

Voltage Power Optimisation (VPO)[®]

Case Study

Down Hall

Country House Hotel

Installation 18th August 2008

Report November 2008



"The installation of the powerPerfector unit was part of our overall "Going Green" project and has helped us achieve the targeted savings in energy consumption we were looking for. The whole process was very simple once the reduction in electricity usage had been identified. powerPerfector helped me to secure funding from The Carbon Trust and installation was a simple process as well. The hotel is now achieving savings in the region of 20% year-on-year in electricity usage."

**Sean Quinney - General Manager
Down Hall - Country House Hotel**

DH

DOWN HALL
Country House Hotel



About Down Hall Country House Hotel

Down Hall Hotel is one of England's most established country house hotels. Located in Hatfield Heath, it is part of the Veladail Collection and is working towards becoming a carbon neutral hotel.



powerPerfector unit details

A pP350kVA/500A unit with an 8% optimisation was installed at the Down Hall Country House Hotel on 18th August 2008. Through installation the following results were achieved:

- **11% reduction in daily average consumption**
- **70,000kg CO2 per year**
- **£11,912 average savings per year**

Electrical load

Comprises largely of lighting and air conditioning. It features 99 rooms and facilities include a restaurant and fitness centre with swimming pool.

FULL REPORT

Contents

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

Introduction

powerPerfactor 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 powerPerfactor 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 powerPerfactor 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 powerPerfactor 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 Down Hall Country House Hotel for a powerPerfactor unit, a pP350kVA /500A unit was installed on 18th August 2008.

A scheduled shut down of the site was required, with the work carried out over the weekend.

Following installation all electrical equipment has operated normally and there have been no

reports of any problems. With further observation over time, our clients tell us that equipment life can be noticeably extended.

THE SAVINGS REPORT

Savings Summary

Reduction in daily average consumption	11%	£32 per day
Projected annual carbon savings	70,000 kg	

Overall savings

A 350kVA powerPerfector unit with an 8% optimisation setting was installed at Down Hall Hotel on the 18th August 2008. The following is an analysis of the half-hourly electricity consumption data for the site. We conclude that a reduction of **11.0%** in average daily kWh consumption has been achieved since the installation of the powerPerfector. This equates to a projected annual carbon dioxide emissions saving of approximately **70,000kg**. The method of analysis is outlined in the following report.

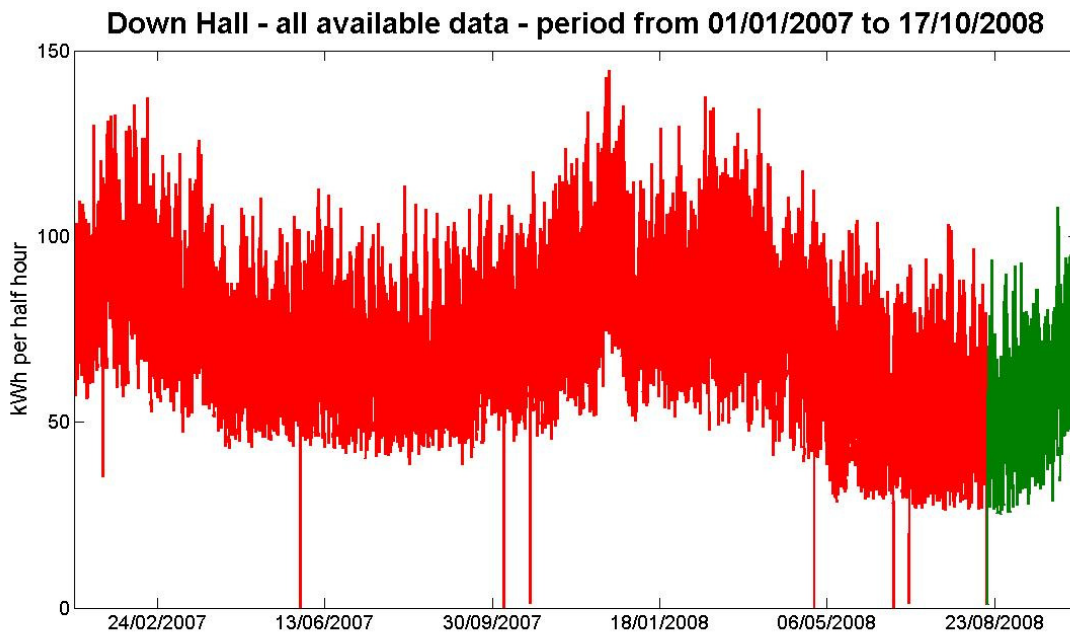
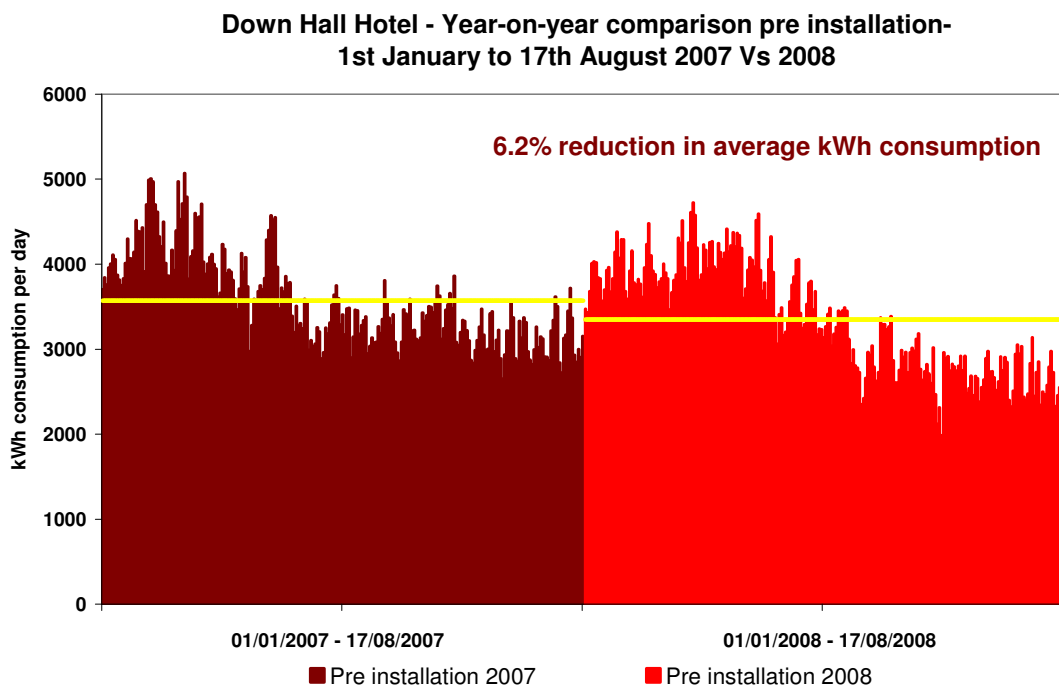


Figure 1 shows the half-hourly consumption from 1st January 2007 to 18th October 2008. The electricity consumption before installation is shown in red and the consumption after installation is shown in green.

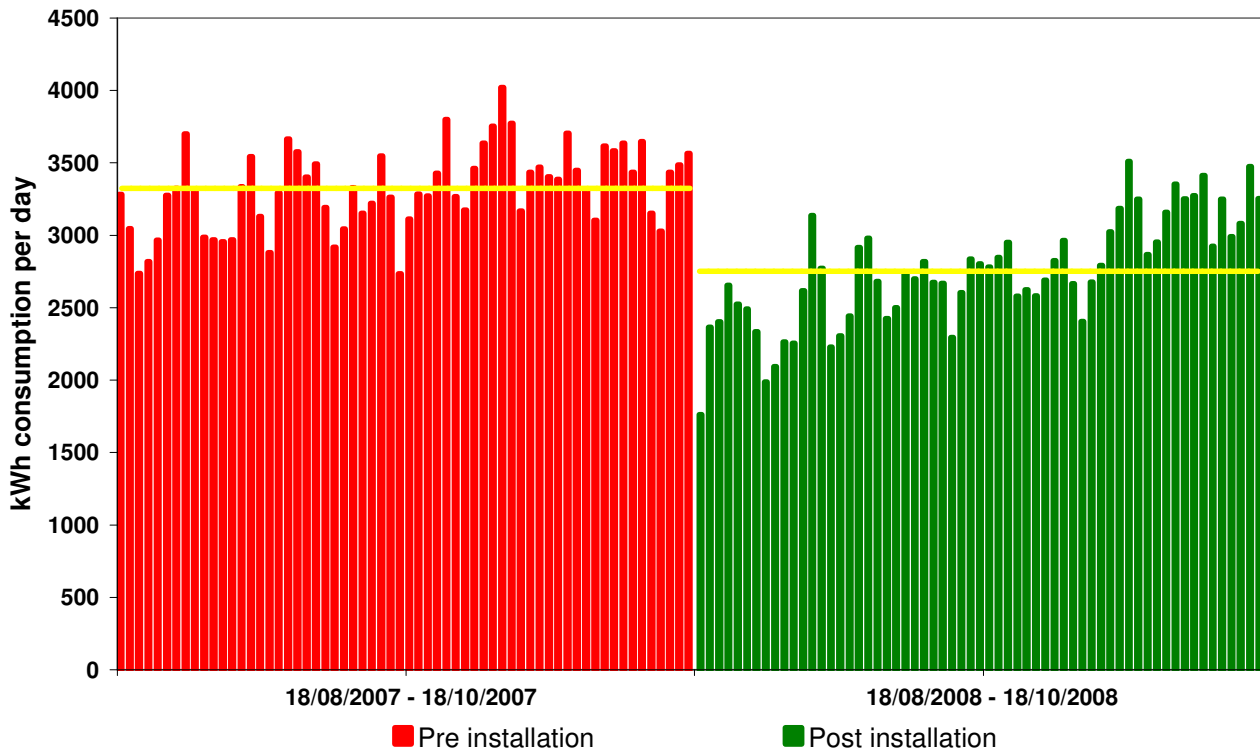
Other energy-saving measures have been implemented on the site approximately 5 months prior to the installation of the powerPerfector. Therefore, it is important to account for any reduction in consumption before the powerPerfector was installed.

Figure 2 displays the period 1st January to 17th August 2007 compared to the same period in 2008 (i.e. immediately before the powerPerfector was installed). The yellow line indicates the average half-hourly kWh consumption for each period considered. A 6.2% reduction in average daily kWh consumption is evident.



To isolate the savings attributable to the powerPerfector, we need to factor in this 6.2% year-on-year reduction in consumption. **Figure 3** shows the daily consumption for the period 18th August to 18th October 2007 compared to the same period in 2008. Energy consumption after the powerPerfector was installed is 17.2% lower than the previous year, so there is a *further* **11.0%** reduction in average daily kWh consumption, which is attributable to the powerPerfector.

Down Hall Hotel - Year-on-year comparison - 18th August to 18th October 2007 Vs 2008



Conclusion

In conclusion, analysis of electricity consumption at this site indicates that an **11.0%** reduction in average kWh consumption is attributable to the **powerPerfector**. This equates to a projected annual saving of approximately **70,000kg** of carbon dioxide emissions.

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 only maintenance that is required is external cleaning of the unit and 5 yearly routine wiring checks. No other maintenance is necessary.

Voltage Power Optimisation Additional Benefits

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 powerPerfector 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, and many of our clients tell us that this increases 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 powerPerfector 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 powerPerfector 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 powerPerfactor 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 powerPerfactor improves the electrical efficiency of your site.
- The powerPerfactor 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 powerPerfactor 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 powerPerfactor 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 powerPerfactor 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.

