part of North East Lincolnshire Council’s wider regeneration strategy”*

**Nigel Hollington, Director of Facilities Management
Commercial and Facilities Management Team**

powerPerfector Plc, 1-10 Praed Mews, London, W2 1QY
Tel: 0845 6014723 fax: 0845 6014724 Email: enquiries@powerperfector.com
www.powerperfector.com



Grimsby Institute of Further and Higher Education

Director of Facilities Management, Nigel Hollington writes:

About Grimsby Institute of Further and Higher Education

The Grimsby Institute of Further and Higher Education is a general education college offering full and part-time Further Education, a growing higher education provision, training for business, education in the community and commercial activities in its main Nuns Corner campus in Grimsby. It is the largest provider of vocational training in North East Lincolnshire and has seen significant growth in recent years in the number of students choosing to continue on to Further and Higher Education courses. With around 1,350 staff, the Institute is the third largest employer in the North East Lincolnshire region and one of the largest colleges in the UK.






The Opportunity

A grant to all FE Colleges became available via the Learning and Skills Council for proven energy efficiency measures, it was decided to utilise this funding stream to reduce our carbon footprint and energy bills.

The Solution

*A unique Voltage Power Optimisation technology, the **powerPerfector**, was identified and after conducting a free site evaluation process, the unit was installed with no disruption to the working of the College. The **powerPerfector** technology is regarded as best practise by the Department for Environment, Food and Rural Affairs (amongst other large UK companies) and is backed by a major energy supplier in British Energy giving us full confidence on the resilience of the technology.*

Savings and Overall Benefits

-  **14% reduction in average kWh consumption (higher than original estimates)**
-  **13% reduction in maximum demand**
-  **222,300kg annual CO₂ savings**
-  **£30,000 annual savings**
-  **2.25 year payback**

Contents

- ⚙️ Introduction
- ⚙️ Overview
- ⚙️ The Savings Report
 - ⚙️ Savings summary
 - ⚙️ Overall savings
 - ⚙️ Conclusions

Introduction

powerPerfector optimises the voltage and improves the power quality for a whole site more efficiently than any other technology available. Optimising the supply voltage allows equipment to use only the energy it requires to operate efficiently.

For example, providing a motor with its optimum voltage prevents excess heat and vibration, while delivering the required torque and speed. When these effects are aggregated across a whole site, substantial energy savings are delivered. The Maximum Demand of the site is also reduced — typically by as much as 10% — which will help keep the site within its Agreed Service Capacity and may reduce penalty charges.

Installing a **powerPerfector** improves power quality on a site considerably. The reactance of some electrical equipment is reduced when voltage is optimised, so there is an overall improvement in power factor. Equipment is protected as the **powerPerfector** eliminates transients up to 25,000V and harmonics are filtered from the mains, while the balancing of phase voltages maximises the efficiency of three-phase equipment. By optimising the power supply at source, the **powerPerfector** is able to extend the lifetime of all the electrical equipment on a site, substantially reducing maintenance overheads in addition to the energy savings.

Overview

Following a process of evaluation to confirm the level of optimisation and suitability of Grimsby Institute of Further and Higher Education for a **powerPerfector** unit, a 1250kVA unit was installed on 10th August 2008.

Following installation all electrical equipment has operated normally and there have been no reports of any problems. With further observation over time equipment life will be noticeably extended.

THE SAVINGS REPORT

Savings summary

| | |
|---|-----------|
| Reduction in average kWh consumption | 14% |
| Reduction in maximum demand | 13% |
| Projected annual carbon dioxide savings | 222,300kg |
| Projected annual financial savings | £30,000 |

Overall savings

A 1250kVA **powerPerfector** unit with a 7% optimisation setting was installed at Grimsby College on 10th August 2008. The following is an analysis of the half hourly consumption data for the site up to 31st October 2008. A 7% optimisation ordinarily yields a 11.5% reduction in average electricity consumption. Our analysis indicates that consumption at the site following installation is **14%** lower than the same period in the previous year. The method of analysis is outlined in the following report.

Figure 1 shows all of the available kWh consumption for the College from 1st October 2007 until 31st October 2008, where the data before installation is shown in red and after installation in green.

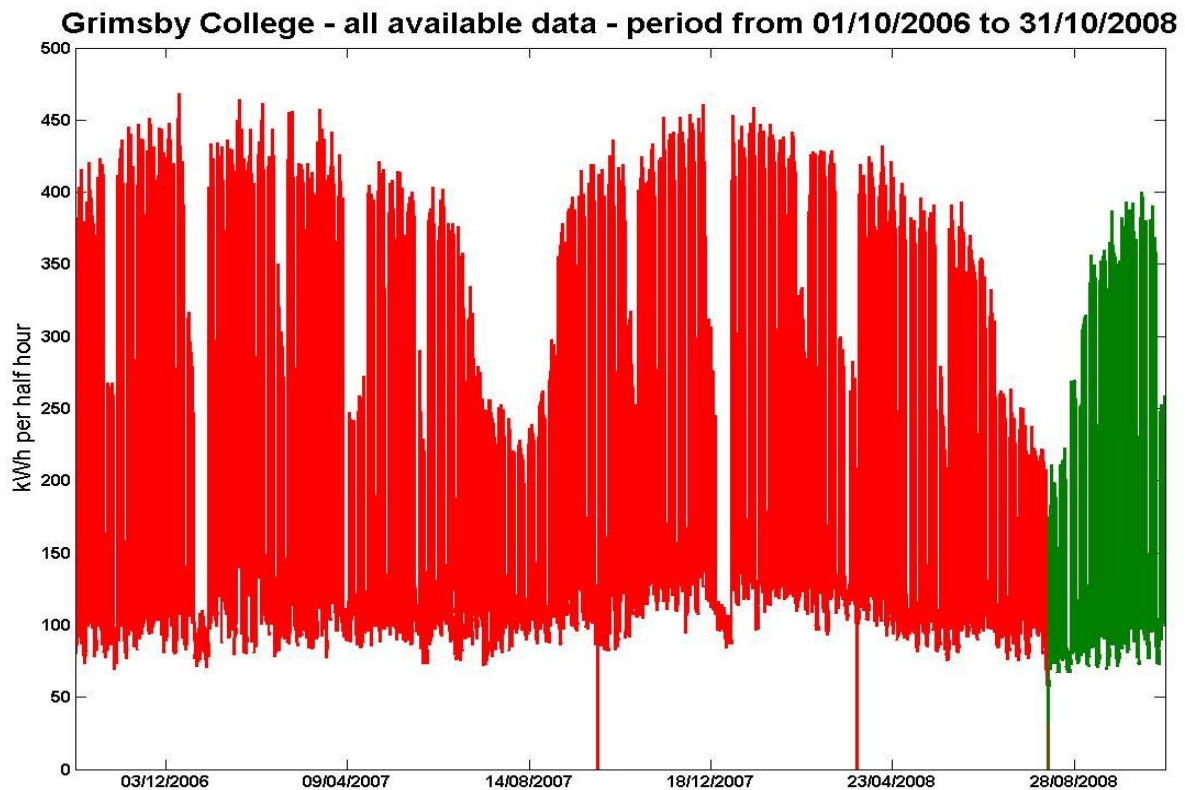


Figure 1

There is a drop in consumption immediately following the *powerPerfector* installation, shown in the **Figure 2** below, which has the two weeks immediately before and after installation. On this basis of comparison there is a **13.5%** reduction in average kWh consumption along with a **13%** reduction in maximum demand.

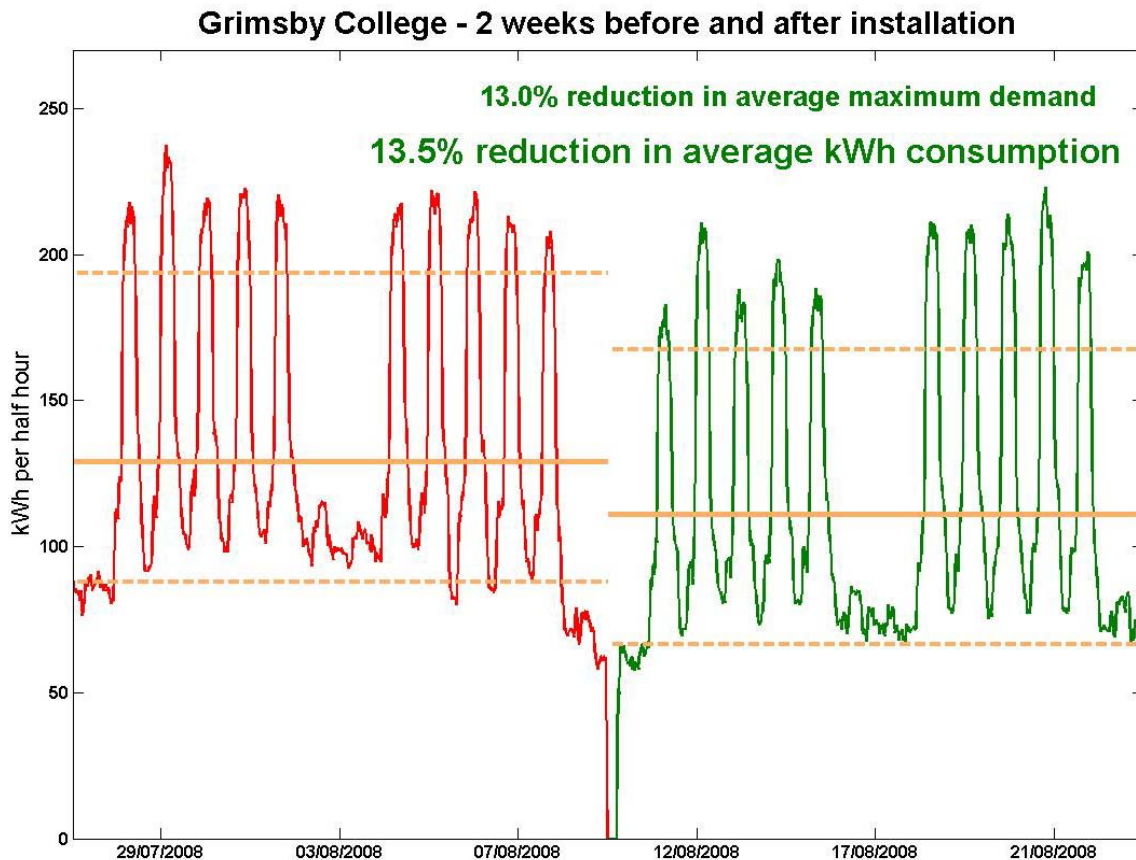


Figure 2

Whilst it is useful to show the immediate reduction, it is preferable to assess the savings over a longer time period, especially since the weeks in the chart above occur during college holidays. **Figure 1** shows that there is a seasonal variation in the electricity consumption, such that the highest consumption occurs during the winter months. We have therefore considered all of the post installation data with the pre installation data for the same period in the previous year, when consumption is likely to be at similar levels. This comparison is shown in **Figure 3**, where there are the same number of school term and holiday weeks in the pre and post installation data. On this basis of comparison, there is a **14%** reduction in average kWh consumption.

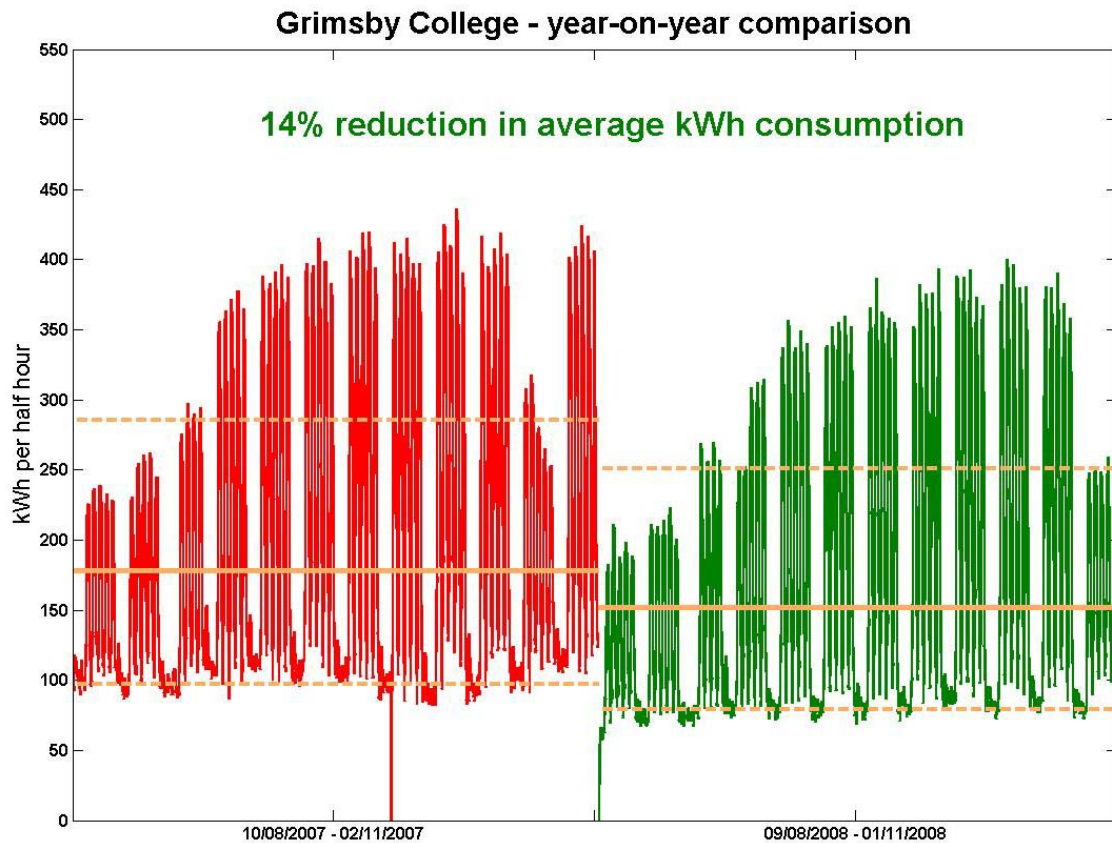


Figure 3

Conclusion

In conclusion, analysis of the site's electricity consumption indicates that the average kWh consumption is **14%** lower than the same period in the previous year, exceeding the predicted savings level. This equates to a projected annual emissions saving of **222,300kg** of carbon dioxide. Additionally, the site's equipment is being driven more efficiently by the *powerPerfector's* higher-quality power output, with improved phase balancing, reduced harmonics and optimised voltage. Equipment lifetimes will be extended as a result, giving further savings going forward that are not included in this analysis. It should be noted that there were no reported problems upon switch over from normal supply to *powerPerfector* and there is no requirement for ongoing maintenance.

The ability of VPO technology to reduce energy (kWh) consumption on a site is well documented, but the technology also provides a range of other benefits. These all contribute to creating a more efficient, robust and reliable electrical supply for your site, and provide further financial benefits on top of the reduced energy costs.

Reduced maintenance burden

Optimising voltage with **powerPerfect** brings your supply voltage to the “higher efficiency” operating range of your equipment. Without this, the ‘raw’ supply voltage to your site is likely to be at the top end of the range of voltages your electrical equipment can tolerate. As well as reducing energy consumption, this reduces the **strain** on your equipment, extending its lifespan.

For example, a lightly-loaded **induction motor** operating at an optimum 380V instead of a ‘raw’ 415V experiences less heating and vibration, reducing wear on bearings and prolonging its life.

The life of **incandescent light bulbs** is almost doubled by optimising their supply voltage.

Most equipment benefits from the lower ‘**pressure**’ when voltages are optimised. Other examples include Variable Speed Drives – which are particularly sensitive to over-voltage – and the capacitor banks in Power Factor Correction systems.

When these effects are **aggregated**, the benefit to your site of extended equipment lifetimes and reduced replacement costs will be substantial. The exact saving is difficult for **powerPerfect** to quantify, but we estimate it to give you a 10%+ reduction of your maintenance and capital replacement costs.

Improved power factor

Optimising supply voltages reduces the **reactance** of electrical equipment, as it prevents over-excitation of magnetic components. The effect of this is to reduce the level of wasteful **reactive power** in the electrical system. Reducing reactive power improves **power factor**, and the **powerPerfect** typically improves power factor by 3-10%.

The **maximum demand** of a site is expressed in kVA (incorporating both real and reactive power). So reducing reactive power reduces the maximum demand of a site, which will lead to reduced kVA demand charges, Agreed Service Capacity (ASC), and increase spare capacity for further growth. (8% optimisation = 6%-10% reduction in MD normally)

Power factor **penalty charges** – which are now uncapped in the UK – can be avoided if your power factor is above 0.95. These may appear on your bill as ‘reactive power charge’, ‘kVAr charge’, ‘use of system charge’ or ‘availability charge’. If your power factor is at around 0.9 at the moment, the **powerPerfect** could remove your exposure to these charges.

In general, the strain on your electrical infrastructure is reduced if power factor is good. If your system is carrying a high proportion of reactive power, impedances and voltage-drop will be excessive, and overall **efficiency** will be low. The **powerPerfect** improves the electrical efficiency of your site.

The **powerPerfect** yields many of the same benefits as **Power Factor Correction**, but does not use capacitors, which can be prone to failure. Instead, it helps correct the underlying cause of poor power factor, while saving energy.

Lower harmonic distortion

The **powerPerfect** is able to **filter harmonics** on the mains incomer. Harmonic distortion is on the increase, leading to apparently random failures of electronic equipment.

As the site is protected from mains-borne harmonics, disruptions to the operation of sensitive **electronic equipment** that could otherwise result from intolerance to harmonic distortion are minimised.

By preventing harmonics from entering the secondary side of the **HV supply transformer**, the **powerPerfect** is able to improve the transformer’s efficiency and increase its effective capacity. Customers whose utility meter is on the HV side of their transformer will see higher savings as a result.

The threat from damaging **resonance** effects is reduced as harmonic distortion is lower, as is the risk of failure of Power Factor Correction capacitors.

The **efficiency** of any equipment containing magnetic components is improved – contributing to energy savings – as the heating effect of harmonics is reduced. This in turn extends operating life by postponing the breakdown of insulating materials.

Reduced neutral currents

As well as providing general harmonic filtration, the **powerPerfect** helps to reduce the level of **triplen harmonics** on a site, by balancing the three phase voltages.

In addition to the benefits listed above, this leads to reduced **neutral currents** and temperatures – even though the neutral cable does not pass through the *powerPerfector* – as triplen harmonics accumulate on the neutral. Lower neutral currents are always desirable, and with an increasing proportion of non-linear loads generating more harmonics than ever before, undersized neutrals are a potential risk on many sites.

Improved phase voltage balance

The operation of **three-phase equipment** – particularly induction motors – is much more efficient if the phase voltages are closely balanced. For large industrial sites that are heavily dependent upon such loads, balancing phase voltages at an optimum level with *powerPerfector* can yield energy savings of over 20% in motors.

Protection

A *powerPerfector* makes an electrical supply more robust, and your site better protected. **Transients** – which are very brief surges in voltage from the grid – are eliminated by the *powerPerfector*, provided they are less than 25,000V.

This level of protection is able to prevent transients from causing catastrophic damage to equipment, but it also prevents smaller, more common transient events that act to degrade equipment over time. This prolongs the expected life of electronic equipment.

