

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

### CASE STUDY

International Student House,  
Great Portland Street

**Installed: May 2008**

**Report: July 2008**



*"We are very pleased with the results and the value for money represented by this investment. We found the staff of powerPerfector helpful and knowledgeable and we would certainly recommend that other institutions in the higher education field consider the possibility of reducing energy costs by using this approach."*

**Peter Anwyl**  
Executive Director  
International Student House London



### **Full Testimonial from International Student Hall (ISH)**

*“The price of energy has almost doubled in the last two years and energy conservation has become a major priority for management at International Students House. We have invested close to £500,000 on improving energy efficiency and one of the top priorities recommended to us from the Carbon Trust was the reduction in voltage of our main electricity supply. This was, for us, a novel idea and we contacted powerPerfector for an analysis of potential savings. powerPerfector estimated a savings payback on our two main intakes of around 25 months. By any standards a very good investment return – if achieved! In the event we had an immediate reduction in load on our main half hourly supply of around 15% which was better than estimated and gives us a savings payback of 22 months.*

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**Executive Director**  
**International Student House London**

## How powerPerfector were able to help International Student House

After International Student House sent annual electricity consumption details, 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 for one week, which recorded the voltage level in the building by connecting to it in to a regular mains socket. After a survey of the site by a powerPerfector Approved Contractor, the installation took place. There was no noticeable change to the operation of the building, although continuous carbon savings were instantly being made every day. After the installation the electricity consumption was analysed to find a reduction of **14.8%**, equating to annual carbon dioxide emissions saving of **60,000 kg**.



## 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. 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

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consumption, this reduces the strain on your equipment, extending its lifespan according to many of our clients. 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.

#### Savings Summary for International Student House:

- Reduction in average kWh consumption: **14.8 %**
- Projected annual carbon dioxide emissions savings: **60,000 kg**
- Projected annual financial savings: **£8,610**

A 210kVA powerPerfector unit was installed with an 8% optimisation at International Students House, Great Portland Street on 23rd May 2008 on one transformer. The following report is an analysis of the half-hourly kWh consumption data for the site up to 15th July 2008. Our analysis shows that the consumption for the available data after installation is **14.8%** lower than the same length of time before installation, equating to a projected annual saving in carbon dioxide emissions of **60,000 kg**. The method of analysis is outlined in the following report.

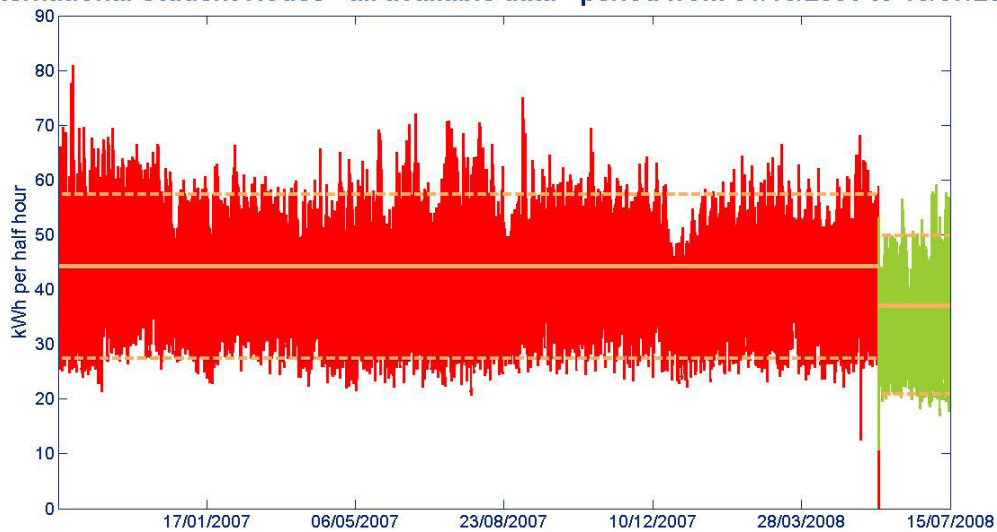


## Analysis

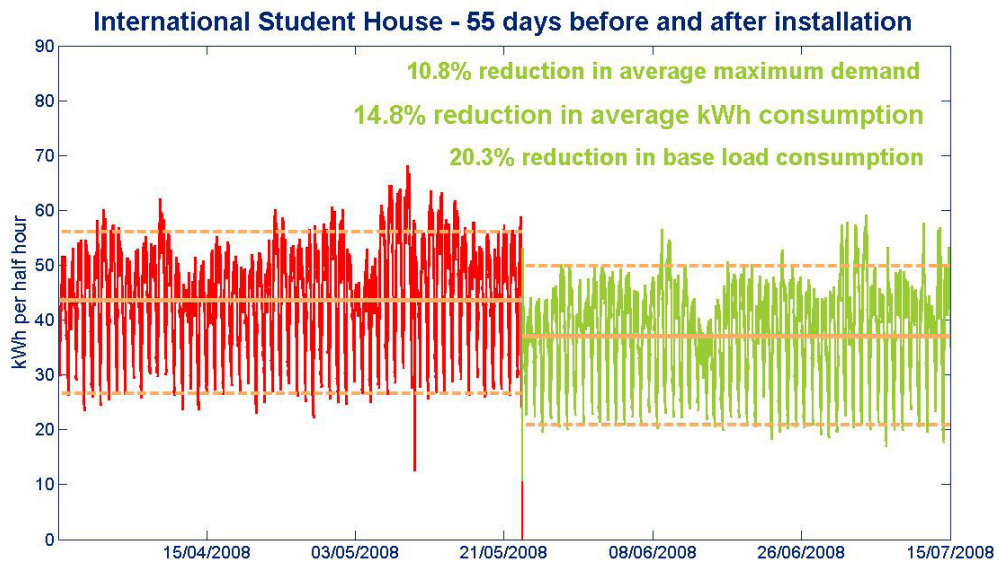
powerPerfector has undertaken an analysis of half hourly consumption data from International Student House, Great Portland Street in order to assess the savings resulting from the powerPerfector installation.

All of the half-hourly kWh consumption data from 1st November 2006 to 15th July 2008 is shown in the graph below. The pre-installation consumption data is shown in red and the post installation data in green.

**International Student House - all available data - period from 01/10/2006 to 15/07/2008**

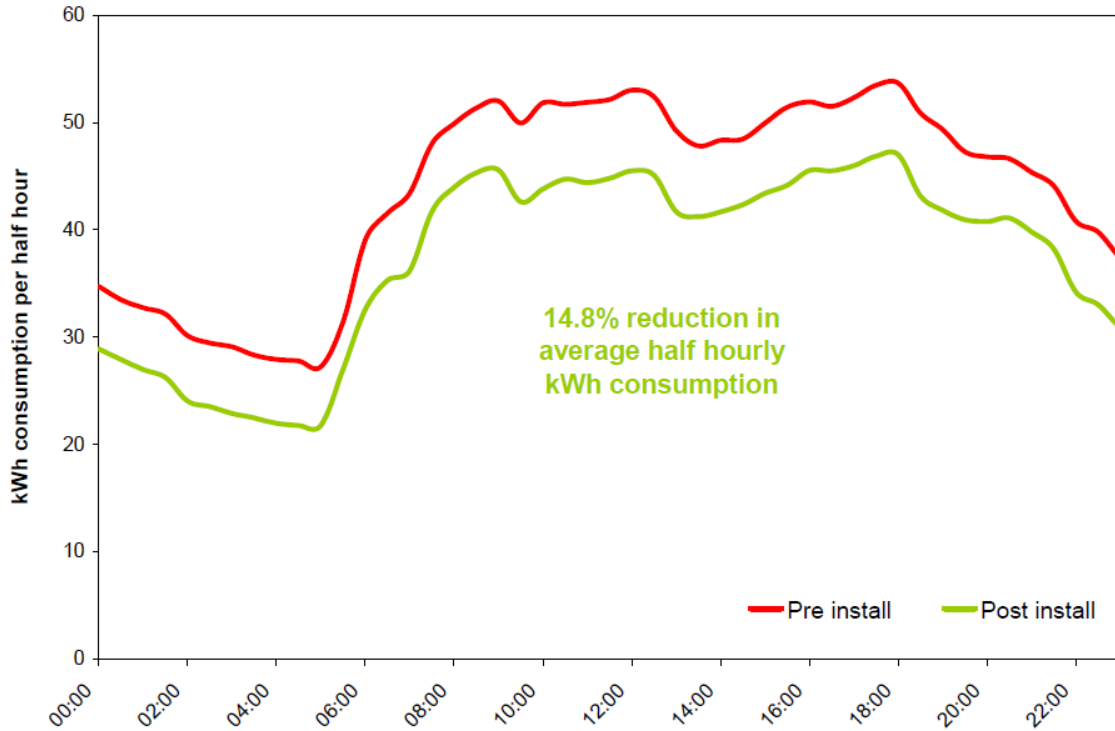


The previous graph shows an immediate reduction in kWh consumption upon installation. In order to assess the reduction that is attributable to the powerPerfector, we have considered a restricted time period over which the consumption is broadly consistent. The following graph shows 55 days before and after installation-55 days being the number of days for which post installation data is available. On this basis of comparison, there is a **14.8%** reduction in average kWh consumption, along with a **10.8%** reduction in maximum demand and **20.3%** reduction in base load.



Using the kWh data, it is possible to look at the consumption profile in greater resolution by plotting average kWh readings for each half hour of the day. The following graph shows the average kWh consumption per half hour for pre- and post-installation data, again considering 55 days before and after installation. The average reduction over each half hourly period is **14.8%**.

### Average day kWh consumption - 55 days before and after installation



### Conclusion

In conclusion, analysis shows that there is a **14.8%** reduction in average kWh consumption based on a comparison of the kWh data for 55 days before and after installation. This equates to a projected annual saving of **60,910kg** in carbon dioxide emissions. 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 on the benefits of voltage power optimisation are appended to this report.

## 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 powerPerfactor 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 powerPerfactor improves the electrical efficiency of your site.
- The powerPerfactor 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 powerPerfactor 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 powerPerfactor 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 powerPerfactor 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.

