

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

### CASE STUDY

**Winterthur Life**  
**Dextra Court**  
**Basingstoke**

Installation: 11th February 2007  
Report: May 2007



## About Winterthur Life

Winterthur Life is an award winning financial management company. The Dextra Court site in Basingstoke comprises an office with a large computer suite and server room.

## powerPerfactor unit details

A 420KVA/600A unit was installed on 11th February 2007 with a –9% Optimisation setting. Through installation the following results were achieved:

- **15.5% reduction in average consumption**
- **£8,070 average savings per year**
- **57 tonnes CO2 per year**

## Electrical load

Dextra Court is a 42,000 sq. ft. office over two stories. It has a server room protected by an uninterruptible power supply (UPS). A large proportion of the load comprises PCs and other computer equipment, as well as fluorescent lighting.

## 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 Dextra Court site for a powerPerfector unit, a pP420kVA / 600A unit was installed on the 11th February 2007.

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

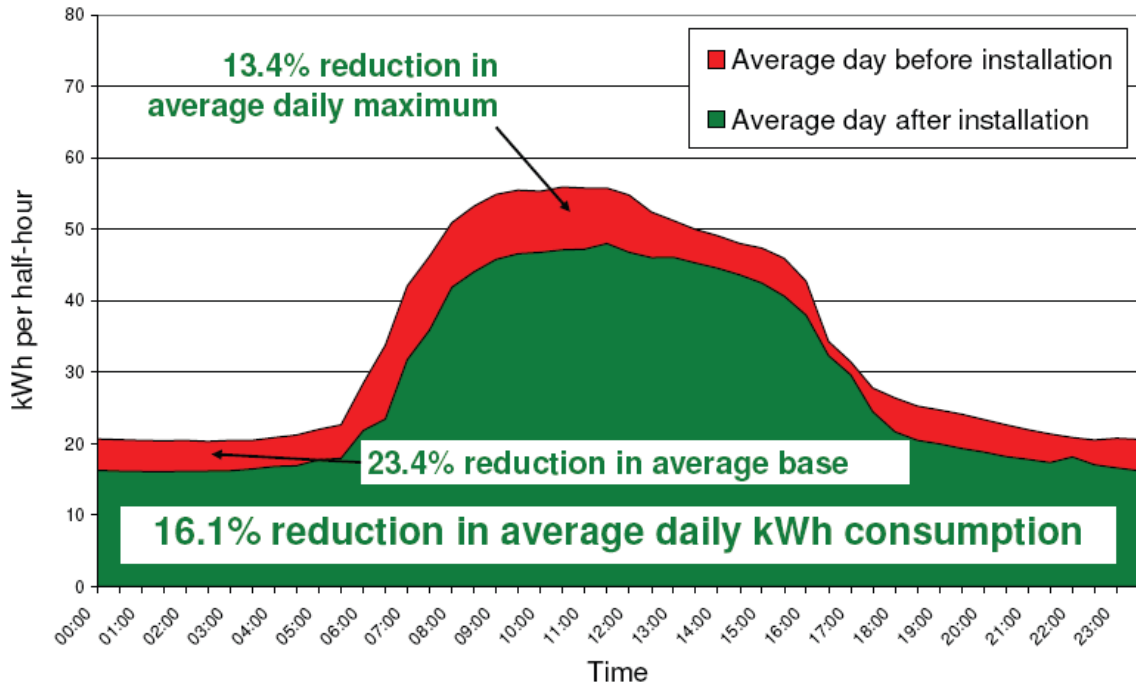
|   |           |                                |
|---|-----------|--------------------------------|
| Reduction in average consumption          | 16.1%     | £22 per day<br>£8,070 annually |
| Projected annual carbon savings           | 57 tonnes |                                |
| Effective base load reduction             | 23.4%     |                                |
| Reduction in daily average maximum demand | 13.4%     |                                |

### Overall savings

A 420kVA powerPerfector with a -9% optimisation setting was installed at Winterthur Life, Basingstoke, on 11th February 2007. The following is an analysis of the half-hourly electricity consumption data for the site to the end of April 2007. Optimising voltage by 9% ordinarily yields a 14.5% reduction in average electricity consumption. As shown in the charts below, in this case average consumption for the period since the powerPerfector was installed has been reduced by at least **15.5%**.

Taking averages of the half-hourly data from the site's fiscal meter from before and after the powerPerfector was installed gives the chart shown below (figure 1). The average base load (overnight consumption) on the site has been reduced by **23.4%**, and average daily maximum demand has been reduced by **13.4%**. On this basis, average daily consumption is down **16.1%**, exceeding the projected level of savings.

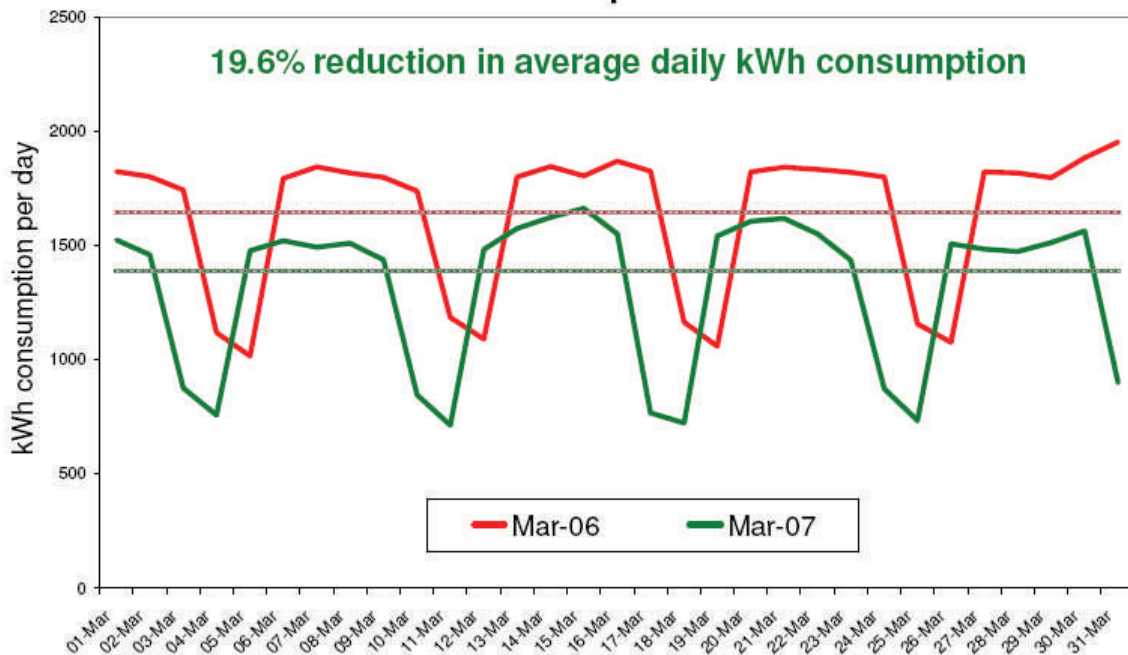
### Winterthur Life - average day before and after installation



**Figure 1**

In the chart overleaf (figure 2), we compare a recent period of electricity consumption (March 2007), to the same period from the previous year. A reduction in average daily consumption of **19.6%** is evident, demonstrating the improvement in efficiency that has resulted from the powerPerfector installation.

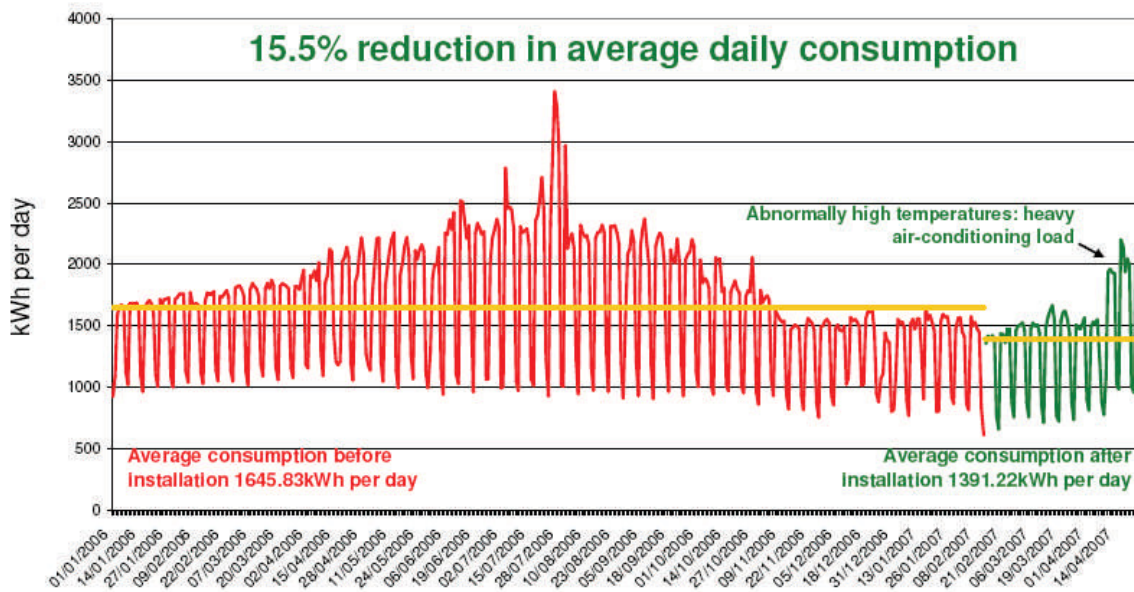
### Winterthur Life - March 06 vs March 07 daily consumption comparison



**Figure 2**

In order to assess the changes in kWh consumption over time, we plot the chart below (figure 3). This shows daily electricity consumption since January 2006. Comparing an average of all the available data from before installation of the powerPerfector to the period since installation, we see a reduction of **15.5%**.

## Winterthur Life - all available data

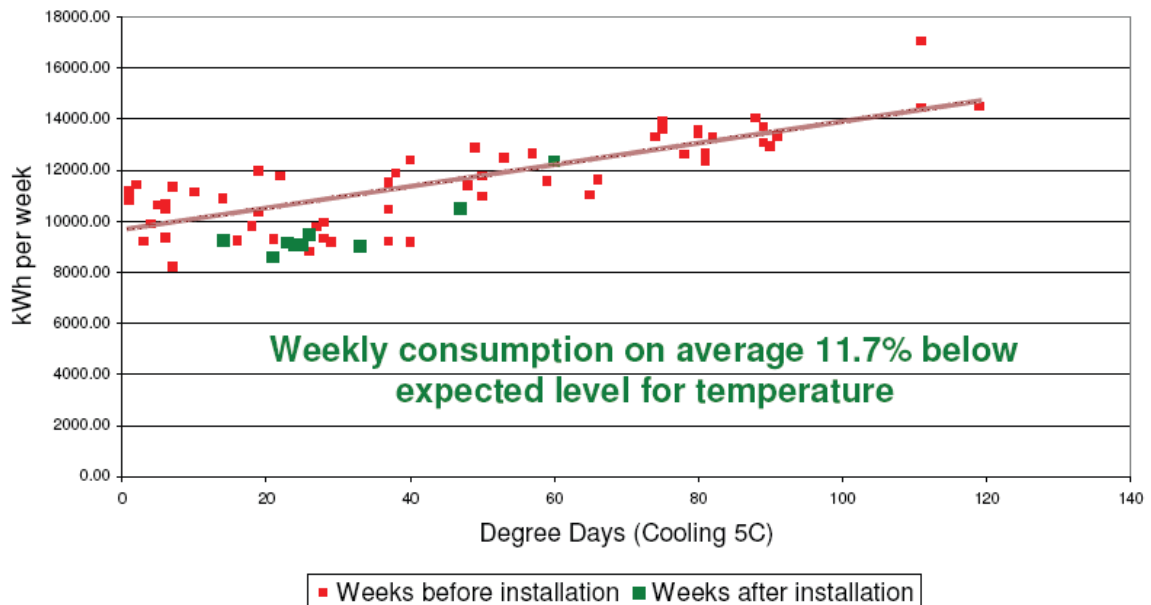


**Figure 3**

**Figure 3** highlights a marked increase in kWh consumption over the most recent three weeks. This is not unprecedented, and has been observed during the previous year. It is likely to be attributable to the abnormally warm weather that occurred during these weeks, causing air conditioning or personal cooling equipment to be used more extensively than normal. To put this period in context, it is possible to show the expected level of consumption for a given temperature. In the chart below, the red points show kWh consumption for the weeks prior to installation (during 2006), plotted against the number of 'Degree Days' for each week. Degree Days are based on Met Office temperature data, and give an indication of how hard heating or cooling equipment must work to compensate for exterior temperature.

The red line therefore shows the 'expected' level of kWh consumption for a week with a given number of Degree Days, based on the 2006 data.

## Winterthur Life - degree day analysis



**Figure 4**

The green points on the chart above (figure 4) show weeks after the installation of the powerPerfector, falling below the expected line with one exception. The average deviation from the expected level is **11.7%**, which demonstrates that considerable savings are being made on the energy consumed by cooling equipment. The most recent week's data, which falls slightly above the expected line, was for a week with extraordinary temperatures for the time of year.

### Conclusion

In conclusion, analysis of the electricity consumption since the installation of the powerPerfector indicate that savings, which have exceeded predictions, are being made relative to historic consumption levels, and based on temperature data for the period. The powerPerfector is ensuring that the site operates with a high level of efficiency, as well as benefiting from improved power quality and protection against transients of up to 25kV.

## 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.

