

# Voltage Power Optimisation (VPO)<sup>®</sup>

## CASE STUDY

### RSPB The Lodge

Installation 9th May 2008



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**David Waller**  
Head of Central Services  
RSPB



## About RSPB -The Lodge

The Royal Society for the Protection of Birds (RSPB) is a nature conservation charity operating both nationally and internationally and is a passionate advocate for meaningful policies aimed at reducing the harmful impact man-made CO2 emissions are having on the environment. The Lodge is the headquarters for RSPB.

## powerPerfector unit details

A pP280kVA/400A unit with a 8% optimisation was installed at the RSPB, The Lodge site on the 9th May 2008. Through installation the following results were achieved:

- **12.8% reduction in average consumption**
- **£12,524 average savings per year**
- **58 tonnes CO2 per year**



## Electrical load

The office electrical load includes two UPS devices, lighting circuits, air conditioning and standard office equipment.

## FULL REPORT

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### 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 the RSPB, The Lodge site for a powerPerfector unit, a pP280kVA / 400A unit was installed on 9th May 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	<b>12.8%</b>
Projected annual carbon savings	<b>58 tonnes</b>
Effective base load reduction	<b>12.4%</b>
Reduction in daily average maximum demand	<b>13.7%</b>

### Overall savings

A 280kVA powerPerfector with a -8% optimisation setting was installed at RSPB, The Lodge, on the 9th May 2008. The following is an analysis of the half-hourly electricity consumption data for the site to the 9th August 2008. Optimising voltage by 8% ordinarily yields a 13% reduction in average electricity consumption. As shown in the charts below, the average consumption for that period since the powerPerfector was installed has been reduced by at least 12.8%. The method of analysis is outlined in the following report.

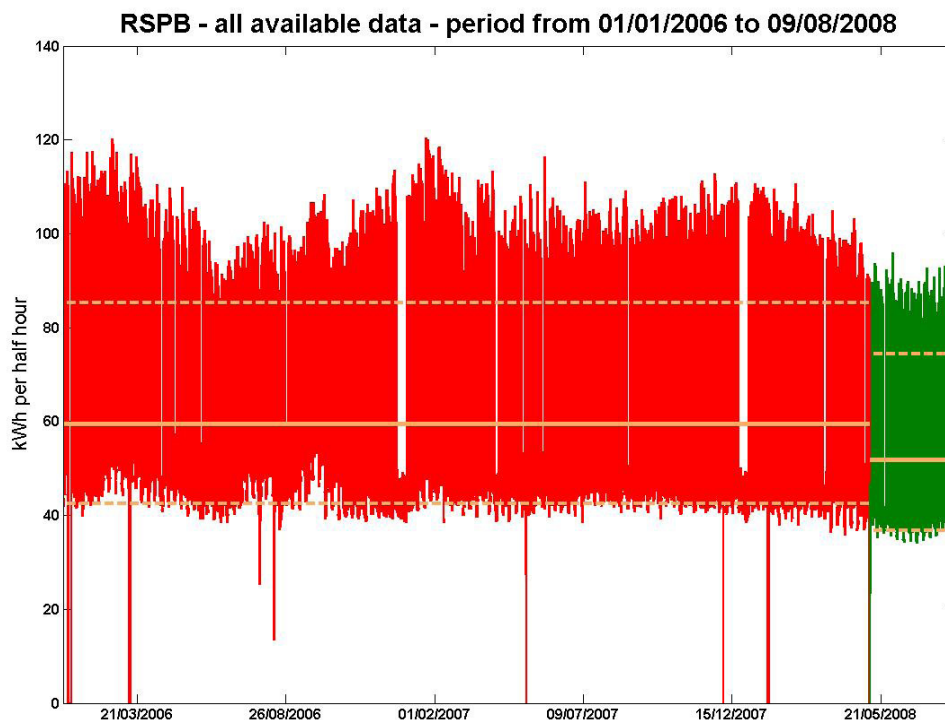
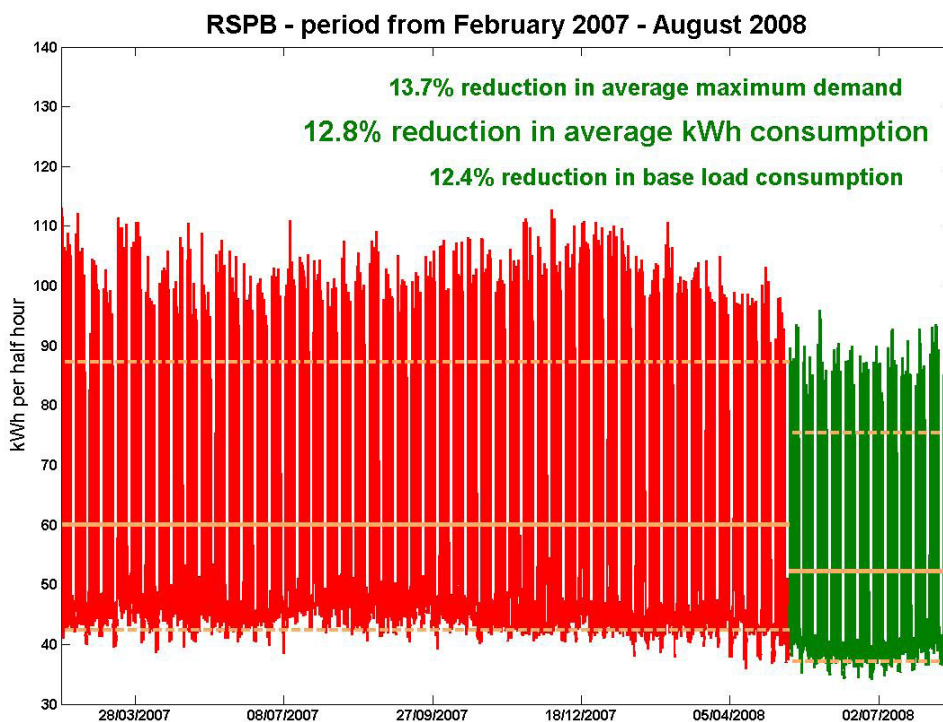


Figure 1

**Figure 1** shows the full consumption profile throughout the period January 2006 to 9th August 2008. The period before the installation of the powerPerfector is in red and the period after in green.

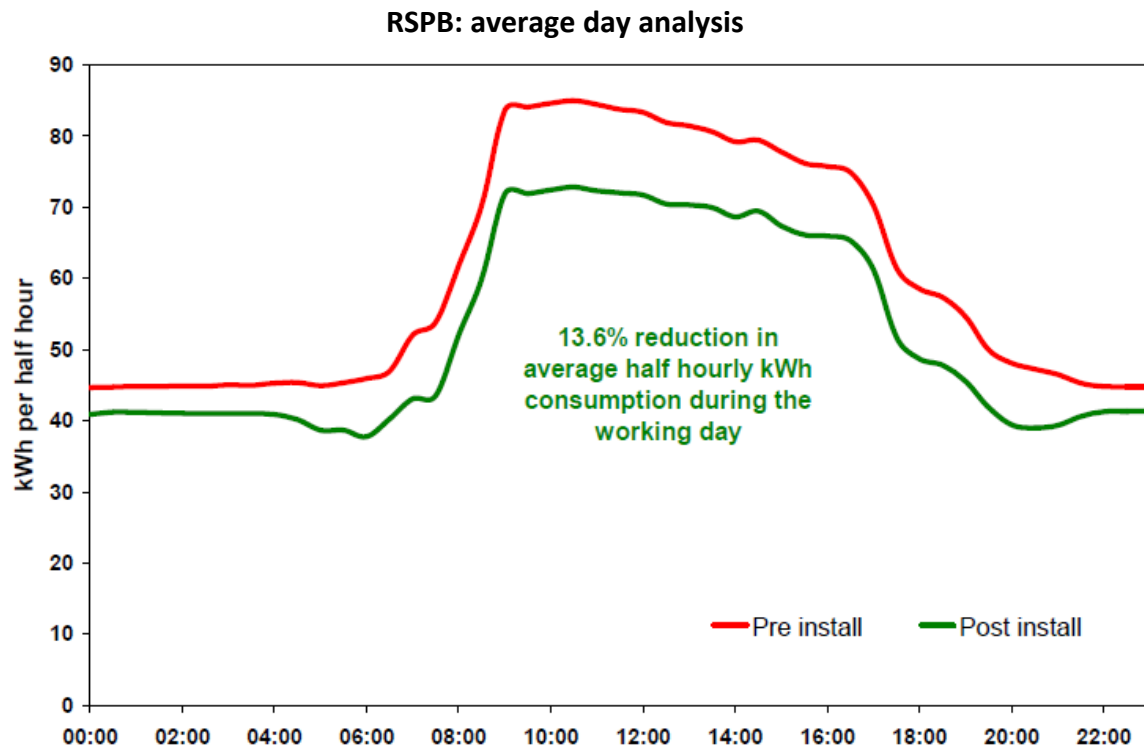
In order to isolate the savings attributable to the powerPerfector, we have considered a more restricted period of time where the kWh consumption shows a broadly similar pattern of consumption. **Figure 1** shows some variation in base load until February 2007, after which it shows a more consistent level. There are also atypically low periods of consumption that coincide with public holidays such as Christmas, New Year and Easter.

**In Figure 2**, we have therefore considered the period from February 2007 onwards compared with all of the post installation period, excluding any weeks where there were public holidays from both the pre and post installation data. On this basis of comparison there is a reduction of **12.8%** in average kWh consumption along with a **13.7%** reduction in average maximum demand and a **12.4%** reduction in base load.



**Figure 2**

Using half hourly kWh readings, it is possible to look at the electricity consumption in greater resolution over the course of an “average” day. **Figure 3** shows the average kWh consumption per half hour considering the same period of time shown in the previous graph. Over each half hourly period, savings tend to be highest during the working day when more energy is being consumed. The average reduction over each half hourly period during the working day is **13.6%**, shown in the following graph.



**Figure 3**

## Conclusion

In conclusion, analysis of electricity consumption at the site following the **powerPerfector** installation indicates that there is a **12.8%** reduction in average kWh consumption based on a comparison of pre installation data to February 2007 with all of the post installation data. This equates to a projected annual saving of **58 tonnes** in 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, beyond the standard 5 yearly electrical checks required for all electrical equipment.

*"RSPB has for a number of years endeavoured to reduce the environmental damage resulting from its own business activities, not least in terms of energy. The Society's biggest single point of energy consumption is its headquarters at Sandy, Bedfordshire, and although many reduction measures had already been taken we were very interested in powerPerfector's claim that a significant reduction was possible by installing a voltage optimiser device.*

*Following a site survey and the production of a kWh/financial savings analysis by powerPerfector, RSPB decided to make the necessary investment. I'm pleased to say the results from the initial 3-month review have been extremely encouraging and in line with the projections made by the company. The Society will make every effort to further reduce its energy but the powerPerfector voltage optimiser will certainly be considered for other sites with suitable electrical demand profiles."*

**David Waller**  
**Head of Central Services**  
**RSPB**

## Voltage Power Optimisation Additional Benefits

The ability of VPO<sup>®</sup> 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 powerPerfector 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 powerPerfector improves the electrical efficiency of your site.
- The powerPerfector 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 powerPerfector 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 powerPerfector 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 powerPerfector 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.

