

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

### **CASE STUDY** **Paton Brown Ltd.** **Production Hall**

Installed: November 2009  
Report: January 2010



“As a ‘green’ company we are always looking for ways of reducing our carbon footprint to supplement our recently achieved ISO14001 qualification. Working closely with powerPerfactor we were then guided through the process of securing a Carbon Trust loan, with repayments being covered by the anticipated savings. Financially, this really is a no-brainer for any company. Not only were we enhancing our green credentials, but it wasn’t costing us anything.

Throughout the process the people at powerPerfactor were wonderful to deal with, the whole process was straightforward and well managed. The help and advice we received was of the highest standard. Most importantly the product performed exactly as we were initially told it would, in fact it exceeded expectations.

I would recommend powerPerfactor to anyone considering using their products. Without doubt it was the best level of service we have received from a company.”

**Duncan Etheridge, FCCA**  
**Finance Director**



### **About Paton Brown Ltd:**

Paton Brown represent excellence and a completely customer focused service in all aspects of Data Management, Print and Distribution.

Within each specialist operational activity, the experienced and organisational skills of our family-run business provides a consistent standard of both quality and reliability.

Paton Brown has almost 50 years of experience in the direct mail industry and a personal interest in the client. Founded as an independent sales promotion company on the premise of supplying high quality products and services to their clients, they've had a lot of time to find out what works best and why.

### **How powerPerfector were able to help Paton Brown Ltd:**

After receiving the annual electricity consumption details for the Paton Brown Production Hall and Print Hall, it was possible to give a provisional quote for two powerPerfector units and to outline the potential for energy savings. A voltage logger was then sent for a week and a half, which recorded the voltage level at the site by connecting it to a regular mains socket. After a survey of the site by a powerPerfector Approved Contractor, the installation took place. Analysis following the installation showed that, in the Production Hall, there was an average reduction in kWh consumption of at least **10.2%** attributable to the powerPerfector installation, equating to annual carbon dioxide emissions saving of **12,712kg.**

### **Getting the source right**

powerPerfector is the world's only Voltage Power Optimiser, giving energy, carbon and cost savings by efficiently optimising a site's supply voltage. By optimising the voltage, electrical equipment runs more efficiently and consumes less energy. The declared electricity supply in the United Kingdom is now, as a result of European Harmonisation, 230V with a tolerance of +10% to -6%. This means that effective voltage can be anywhere between 216V and 253V depending on local conditions. Most electrical equipment manufactured for Europe and the UK is rated at 220V and operates more efficiently at this level. Forcing appliances to operate at a higher voltage in the UK (242V is the average supply level) leads to significantly higher energy consumption, increased heat losses and a reduced life span. 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, extending its lifespan according to many of our clients.

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### **Savings Summary for the Production Hall at Paton Brown Ltd:**

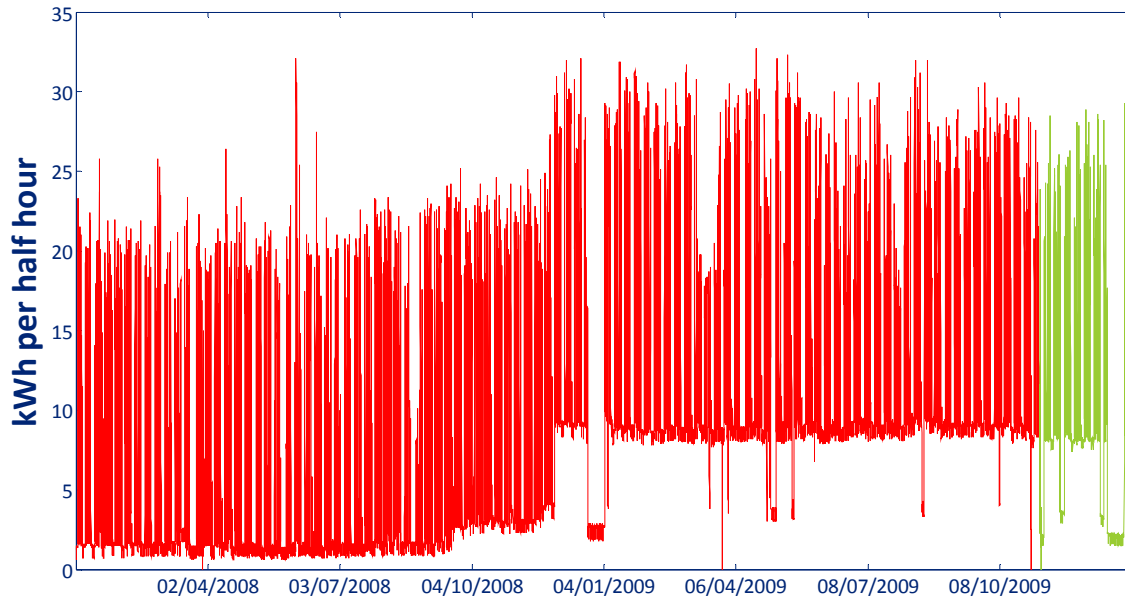
- Reduction in average kWh consumption: **10.2%**
- Projected annual carbon dioxide emissions savings: **12,712 kg**
- Projected annual financial savings: **£ 2,694**

Two 105 kVA powerPerfector units, one with a 10% optimisation setting (in the Production Hall) and the other with an 11% optimisation setting (in the Print Hall) were installed with Paton Brown Ltd on 7th November 2009. The following report is an analysis of the kWh consumption data for the Production Hall obtained through the half hourly meter for that supply using data up to 9th January 2010, the Print Hall is not metered half hourly hence this report only refers to the Production Hall. Our analysis indicates that electricity consumption has been reduced by at least **10.2%** since the powerPerfector was installed. This equates to a projected annual carbon dioxide emissions saving of approximately **12,712 kg** and an annual financial saving of **£2,694**.

The method of analysis is outlined in the following report.

The chart below shows the half hourly kWh consumption of the site from 1st January 2008 to 9<sup>th</sup> January 2010.

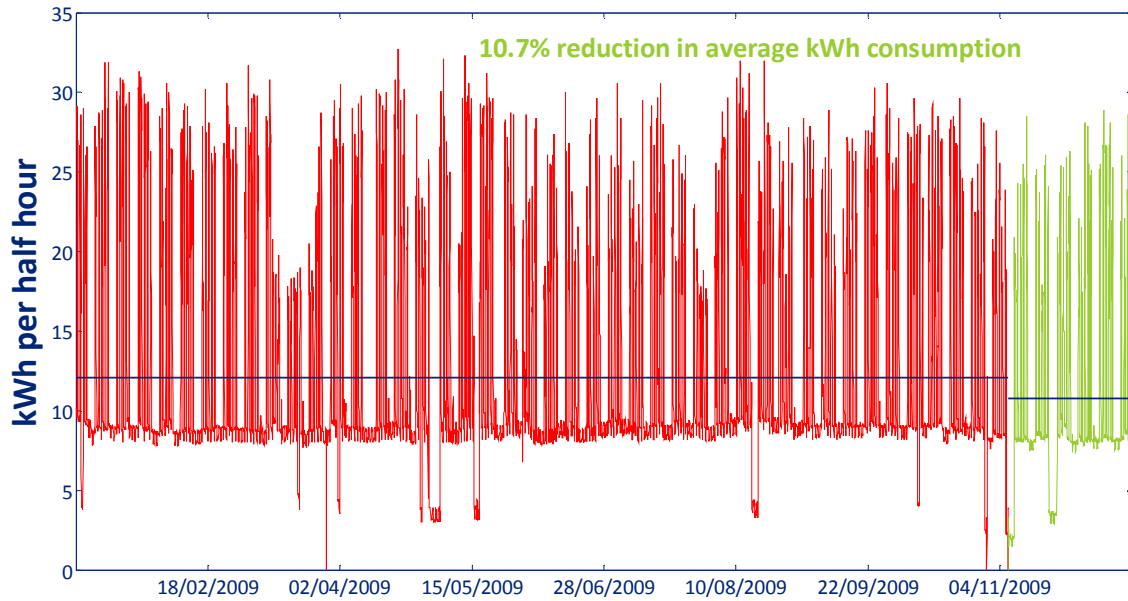
### Paton Brown Ltd - all available data



The energy consumption of the Production Hall is relatively unpredictable. External temperature does not have a consistent affect on the energy consumption and there are unpredictable drops, where energy consumption falls to half of the typical level, which are not correlated with bank holidays.

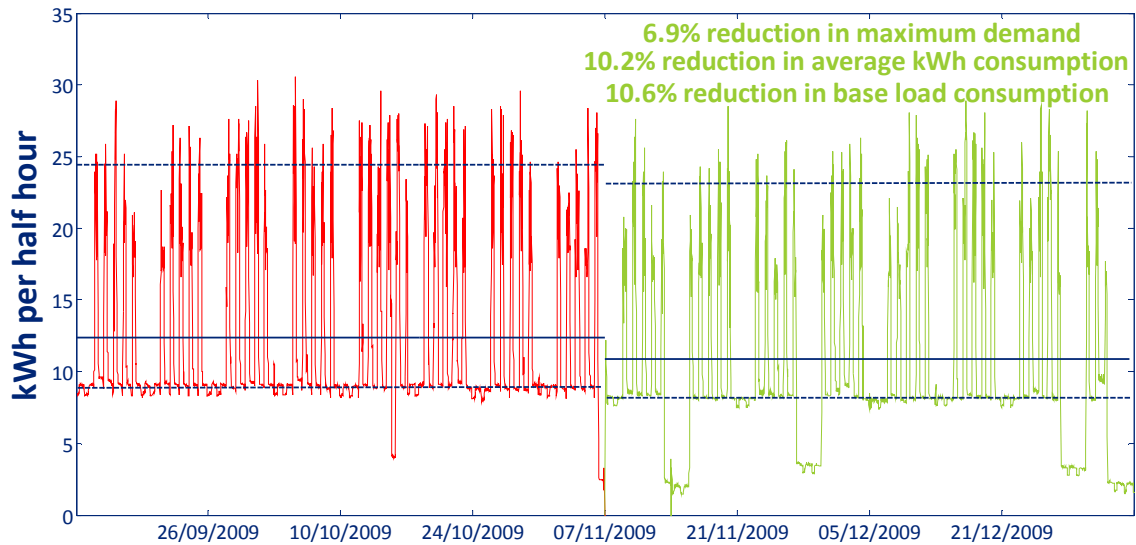
It is clear from the previous graph that energy consumption at this site saw a step increase in base load of around 5 kWh at the beginning of December 2008. Therefore a comparison on the basis of data subsequent to this step increase is a better representation of the reductions resulting from the installation of the powerPerfector. The following graph shows the energy consumption from 6<sup>th</sup> January 2009 to 18<sup>th</sup> December 2009, hence this comparison does not include any of the pre step change data, nor does it include the atypically low energy consumption seen around the Christmas and New Year periods.

## Paton Brown Ltd - period from 06/01/2009 to 18/12/2009



On the basis of the above comparison there has been a 10.7% reduction. To assess the immediate affect of the installation the 8 weeks immediately before and after install have been compared in the following graph. In order to compare the energy consumption of the site when it is in operation, weekends have been excluded from calculation of the averages and the low period around Christmas, from 24<sup>th</sup> December 2009 to 1<sup>st</sup> January 2010, has also been excluded to avoid overestimating the savings attributable to the powerPerfector.

## Paton Brown Ltd - 8 weeks before and after installation



This basis of comparison shows that the average half hourly kWh consumption was 10.2% lower in the 8 weeks after the installation than in the 8 week leading up to it. As weekends have been excluded, this basis of comparison omits any of the unpredictable, atypical drops in energy consumption mentioned previously, which makes it a strong basis for comparison.

In order to further measure the level of energy consumption that could be expected at the Production Hall site, it would be useful to analyse any production data that may have an affect on the level of energy consumption.

In conclusion, based on the energy consumption prior to the installation of the powerPerfector, the reduction in kWh consumption at the Production Hall site is at least 10.2%. It is possible that the reduction in kWh consumption could be calculated more accurately with supporting data, such as productivity levels, which may allow modelling of pre-install data to show what level of consumption could have been expected, had the powerPerfector not been installed. However, there is clear evidence to indicate that the level of kWh consumption has been reduced by between 10.2 and 10.7%.

In addition, the powerPerfector with Paton Brown Ltd are also ensuring that the site benefits from improved power quality and protection from transients of up to 25,000 V. Further details of the benefits of voltage power optimisation are appended to this report.

## 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.

