

Voltage Power Optimisation (VPO)[®]

CASE STUDY

Brown & Holmes Tamworth

Installed: April 2009

Report: February 2011

BROWN & HOLMES (Tamworth) LTD
Precision Workholding and Machining



"With the help of a four year interest free Carbon Trust loan, we installed a powerPerfactor unit into our offices in April 2009 which is now delivering substantial energy, financial and carbon savings of 15.1%. Along with other energy saving measures, the installation of the powerPerfactor unit has gone a long way to helping Brown & Holmes achieve lower levels of energy consumption."

Kevin Ward
Director
Brown & Holmes





About the Brown & Holmes – Tamworth

Since 1939, Brown and Holmes have maintained an enviable position in the marketplace by delivering superior quality workholding solutions. Brown and Holmes pride themselves on offering a complete service and their skills base includes design, manufacture, assembly, testing and inspection, tooling support, installation and after sales support. They specialise in the supply of standard and semi-standard CNC Cubes and Tombstones, test rigs, jigs and fixtures, special machines and gauges; also offering high precision machining and complex assembly work.

How powerPerfector were able to help Brown & Holmes

After Brown & Holmes sent its annual electricity consumption details, it was possible to give a provisional quote for a powerPerfector unit and the energy savings that would be expected. A voltage logger was then sent for one week, which recorded the voltage level in the building by connecting to it in to a regular mains socket. It was found that the average voltage at the site was 245 volts (V), 15V higher than the nominal supply in the UK. After a survey of the site by a powerPerfector Approved Contractor, the installation took place. There was no noticeable change to the operation of the building, although continuous carbon savings were instantly being made every day at the site. Just under 2 years after the installation the electricity consumption was analysed to find a reduction of **15.1%**, equating to annual carbon dioxide emissions saving of **39.9 tonnes**.





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 -10%. This means that effective voltage can be anywhere between 207V 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. It is estimated that 90% of sites in the UK are operating at too high a voltage and could therefore benefit from installing a powerPerfector.



Savings Summary for Brown & Holmes - Tamworth:

- Reduction in average kWh consumption: **15.1 %**
- Projected annual carbon dioxide emissions savings: **39.9 tonnes**
- Projected annual financial savings: **£7,000**

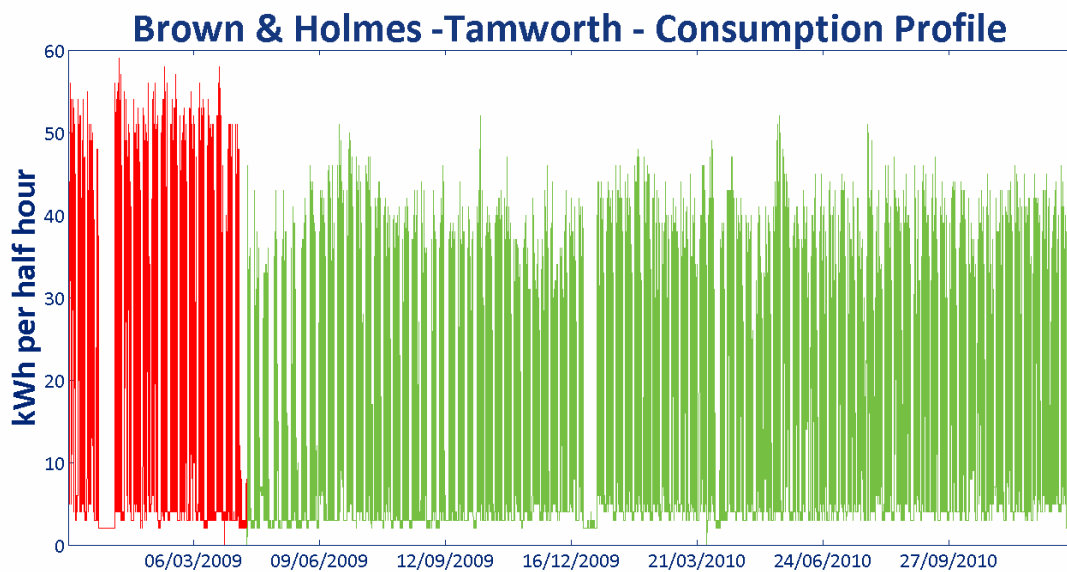
A 210kVA powerPerfector unit with an 8 % optimisation setting was installed at Brown & Holmes on 14th April 2009. The analysis shows that the electricity consumption at the site has been **15.1%** lower than when compared to the same period prior to installation. This equates to a projected annual carbon dioxide emissions saving of approximately **39.9 tonnes** and an annual financial saving of **£7,000**. The method of analysis is outlined in the following report.



Analysis

Consumption Profile

The chart below shows all available kWh data for Brown & Holmes, Tamworth, from 1st December 2008 to 31st December 2010. Data before installation is shown in red and after installation in green.



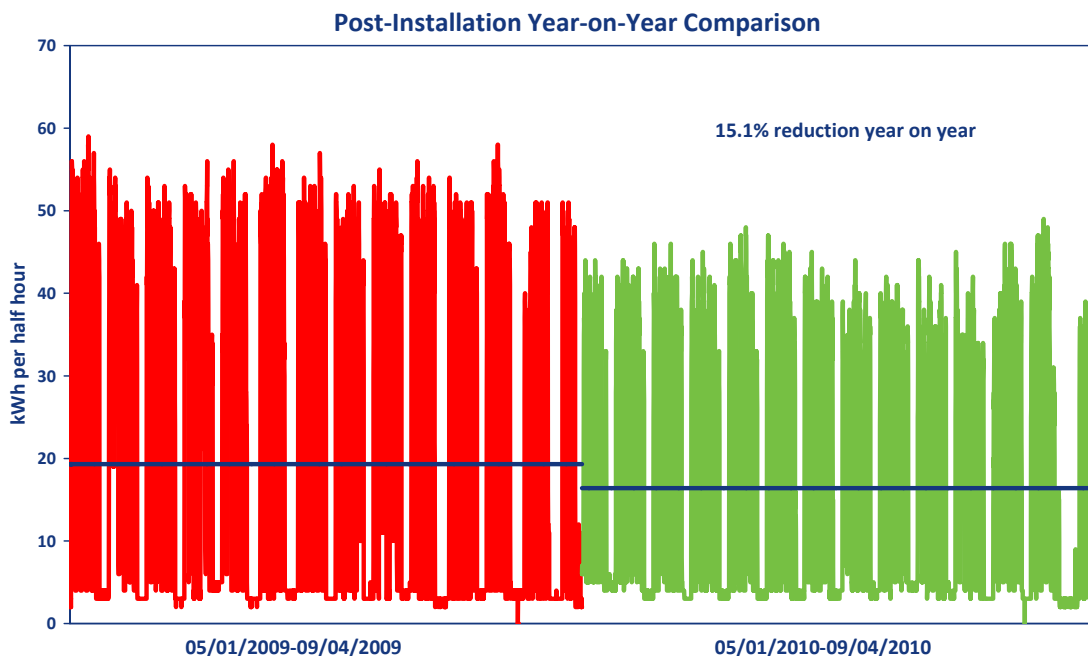
Although only four full months of pre-installation data are available, a reduction in consumption since the installation of the powerPerfector is apparent. The post installation data allows us to see the prolonged effect on consumption that the powerPerfector has had.

The consumption profile above does not follow any seasonal trend, suggesting that there is not a tangible correlation with external temperatures. This is confirmed by the poor correlation between Degree Days and actual energy consumption shown by the daily Degree Days model, with an R^2 value of 0.3. The R^2 value, also known as the coefficient of determination, can be interpreted as the proportion of the variance in the energy consumption attributable to the variance in Degree Days (1.0 indicating perfect correlation and 0 indicating no correlation).

Savings Analysis

As there is little correlation between consumption and external temperature an alternative method of analysis is year-on-year. The purpose of a year-on-year analysis is to compare kWh consumption for a period of post-installation-data with kWh consumption for the same period in the previous year. Therefore it is important when carrying out year-on-year comparisons that the two periods chosen are representative of the typical energy use on the site. The time period used in the year-on-year analysis is 5th January 2009 – 9th April 2009 and 5th January 2010 – 9th April 2010.

The result is charted below, and shows a reduction in average kWh consumption of 15.1 %.



Conclusions

In conclusion, the year-on-year analysis confirms that the electricity consumption following the installation of the powerPerfector at Brown & Holmes, Tamworth is **15.1%** lower when compared to the same period prior to installation. This equates to a projected annual carbon dioxide emissions saving of approximately **39.9 tonnes** and an annual financial saving of **£7,000**.

The response of any piece of electrical equipment to Voltage Power Optimisation will be the same throughout its lifetime. The efficiency improvement delivered by the powerPerfector to a given electrical load will, therefore, be constant and the savings figure concluded upon will not vary with time.

For any questions relating to the processes outlined above, the powerPerfector Analysis Team can be contacted as follows:

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The powerPerfector is also ensuring that the site operates at a higher level of efficiency, as well as benefiting from improved power quality and protection from transients of up to 25,000V. Further details about the benefits of Voltage Power Optimisation are appended to this report.

Appendix 1:

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 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.



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