power Perfector

energy saving like no other

CASE STUDY

Civic Centre

London Borough of Bromley

Installed: February 2009
Report: August 2009

Bromley

THE LONDON BOROUGH

Case Study

London Borough of Bromley Civic Centre

About Bromley Civic Centre

In 1965, the London Borough of Bromley was formed from the boroughs of Bromley and Beckenham and the urban districts of Orpington, Penge, and the Chislehurst part of Chislehurst and Sidcup. The borough now extends from Penge, Mottingham and St. Paul's Cray in the north to Biggin Hill in the South. Around 300,000 people live in the borough. The Civic Centre has built up and around a beautiful construction, the Old Palace, which was built in 1775 for the Bishop of Rochester.

How powerPerfector were able to help Bromley Civic Centre

Using the annual energy consumption data for the site, 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 to record the voltage level in the building by connecting it to a regular mains socket. After a survey of the site by a powerPerfector approved contractor, the installation took place. The installation was completed at a time when there would be no disturbance to the building. After the installation electricity consumption was analysed to find an average saving of **11.5%** equating to annual carbon dioxide emissions saving of **188,300kg**.

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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 savings 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.

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Savings Summary for Bromley Civic Centre:

- Reduction in average kWh consumption: **11.5%**
- Projected annual carbon dioxide emissions savings: **188,300kg**
- Projected annual financial savings of at least: **£40,000**

Two powerPerfector Plus units, a 420kVA and a 560kVA, were installed at London Borough of Bromley's Civic centre on 8th February 2009. The following report is an analysis of the monthly kWh consumption data for the site from 1st April 2007 up to 1st April 2009. Using half-hourly data from two MPANs where the two powerPerfectors were installed, a reduction in average consumption of **11.5%** was found. This equates to a projected annual emissions saving of **188,300kg** of carbon dioxide. The methods of analysis are outlined fully in this report for MPAN 1200010182560 and MPAN 1200010260066 and the overall effect for the powerPerfectors combined.

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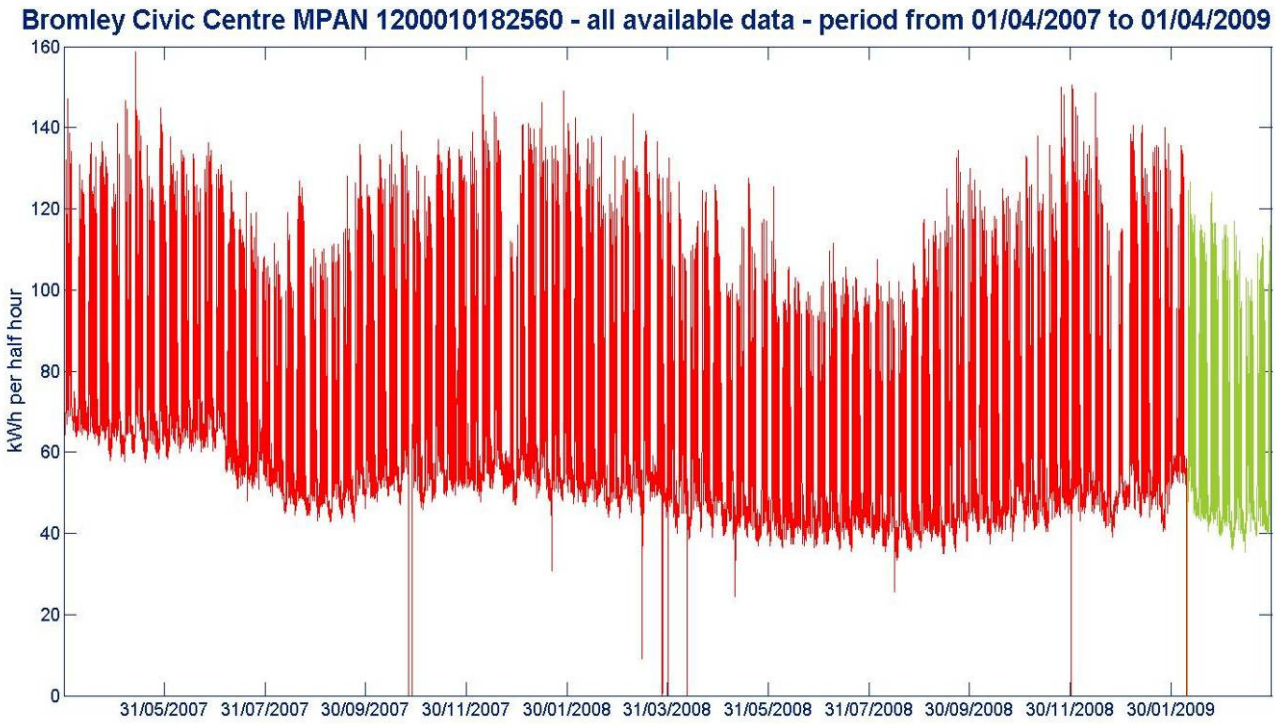
MPAN 1200010182560

The chart below shows all of the available kWh consumption data from 01/04/2007 to 01/04/2009. The data before installation is shown in red and after installation in green.



The chart indicates that energy consumption at the site has a strong dependence on seasonal variations. The kWh consumption is broadly higher in the colder, winter months and lower in the warmer months. The graph also shows that over the Christmas and New Year periods that there is a large reduction in the electricity consumption, as would be expected in times when the buildings would be unoccupied.

The following chart is a comparison of the post-installation consumption, from 7th February 2009 to 2nd April 2009, with the consumption for the same period during 2008, before installation. On this basis, there is a 12% reduction in average kWh consumption, as well as an 11.7% reduction in average maximum demand.

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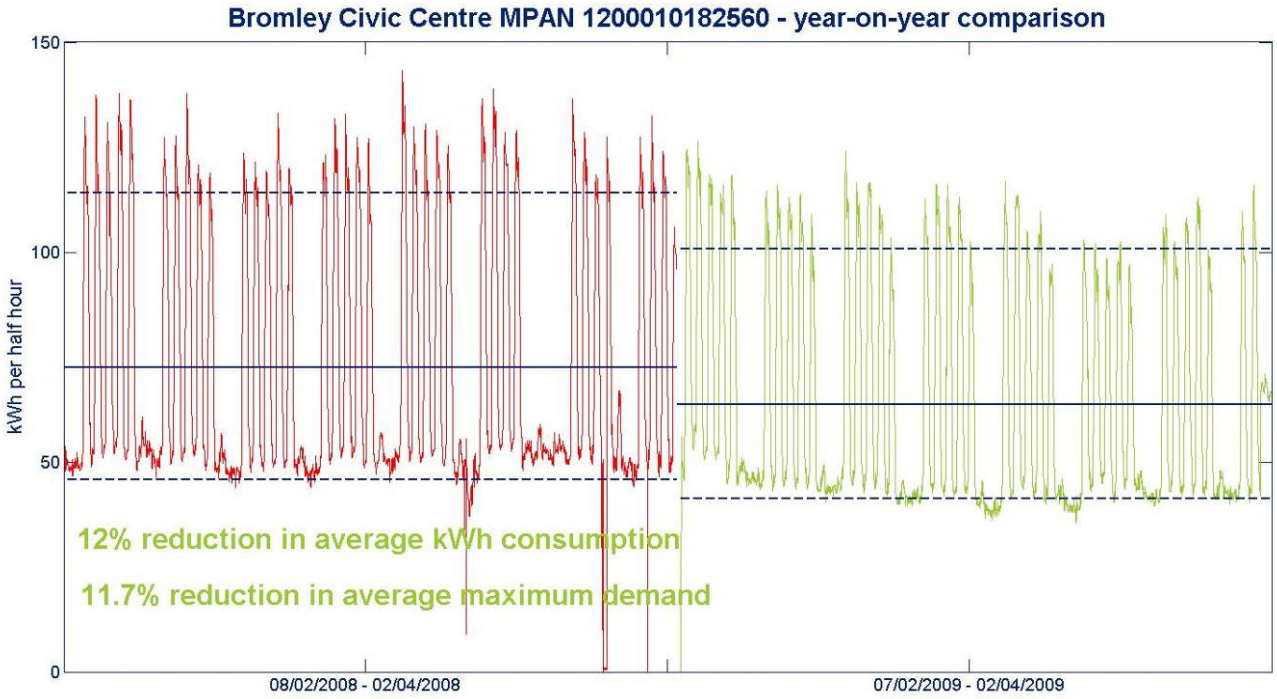

Whilst the comparison above is a useful indication of the savings achieved, an established method of quantifying energy savings in the context of seasonal changes is known as a "degree days" analysis. Degree days are calculated from Met Office temperature data for regions of the UK and represent the difference between external temperature and a baseline temperature over a given period of time. This method of analysis is appropriate if a plot of a site's electricity consumption against degree days shows a good correlation, which is indicated by an approximately linear relationship. It is generally more accurate than a straightforward year-on-year comparison and also allows more of the data set to be taken into consideration. Further details on the use of degree days in this context are available from the Carbon Trust website[1].

The graph below shows the degree days analysis for MPAN 1200010182560. It should be noted that consumption data for the period from 01/04/2007 to 06/09/07 has been excluded from this analysis as it was showing atypically high consumption for summer months comparatively to the rest of the data. The two weeks over the Christmas and New Year periods for 2007 and 2008 have also been removed as they have shown atypically low consumption, as was seen in the first graph.

[1] http://www.carbontrust.co.uk/resource/degree_days/what_are.htm

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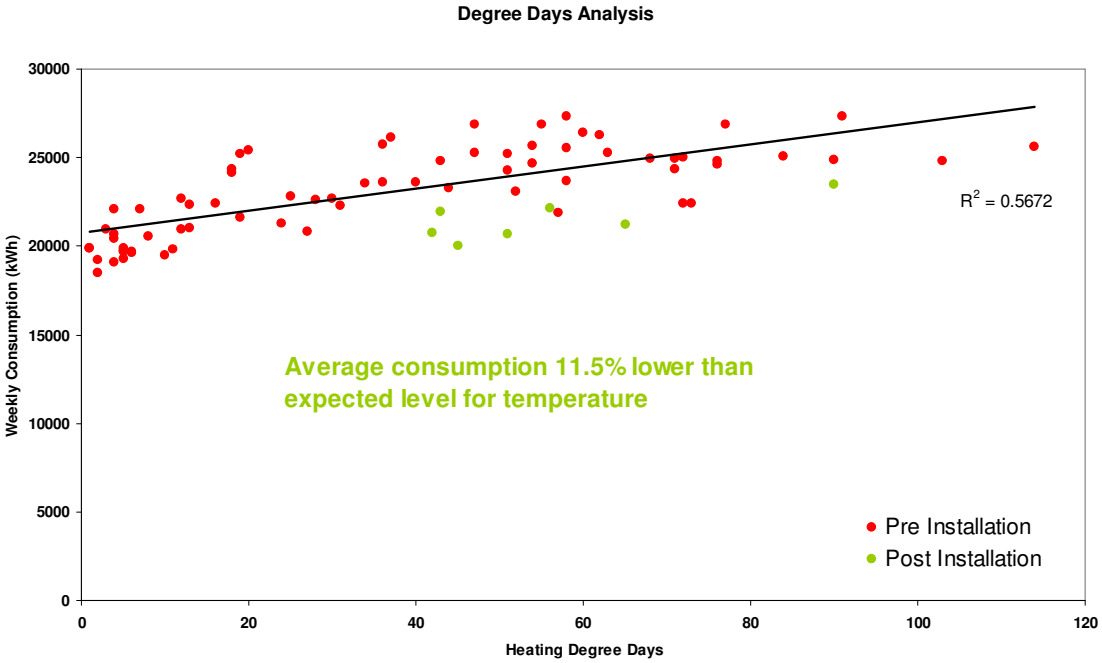

The degree days analysis for this MPAN showed average reduction of 11.5 % from expected levels for temperature. There is a good R^2 value for correlation between the degree days and weekly kWh consumption of 0.6 (where an R^2 value of 0 shows no correlation and an R^2 value of 1 shows perfect correlation) which shows the accuracy of this analysis method for the site.

This figure has been used for the savings assessment because it takes into account all of the electricity consumption, as was shown on the first graph. In conclusion, the powerPerfector Plus installed on this supply has reduced the average kWh consumption by approximately **11.5%**, equating a projected annual CO2 emissions saving of at least **92,800kg** and annual financial savings of at least **£20,000.**

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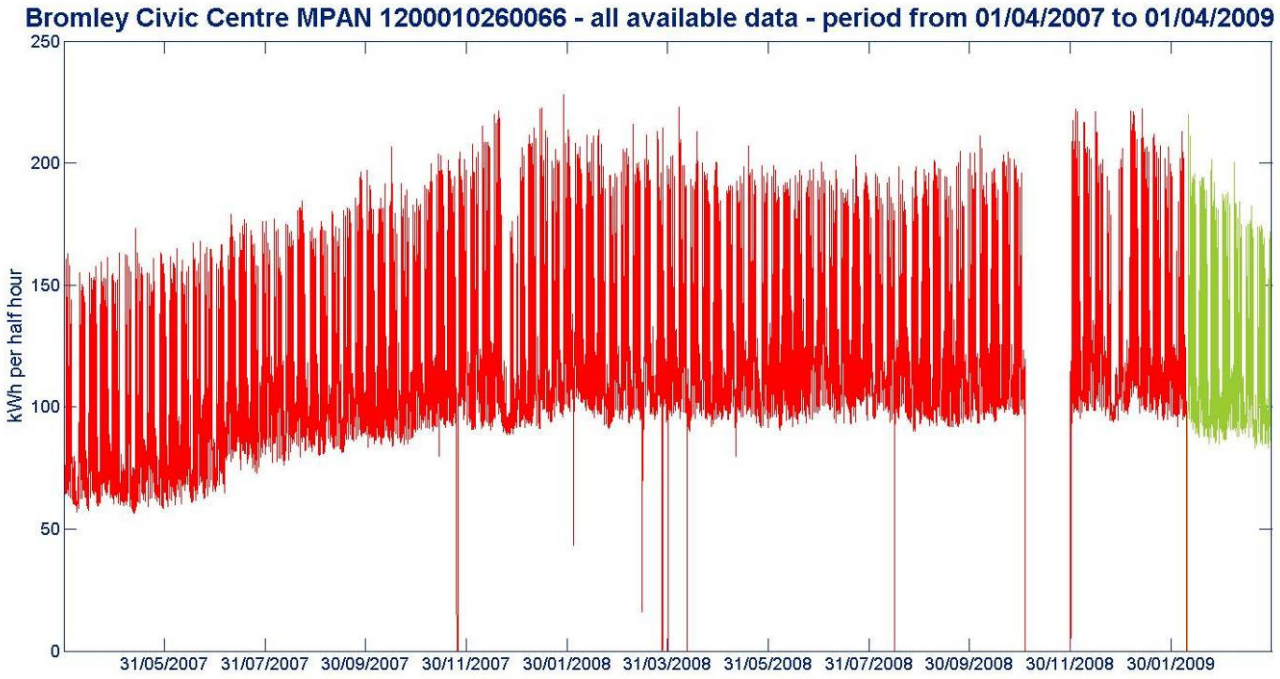
MPAN 1200010260066

The chart below shows all of the available kWh consumption data from 01/04/2007 to 01/04/2009. The data before installation is shown in red and after installation in green. The gap seen during the month of November 2008 reflects the absence of half-hourly data for that period.



It can be seen from the chart that there has been a significant change of consumption pattern from 2007 to 2008. In contrast to the other MPAN, the consumption is not strongly affected by seasonal variations.

The following charts plots a comparison between the consumption witnessed during the 54 days after installation and the consumption for the same period the year before. A reduction of 9.4% in average kWh consumption is apparent.

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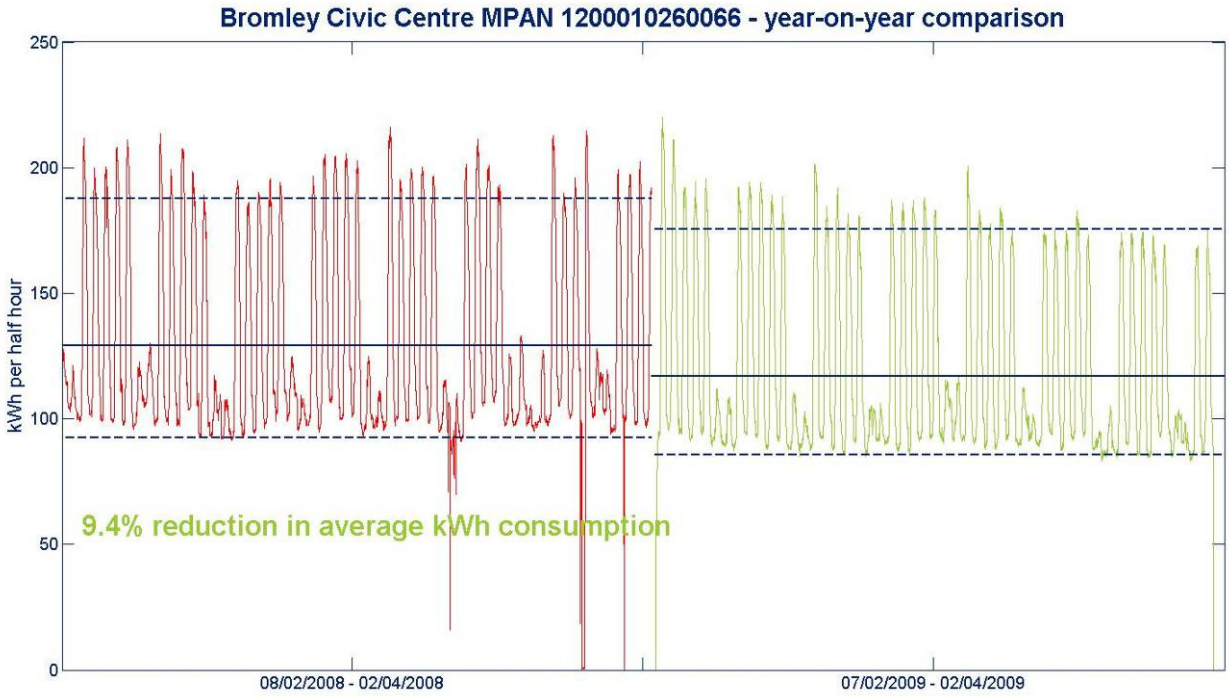

However, by comparing the total consumption for the two months just before installation with the same months the year before (1st December 2008 to 7th February 2009, until the missing gap in the data), a 2% increase is observed as seen in the chart below.

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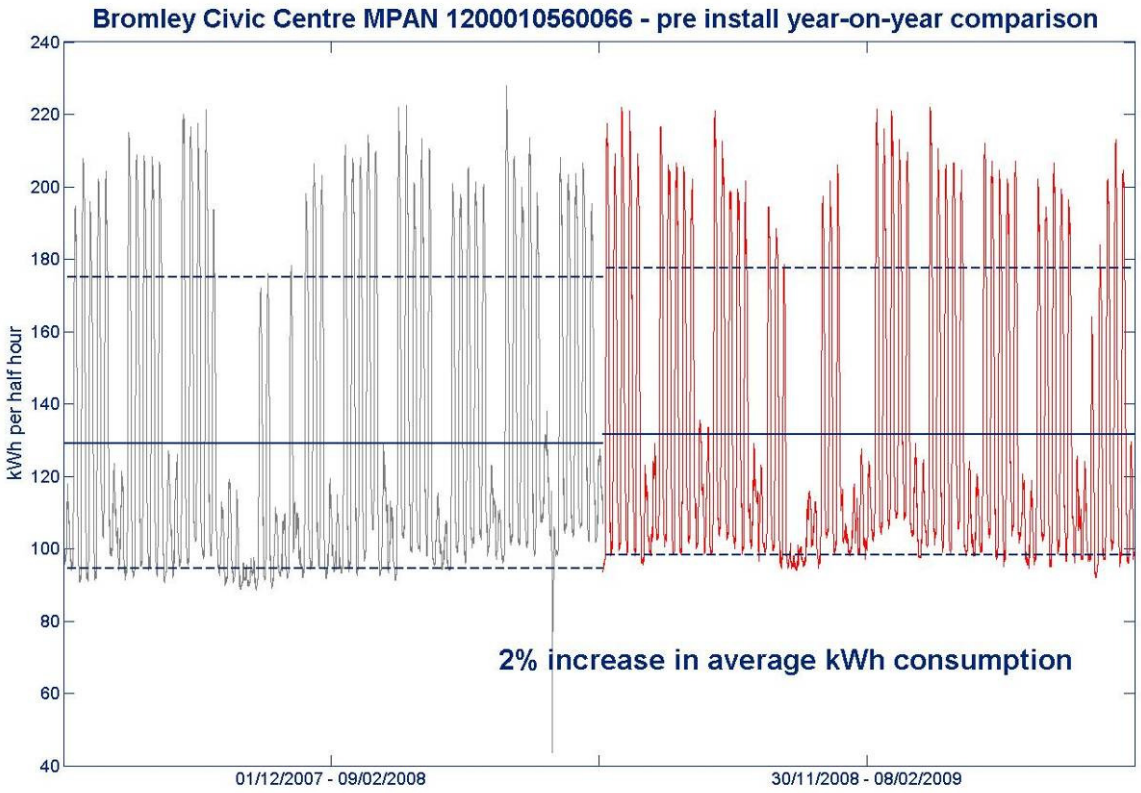

If we assume that this increase in consumption should be reciprocated for the months following installation, then the 9.4% reduction in consumption since the installation is an underestimation of the savings. Therefore the savings achieved by the powerPerfector for MPAN 1200010260066 are within the **11-12%** range, equating to a projected annual CO2 emissions saving of at least **95,550kg** and annual financial savings of at least **£20,000**.

In conclusion, a combined reduction of around **11.5%** in average kWh consumption is observed for the whole site. This would equate to a projected annual emissions saving of at least **188,300kg** of carbon dioxide, and annual financial savings of at least **£40,000**.

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

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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, extending 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

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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.

Voltage Power Optimisation
Additional Benefits

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 potential risks 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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