

Voltage Power Optimisation (VPO)[®]

CASE STUDY

ASDA
Cookstown
Blackburn
October 2008

ASDA

"Asda has installed a number of PP units in 2008 with good results. We have significantly reduced both consumption and our carbon footprint. Paybacks to date have been excellent and we are currently exploring the possibility of further installations throughout 2009."

Brad Hawkins - Energy Projects Manager, ASDA

Independent Analysis conducted by:



About ASDA

ASDA was first founded in the 1960s in West Yorkshire. Since then over 300 ASDA stores have opened around the UK. Today, ASDA is owned by Wal-Mart, and has recently been awarded the title of 'UK's Best Value Supermarket' for the 11th year in a row.

powerPerfect unit details

Store Name	Installation date	Unit Size	Optimisation Setting
Cookstown	23/06/2008	560kVA	5%
Blackburn	10/08/2008	1000kVA	8%

Types of electrical load

All the listed ASDA sites have a range of loads, including refrigeration, ventilation and air conditioning, fluorescent and hi-bay lighting, and a variety of electrical cooking appliances.



External 1MVA powerPerfect unit installed at ASDA Clapham

THE SAVINGS REPORT

Savings summary

The following independent savings analysis has been conducted by the Energy ICT. These savings values are in addition to other energy saving approaches implemented in each ASDA store. The levels of savings are in some cases slightly lower than normally achieved by powerPerfector, but these installations follow a successful lighting initiative by ASDA Energy, where energy-efficient T8 fittings have been installed to replace older fluorescent lights. powerPerfector routinely revises its savings estimations in these cases, as T8 lighting achieves savings by adjusting the power supplied to lighting with a high-frequency electronic ballast.

Half hourly kWh readings have been analysed in the following ways:

- The effect of external temperature has been factored in to calculate the *expected* level of kWh consumption. kWh consumption before installation is shown in blue, consumption after installation is shown in green and the expected level of consumption is represented by the red line. The red line is derived from a regression analysis, whereby variables including maximum and minimum temperature, and the expected consumption profile for the day of the week, have been used along with historic consumption data to give an expected kWh reading.
- A cumulative representation of the monthly savings in kWh, calculated against expected consumption.

The graphs overleaf show this analysis for the ASDA stores at Cookstown and Blackburn, as provided by Energy ICT. Following this, is a full summary of the results achieved at ASDA stores so far.

Store Name	Project Date	Savings (%)	Cumulative Savings (kWh)	Month -1 (kWh)	Month -2 (kWh)	Month -3 (kWh)	Month -4 (kWh)
Cookstown	23/06/2008	13.5	68078		30143	30290	7646
Blackburn	10/08/2008	16.8	104386	63685	40701		
		Total	172464				

Further evidence of the improvement in electrical efficiency at Blackburn, where energy use and reactive power were monitored using a power quality analyser can be found at the end of this report.

Conclusion

powerPerfect has been shown to produce significant savings on top of other ongoing initiatives and will continue to be part of the retro-fit energy plans for ASDA. As part of this first phase the **powerPerfect** will also be evaluated for inclusion in the 'new build' stores.

The site's equipment is being driven more efficiently by the **powerPerfect**'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, and there is no requirement for ongoing maintenance. The only maintenance that is required is external cleaning of the unit and 5 yearly routine wiring checks. No other maintenance is necessary.

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, suitable powerPerfector units were installed at the ASDA stores, ranging from a 210kVA unit to a 1000kVA unit, with optimisation settings between 6% and 9%.

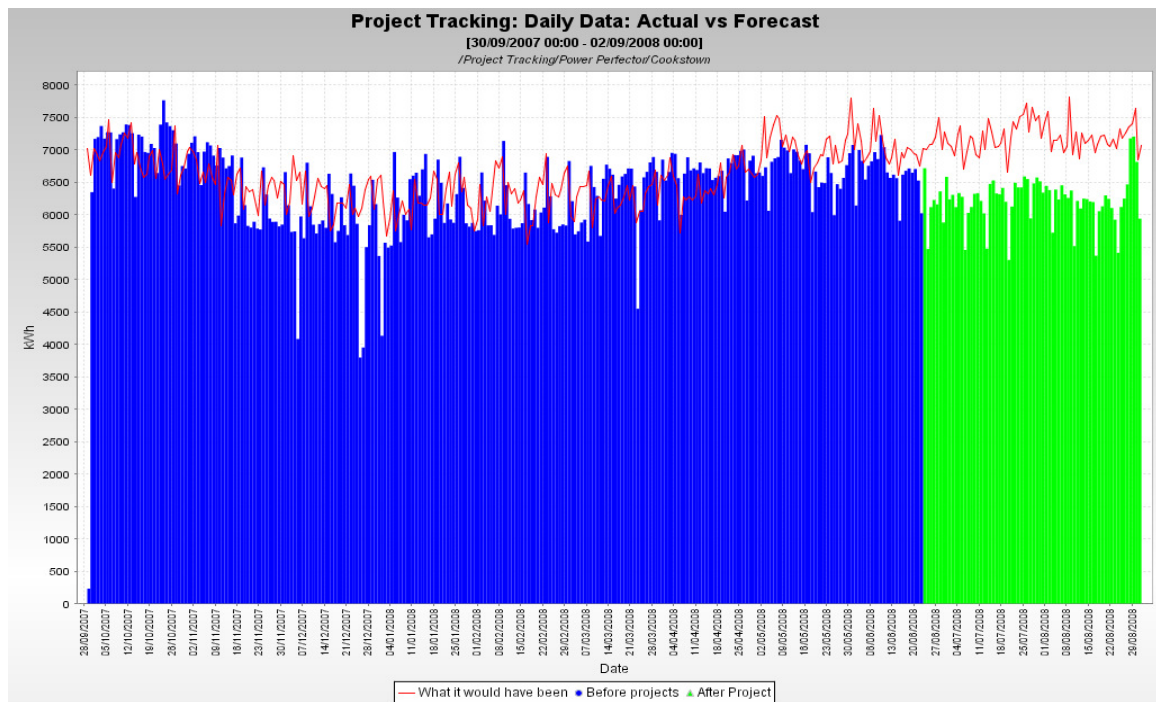
A scheduled shut down of the sites was required, with the work carried out over a weekend.

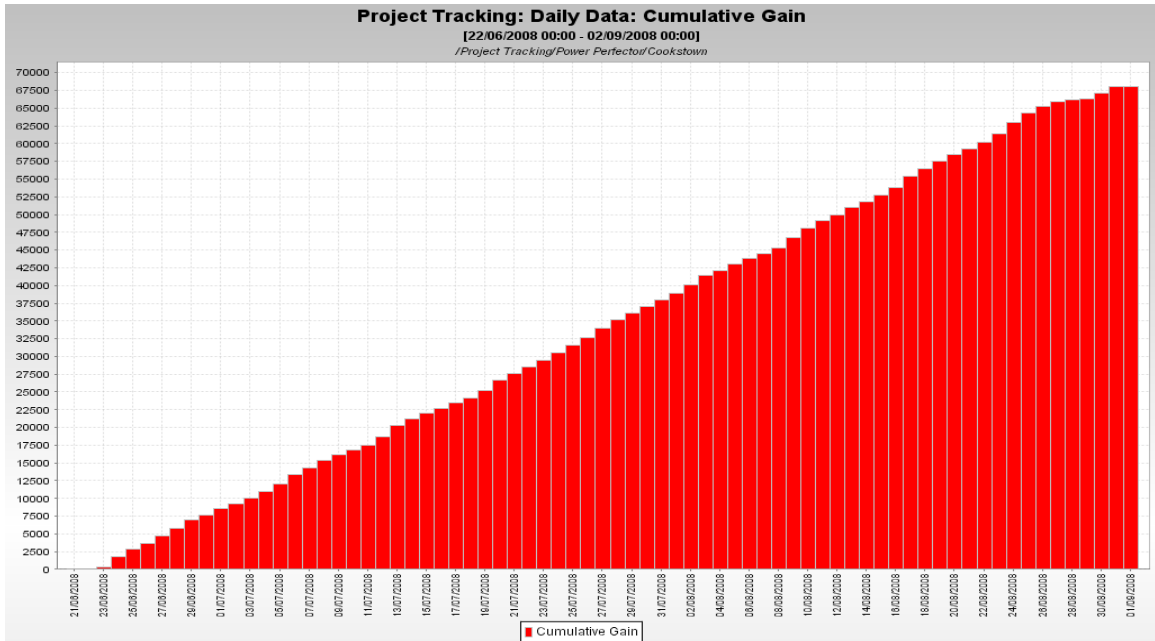
Following installation all electrical equipment has operated normally and there have been no reports of any problems. With further observation over time equipment life will be noticeably extended.

ASDA Cookstown

13.5%

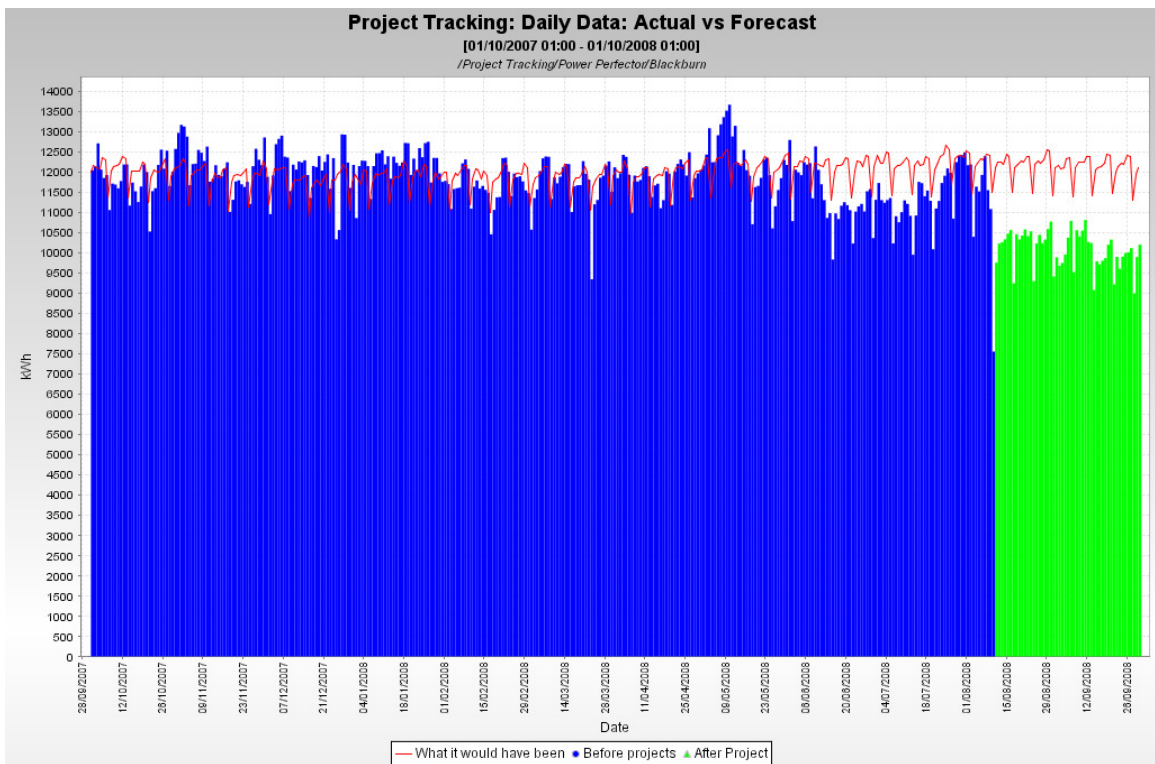
savings

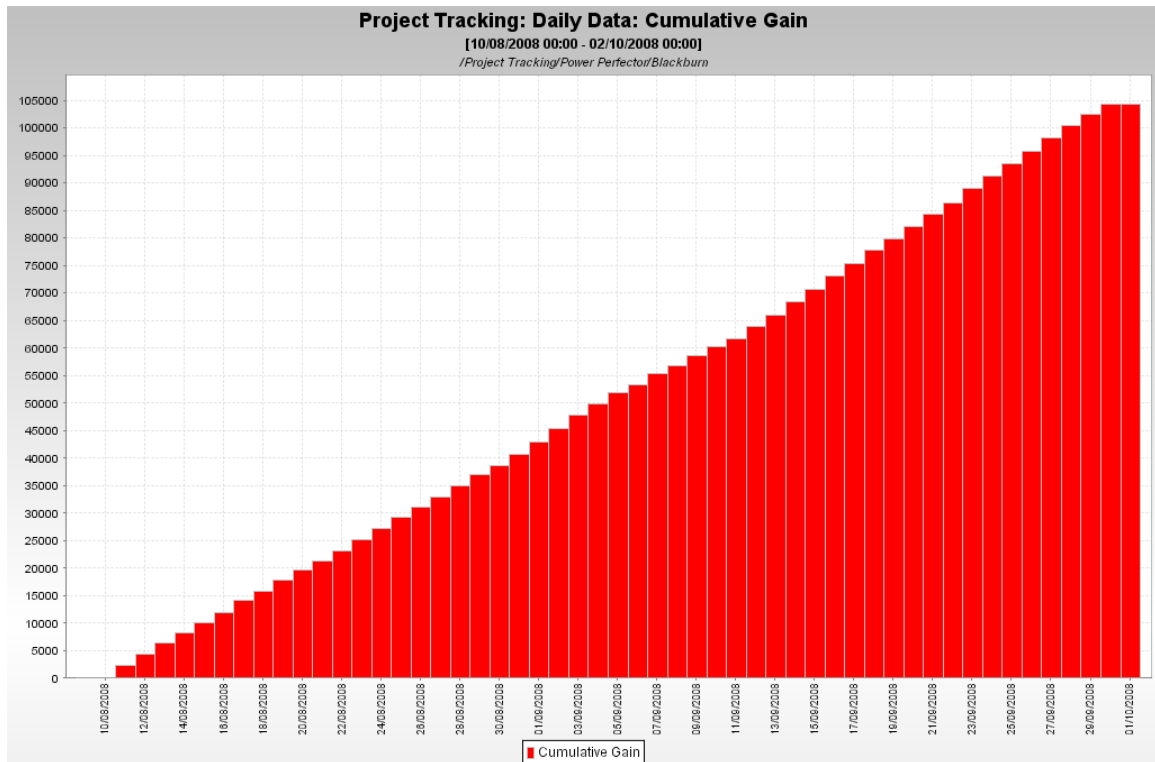




ASDA Blackburn
saving

16.8%





Summary of Savings

The table below is a summary of the savings for the following ASDA stores, provided by Energy ICT on 3rd October 2008.

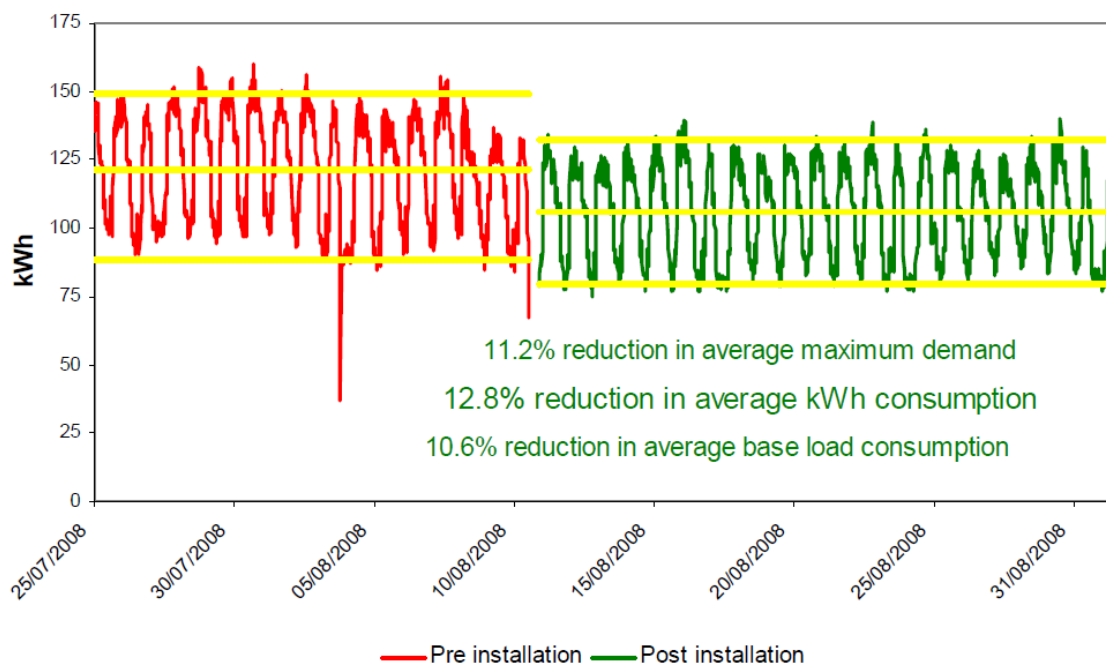
Store Name	Project Date	Savings (%)	Cumulative Savings (kWh)	Month -1 (kWh)	Month -2 (kWh)	Month -3 (kWh)	Month -4 (kWh)	Month -5 (kWh)	Month -6 (kWh)	Month -7 (kWh)
Pontefract	30/03/2008	9.6	34445	7054	5155	4724	6031	5426	5372	408
Perth	04/05/2008	7.5	134949	34450	22711	27524	29307	19241		
Clapham	22/06/2008	11.1	46130	50897	46002	31809	9490			
Cookstown	23/06/2008	13.5	68078		30143	30290	7646			
Peterhead	25/07/2008	12.2	34253	20577	13967					
Arnold	04/08/2008	9.6	54829	34825	18387					
Blackburn	11/08/2008	16.8	106130	63685	40701					
Southampton	17/08/2008	10.1	48864	32709	14873					
		Total	621446							

Further analysis by powerPerfector ASDA Blackburn—Power Quality Data

The following analysis has been conducted by powerPerfector's analysis team and is based on data using a power quality analyser installed at ASDA Blackburn on 25th July and taken out on 1st September 2008. This analysis shows the immediate effects of the powerPerfector installation.

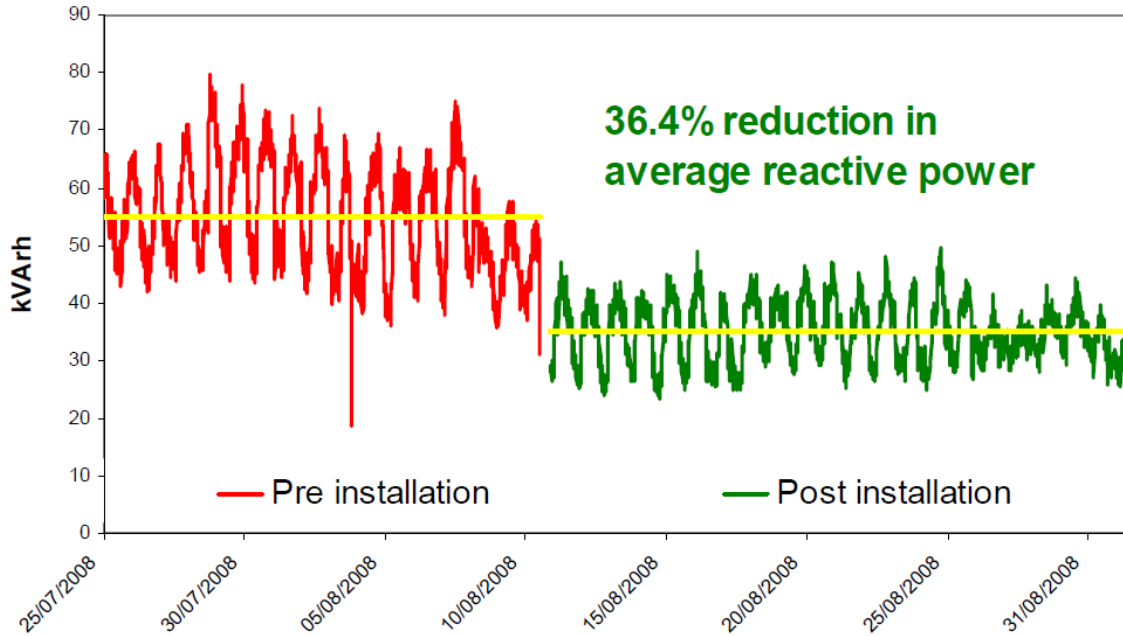
The electricity consumption for this period is shown in the chart below. A **12.8%** reduction in average kWh consumption is evident, along with an **11.2%** reduction in average maximum demand and **10.6%** reduction in average base load.

ASDA Blackburn - kWh consumption



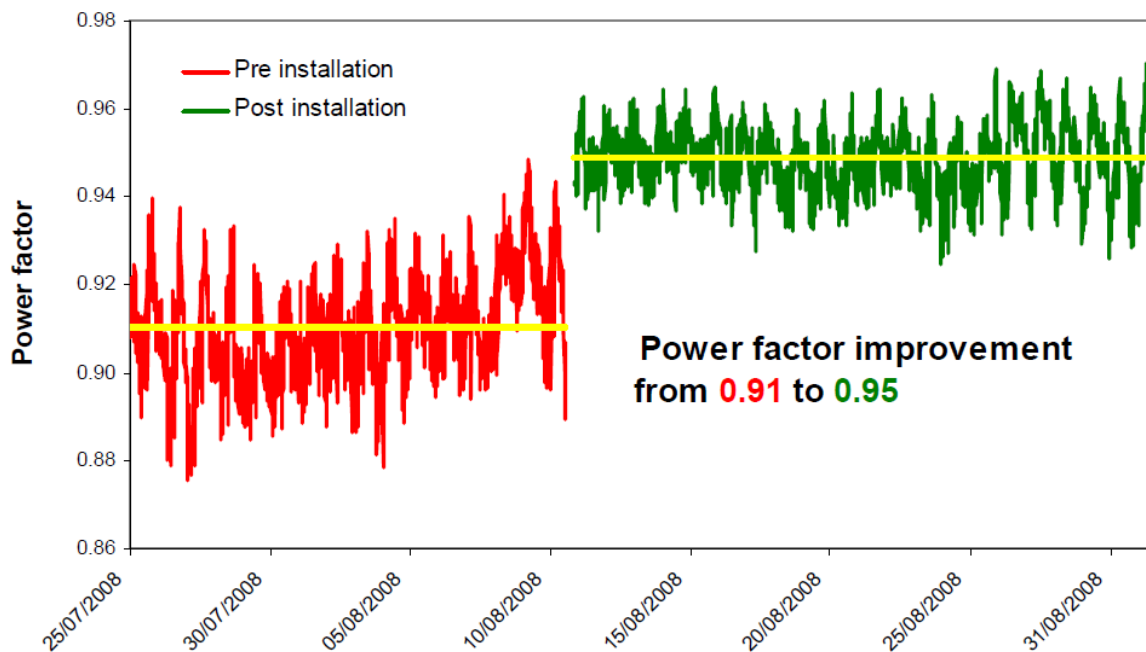
We can also demonstrate the effect of the powerPerfector on the reactive power, which is shown in the chart overleaf. A reduction of **36.4%** was apparent when comparing the data for the same period

ASDA Blackburn - Reactive power



With this improvement in reactive power, there is an associated improvement in power factor as shown in the following chart. An average improvement from **0.91** to **0.95** in power factor was observed.

ASDA Blackburn - Power Factor



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.

