

Voltage Power Optimisation (VPO)[®]

CASE STUDY

Trelleborg Industrial IAVS

Installed 4th August 2006



“The installation of the powerPerfector unit has been an undoubted success and has helped in driving the business forward in terms of reducing carbon emissions/ cost and enabling the business to meet its environmental objectives for 2006.”

Richard Kenyon, UK Plant Manager , Trelleborg IAVS



About Trelleborg Industrial IAVS

Trelleborg Industrial AVS is a world leader in the design and manufacture of rubber-to-metal bonded engineering products, anti-vibration mountings and suspension components for rail, marine, off-highway, industrial, defence and power generation applications.

They work out of a 13,000m sq plant on a Greenfield site at Bursom Park near Leicester. The rubber compound manufacturing area is served by one of the most modern raw materials handling plants in Europe. The computer controlled manufacturing facilities are supplemented by technical laboratories equipped for material testing, product evaluation and research and development.

- **12% reduction in daily average consumption**
- **£51,646 per year**
- **401 tonnes CO2 per year**

Electrical load

The site covers 13,000m². Approximately 65% of the load at the site is resistive, whilst 35% is inductive. Around 35% of the site's load consists of Variable Speed Drives, which are used to improve motor efficiency.

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 Trelleborg IAVS site for a powerPerfector unit, a pP2MVA / 2900A unit was installed on the 4th August 2006.

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 daily average consumption	12%	£142 per day £51,646 annually
Savings following normalization of data*	15%	
Reduction in daily average maximum demand	10%	

* Data normalized to account for increased production post installation

Overall savings

A 2000kVA powerPerfector with a –8% Optimisation setting was installed at Trelleborg IAVS, Leicester, on 4th August 2006. The following is an analysis of the half-hourly electricity consumption data for the site to the end of September 2006. Optimising voltage by 8% yields an average 13% reduction in average electricity consumption. As shown in the charts below, the mean consumption for the period since the powerPerfector was installed has been reduced by at least **12%**. The method of analysis is outlined in the following report.

Figure 1 shows the half-hourly kWh consumption for the period June – September 2006, giving approximately 2 months of data either side of the powerPerfector installation. Based on the average consumption before and after installation, we see a reduction of **12%**. We calculate that this represents a financial saving of over **£9,900** from 4th August till the end of September 2006, and a reduction in carbon emissions of over **53 tonnes**.

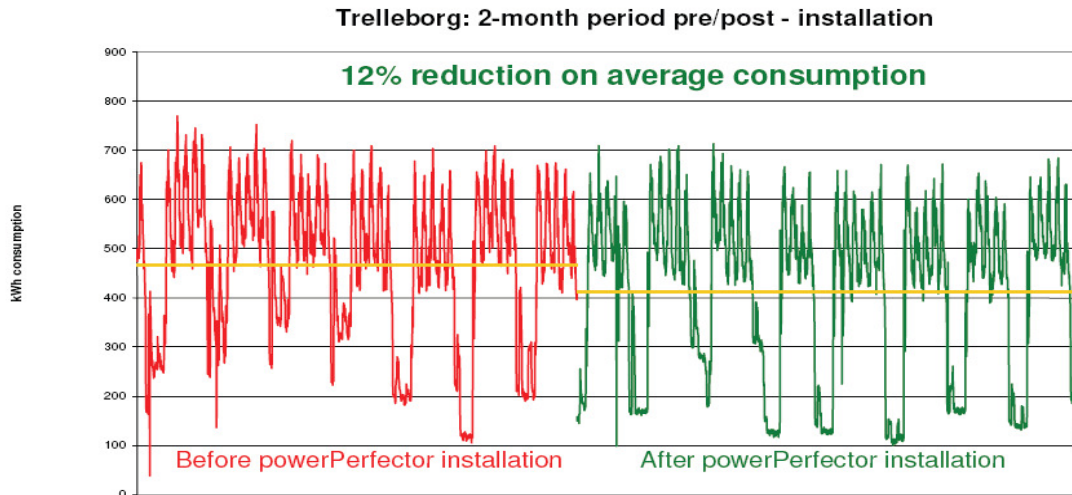


Figure 1 - Savings on average consumption over a 4-month period

Figure 1

Savings will be made from a reduction in the capacity charges due to the fall in the maximum demand (MD) provided by the powerPerfector. This is shown for the same period 4-month period in **figure 2**, and is a reduction of **10%**.

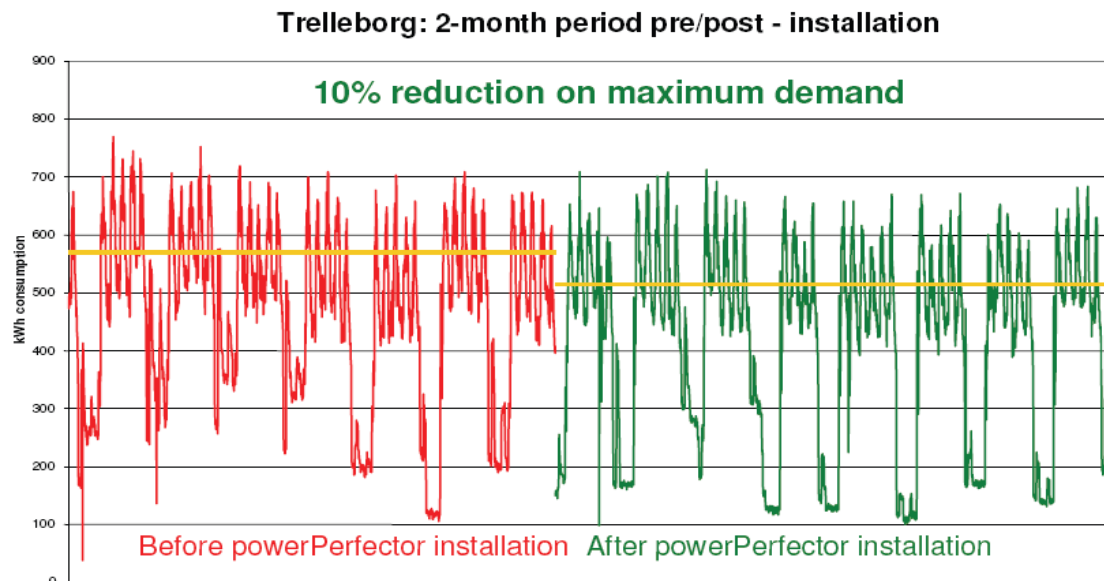


Figure 2

Reduction from previous year

A comparison of consumption data from September 2005 with the same period this year also shows a saving of **12%** on average consumption, shown in **figure 3**.

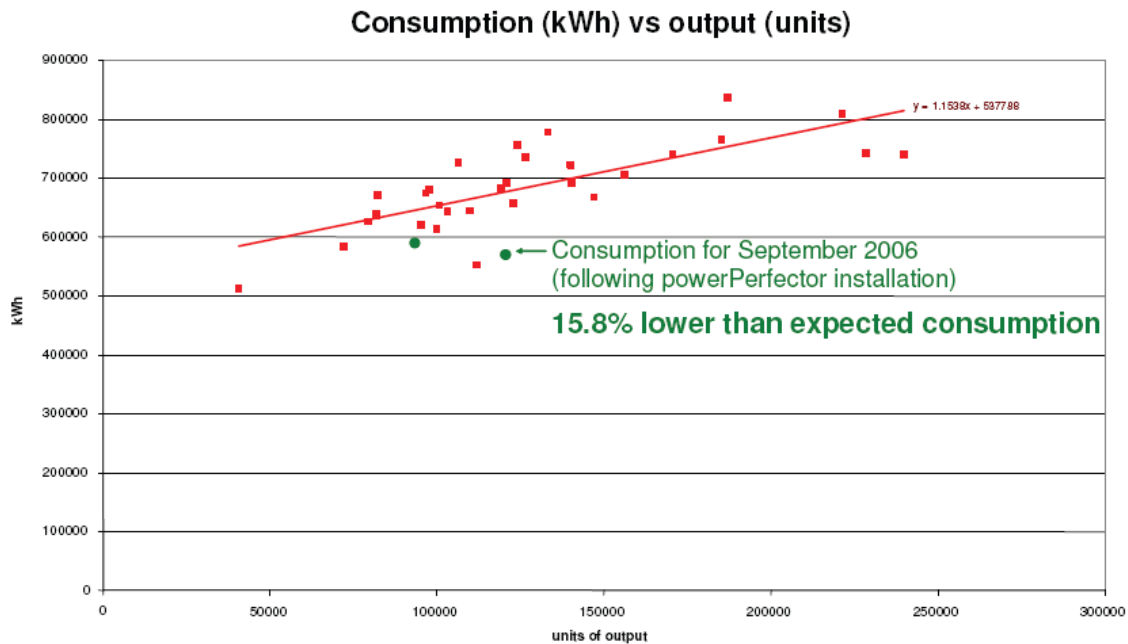


Figure 4

We have monthly data on output volume and press hours, so we are able to normalise consumption data to account for changes in production patterns. If we consider a 1-month period before and after installation, an 8.4% reduction in kWh consumption is apparent, but it is evident from output data that production was increased by 14% and press hours were increased by 70% over the same period. This should be taken into account when assessing the effect of the powerPerfector, so in **figures 5 and 6** (overleaf) we normalise for manufactured quantity and press hours respectively. These charts provide further evidence for the savings effect of the powerPerfector, as they show savings of **12%** and **15%**.

**Trelleborg: 2-month period pre/post -installation, normalised against
Manufactured Quantity (monthly)**

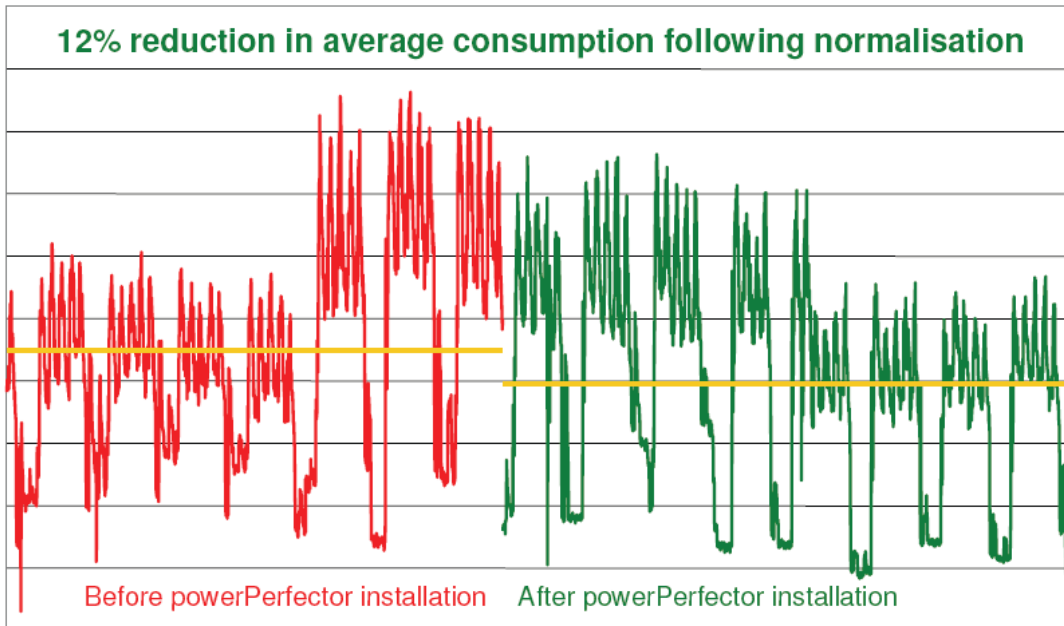


Figure 5

**Trelleborg: 2-month period pre/post -installation, normalised against
Press Hours (monthly)**

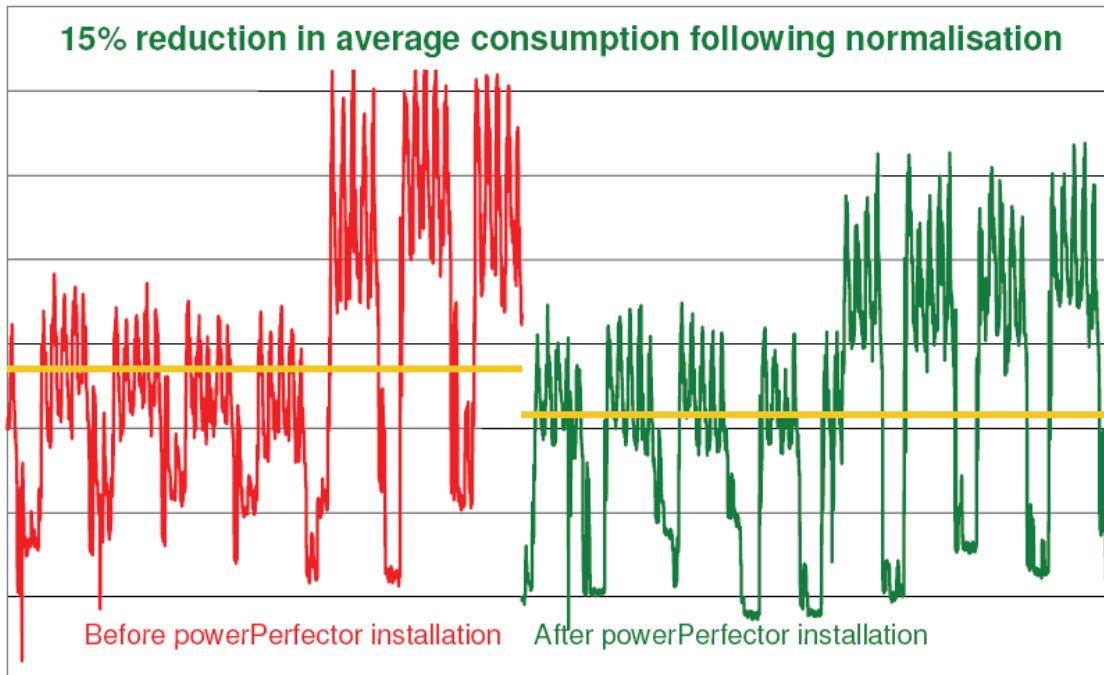


Figure 6

Conclusion

Consumption data for the site has been subject to a number of types of analysis, each of which shows a reduction in electricity consumption well within the expected range following the installation of the **powerPerfector** unit. We conclude, therefore, that at least a 12% saving on electricity consumption has been achieved, with associated reductions in costs and carbon 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, our clients tell us, 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[®] 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.

