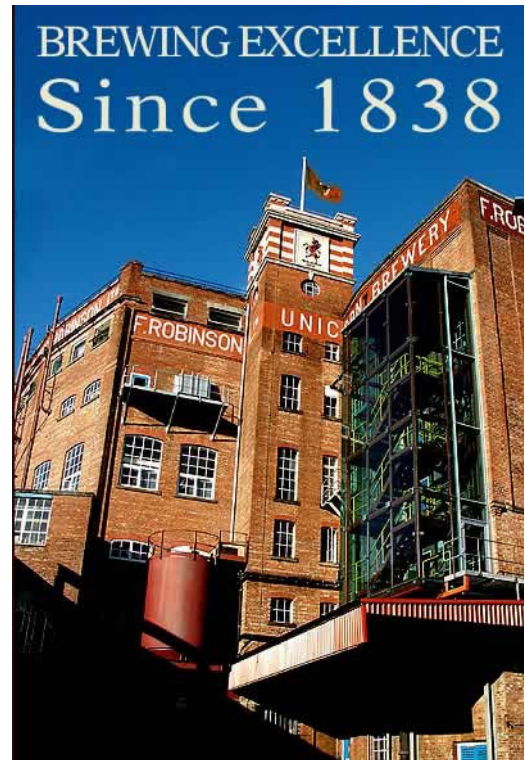


Voltage Power Optimisation (VPO)[®]

CASE STUDY **Frederic Robinson Breweries** **Stockport**

Installation 6th April 2008
Report August 2008



“In the current climate it is very hard to ignore a technology that can be fitted so easily into a site that gives such immediate savings.”

Bill Doodson - Chief Engineer, Frederic Robinson Breweries

About Frederic Robinson Breweries

When William Robinson bought the Unicorn Inn in Stockport on 29 September 1838 he was establishing a company that was to become one of Britain's largest regional brewers. Now run by the fifth and sixth generation of the family, the company continues to develop whilst still using traditional brewing methods. With an estate of over 400 houses stretching from Northern Cumbria through the Lake District, North Wales, Cheshire, Derbyshire and Staffordshire, together with the expansion of wholesale, free trade, off trade activity and a state of the art bottling facility, Robinsons is well placed to continue its success story in the future.

powerPerfector unit details

A pP 1,000kVA / 1,450A unit with 9% voltage optimisation setting was installed at the Frederic Robinson Breweries in Stockport on the 6th April 2008. Installation of the powerPerfector achieved the following results:

- **10% reduction in daily average consumption**
- **£21,000 average savings per year**
- **154,000kg CO2 per year**

Bill Doodson, Chief Engineer at Frederic Robinson Breweries writes:

“I was very sceptical that we would achieve savings of over 7% by fitting the powerPerfector due to the fact the site is already very energy efficient. There are over 100 electric motors on the site on pumps, compressors and drives, varying from 0.75kW to 75kW, all but a few of them are fitted with Variable Speed Drives for either control purposes or to save energy or both. Any new motor fitted in the last 6 years has also been an Eff 1 design, so to get well over 10% saving is remarkable. In the current climate it is very hard to ignore a technology that can be so easily fitted in to a site that gives such immediate savings.”

FULL REPORT

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Introduction

powerPerfactor 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 powerPerfactor 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 powerPerfactor 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 powerPerfactor 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 for the Frederic Robinson Breweries, a 1,000kVA / 1,450A powerPerfector unit was installed on 6th April 2008.

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 average kWh consumption	10%
Projected financial saving	£21,000 annually
Projected carbon dioxide emissions savings	154,000 kg annually

Savings Analysis Report

A 1,000kVA powerPerfector unit with a 9% optimisation setting was installed at the packaging unit at Frederic Robinson Brewery on 6th April 2008. The following report is an analysis of the electricity consumption and production data for the site up to 18th August 2008.

The half hourly electricity consumption profile from 1st January 2008 – 18th August 2008 is shown in **Figure 1**. The consumption before installation is shown in red and after installation in green.

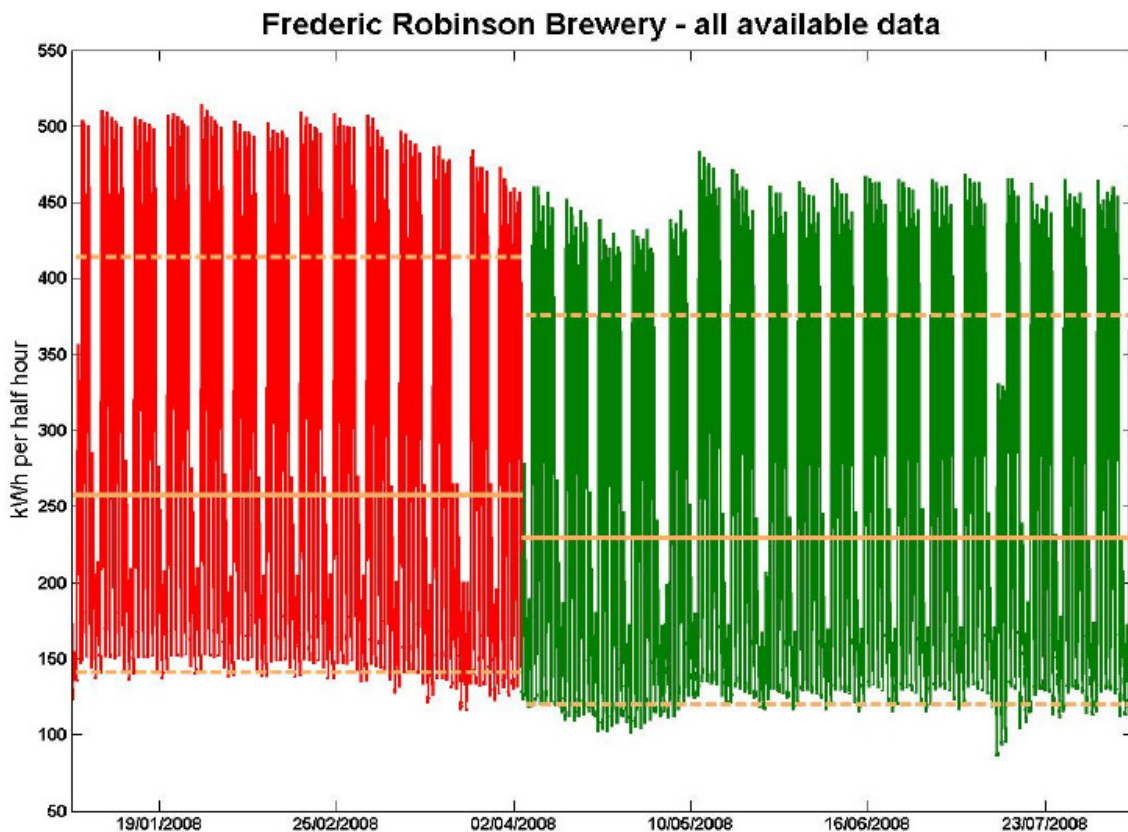


Figure 1: kWh Consumption Before and After Installation

Whilst there is a substantial reduction in kWh consumption over all the available data shown in the previous chart, much of the variation in consumption corresponds to changes in production volumes. **Figure 2** shows the weekly kWh consumption data and the weekly total for barrels (Bbls) of product.

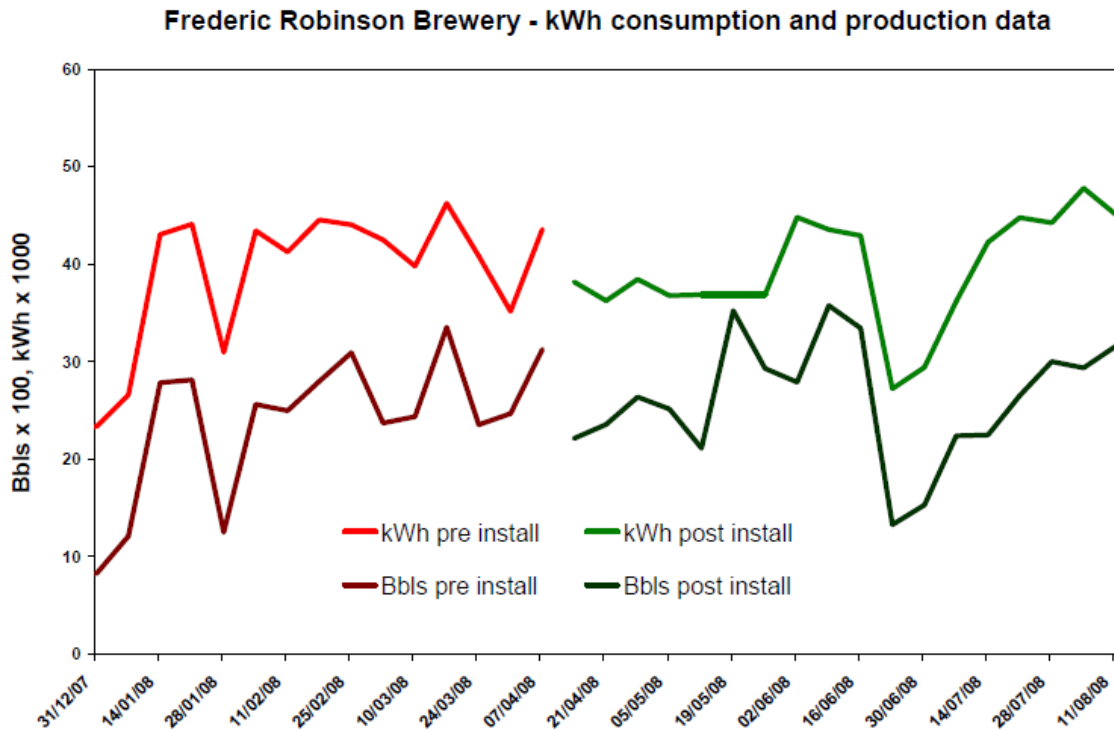


Figure 2: kWh Consumption and Production Volume in Barrels (Bbls) Before and After Installation

Figure 2 indicates that there is a good correlation between the energy consumed and the number of barrels produced. Using weekly barrel production data, the brewery calculates a Specific Energy Ratio (SER), which is the amount of energy used to produce a barrel of product. A comparison of the SER for the periods before and after powerPerfector installation gives a reduction of **10.75%** as shown in the **Figure 3**.

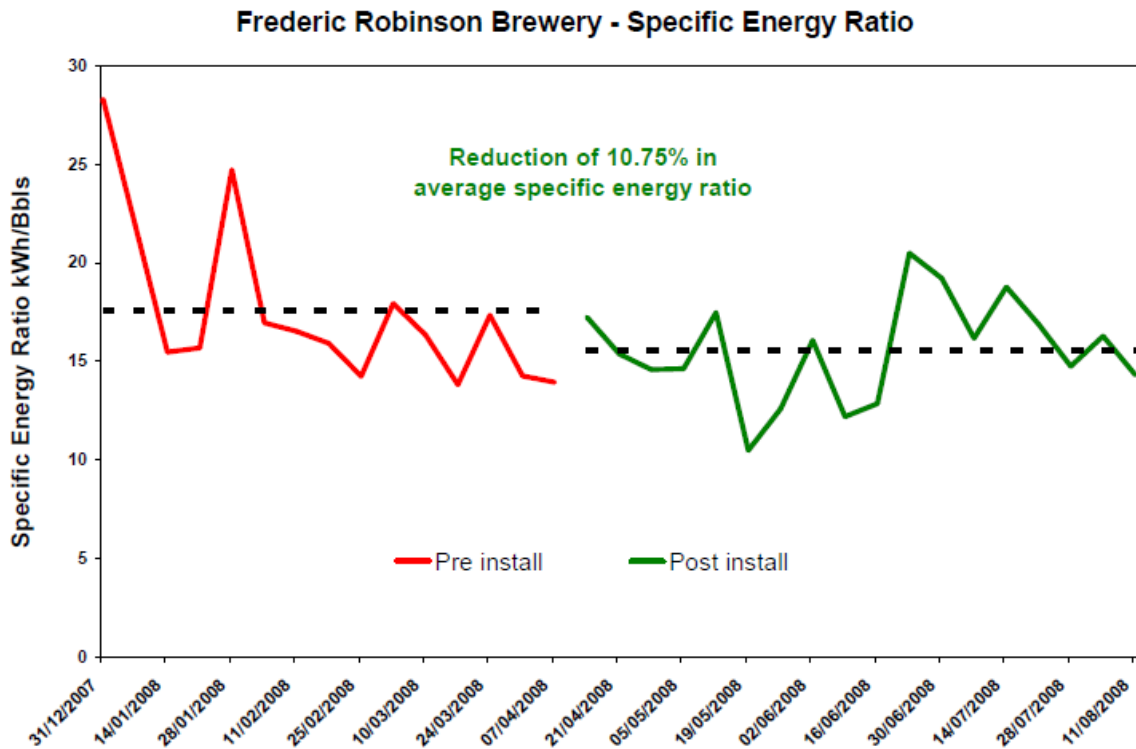


Figure 3: Comparison of Specific Energy Ratio Before and After Installation

Conclusion

In conclusion, analysis of electricity consumption and production at the site following the powerPerfector installation indicates that there is a 10.75% reduction in the average specific energy ratio based on a comparison of the pre and post installation periods. This equates to a projected annual saving of £21,000 and 154,000kg of carbon dioxide emissions. The powerPerfector is also ensuring that the site operates with a high level of efficiency, as well as benefiting from improved power quality and protection against transients of up to 25kV.

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.

