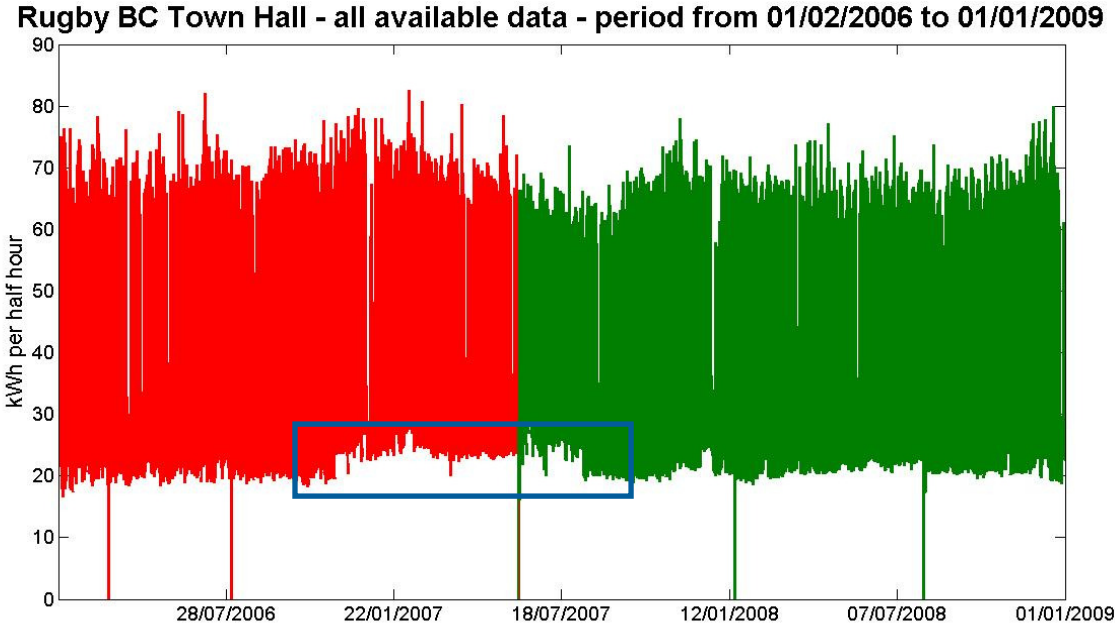
Rugby Borough Council
Town Hall

Analysis of half-hourly kW data following *powerPerfector* installation

Report January 2009

A 210kVA ***powerPerfector*** unit with a 6% optimisation setting was installed at Rugby Borough Council Town Hall on 2nd June 2007. The following is an analysis of the half-hourly electricity consumption data for the site up to 31st December 2008. We conclude that electricity consumption is **9.0%** lower than before installation. This equates to a projected annual carbon dioxide emissions saving of approximately **12,900kg**. The method of analysis is outlined in the following report.

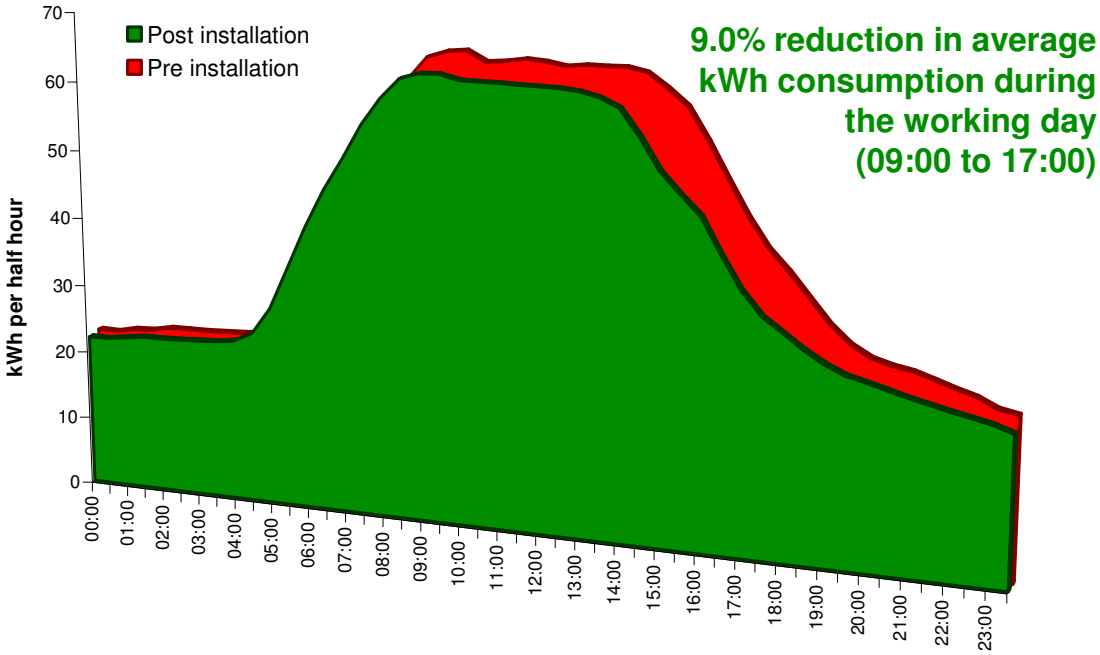
The chart below displays the full half-hourly kW consumption profile from 1st February 2006 to 31st December 2008. The electricity consumption before installation of the ***powerPerfector*** is shown in red and the consumption after installation is shown in green.



The chart above shows there are two levels of base load (overnight consumption), which indicates operational changes on site. A significant change in base load to a higher level encompasses the date of installation (as annotated on the chart).

It is important to consider the savings during the working day to prevent the fluctuation in base load from distorting the savings figure. It is possible to look at the average kWh consumption per half hour. The chart below displays the average day before and after installation considering all the available data, excluding holidays and weekends. A **9.0%** reduction in average kWh consumption during the average working day hours (09.00 to 17.00) is apparent.

Rugby BC Town Hall - average day analysis



In conclusion, analysis of the electricity consumption since the installation of the ***powerPerfector*** indicates that average consumption is **9.0%** lower during the working day than before installation. 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.

powerPerfector

Appendix: The benefits of Voltage Power Optimisation

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 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.