

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

### CASE STUDY

#### Carrs Volkswagen

Installed: February 2008

Report: March 2008



"I found powerPerfector efficient, easy to deal with and most important of all the kit really does reduce our bills"

- Jon Keast, Carrs Volkswagen

## About Carrs Volkswagen

Carrs Volkswagen is in Indian Queens, Cornwall, where it employs 55 people in its two showrooms and two car workshops. It was one of the first car showrooms to install a powerPerfector.

## How powerPerfector was able to help Carrs Volkswagen

After receiving the annual electricity consumption details for Carrs Volkswagen, it was possible to give a provisional quote for a powerPerfector unit and to outline the potential for energy savings. A voltage logger was then sent for a little more than a week, 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 at a time which would cause minimum disruption to the site. Analysis following the installation showed that there was an average reduction in kWh consumption of **9.3%** attributable to the powerPerfector installation, equating to annual carbon dioxide emissions saving of **14 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. As a result of equipment specification and the range of voltage supply, there is an opportunity to achieve cost saving by optimising voltage at source and at the same time improve the operation and lifespan of a site's electrical infrastructure. 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 Carrs Volkswagen:

- Reduction in average kWh consumption: **9.3%**
- Projected annual carbon dioxide emissions savings: **14 Tonnes**
- Projected annual financial savings: **£2,200**

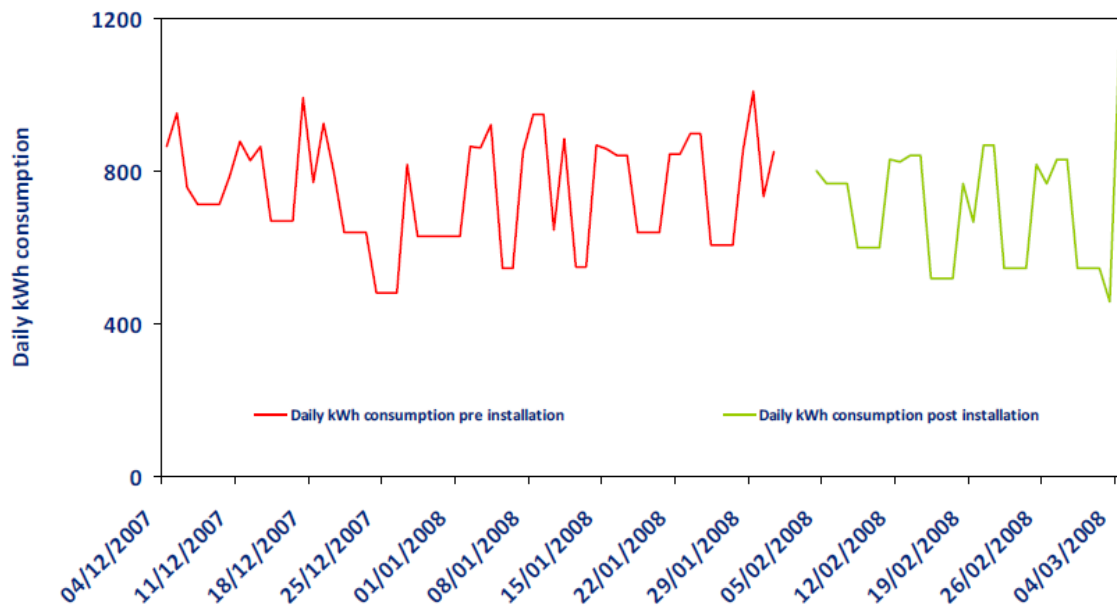


A 105kVA powerPerfector unit with an 8% optimisation setting was installed at Carrs Volkswagen on 2nd of February 2008. The following report is an analysis of the daily kWh consumption for the site up to 4th March 2008. Our analysis shows that savings of **9.3%** on average daily consumption have been achieved when comparing a 28 day period before installation with a 28 day period after installation. A reduction of **9.3%** equates to a projected annual emissions saving of **14 Tonnes** of carbon dioxide.

The methods of analysis are described in the report.

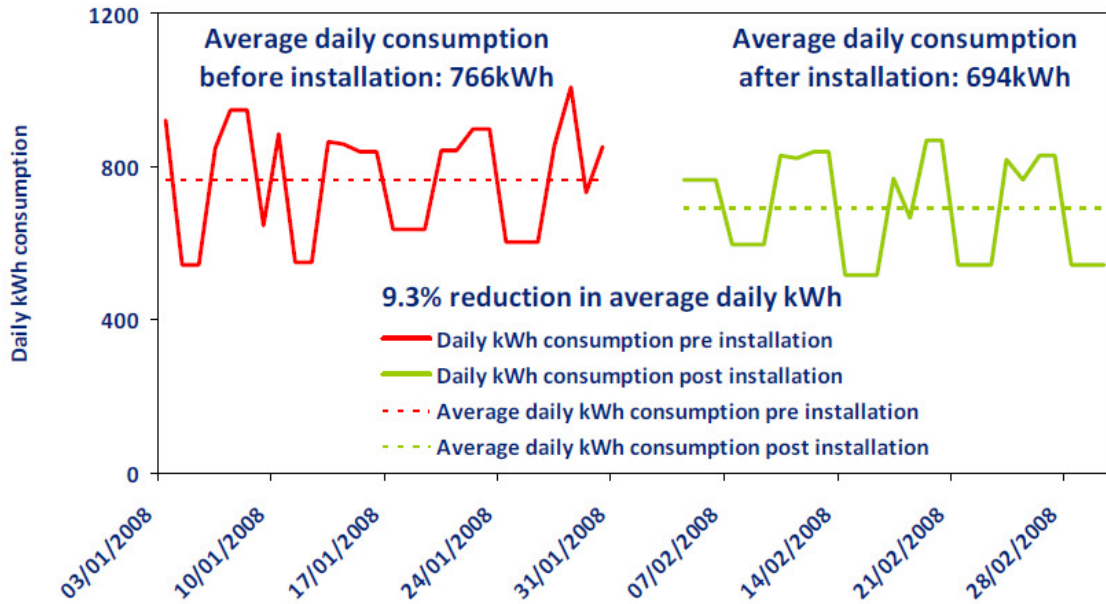
The following graph shows the daily kWh consumption profile before and after installation, obtained from recorded meter readings. The electricity consumption before installation of the powerPerfector unit is shown in red and the post installation consumption is shown in green.

**Carrs Volkswagen -  
Daily kWh consumption from 04/12/2007 to 04/03/2008**



As expected, low levels of consumption were recorded over the Christmas and New Year Holiday periods. To remove the effect of these holidays from the savings calculations a 28 day period before (04/01/08 to 31/01/08) and after (04/02/08 to 02/03/08) installation was considered. This also excludes the first consumption reading taken after installation, which is atypically low due to the shutdown required for installation. Considering these two 28 day periods a **9.3%** reduction in average daily kWh consumption is apparent, as shown in the following graph.

### Carrs Volkswagen: Daily kWh consumption 1 month pre and post installation



In conclusion, the powerPerfector is performing as expected. We are delighted to report that there are savings of **9.3%** in the kWh consumption at Carrs Volkswagen. This equates to an annual saving of **14 Tonnes** of CO2 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. Based on our clients' experience, 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.

## 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.

