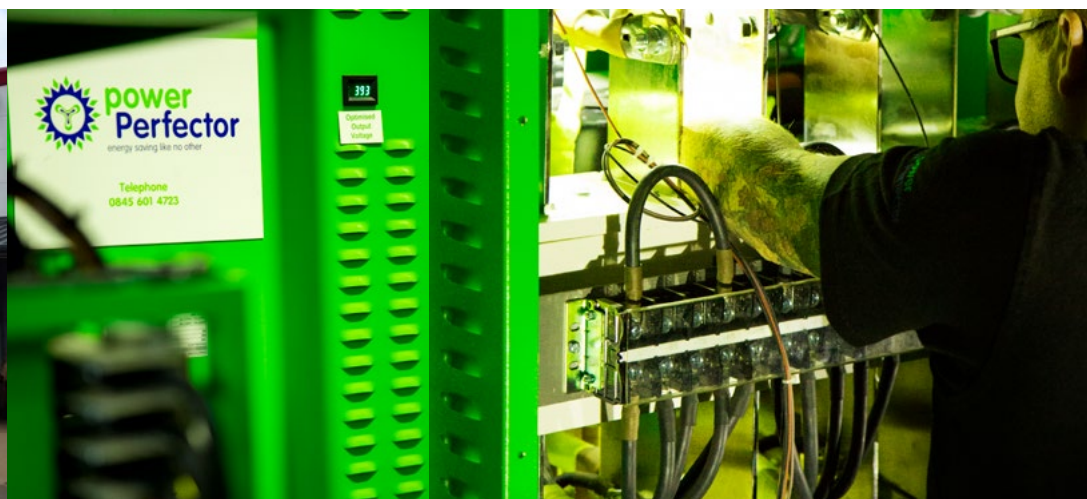


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SAVINGS ANALYSIS

Costco Wholesale, Derby, Derbyshire

powerPerfector iQ Voltage Power Optimisation®



powerPerfector technologies from iESCO, The Intelligent Energy Saving Company
iESCO Ltd. 344-354 Gray's Inn Road, London, WC1X 8BP, United Kingdom

Executive summary

A 690kVA / 1000Amp powerPerfactor with a 8% optimisation setting was installed at Costco Derby in February 2013. Since this original installation powerPerfactor technologies have evolved with the introduction of the most advanced electronic voltage control technology available named the 'iQ'.

The iQ is the fastest, most accurate and precise control technology on the market; this new advancement upgrades a standard powerPerfactor unit to a 'powerPerfactor iQ' (pPiQ). In 2016 the powerPerfactor unit at this site was upgraded with an iQ to provide the following benefits:

Improved savings

Existing powerPerfactor savings are improved by up to 30%.

Security of supply

The site is protected against harmful voltage dips, sags, intervals and swells.

Improved site efficiency

Highly stable voltage supply and phase voltage imbalance corrected.

The following report analyses electricity consumption data from a Power Quality Analyser and indicates that the average kWh consumption at site is 13.46% lower.

This reduction equates to approximately:

171,895 kg

of carbon dioxide emissions

315,403 kWh

of energy

£28,386

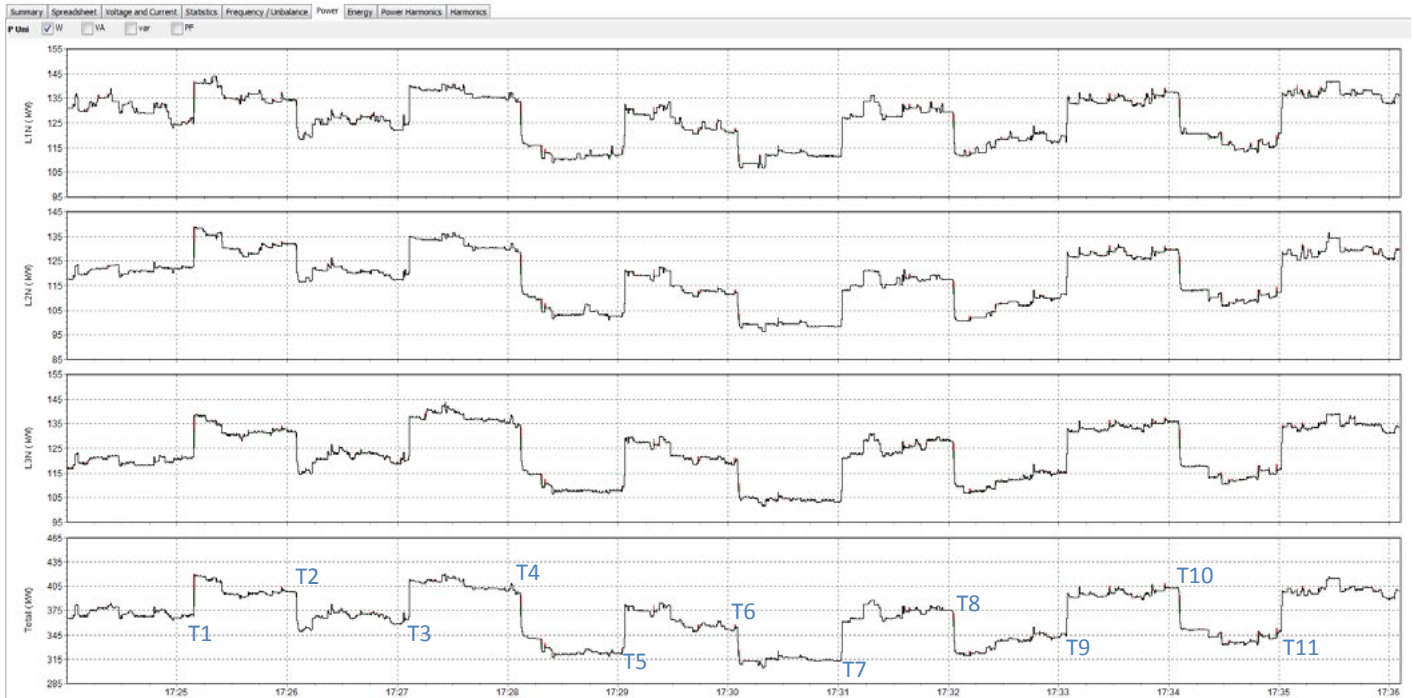
of annual financial savings
(using 9pence/kWh)

pPiQ installation



TEST 1 kW per phase and Total kW

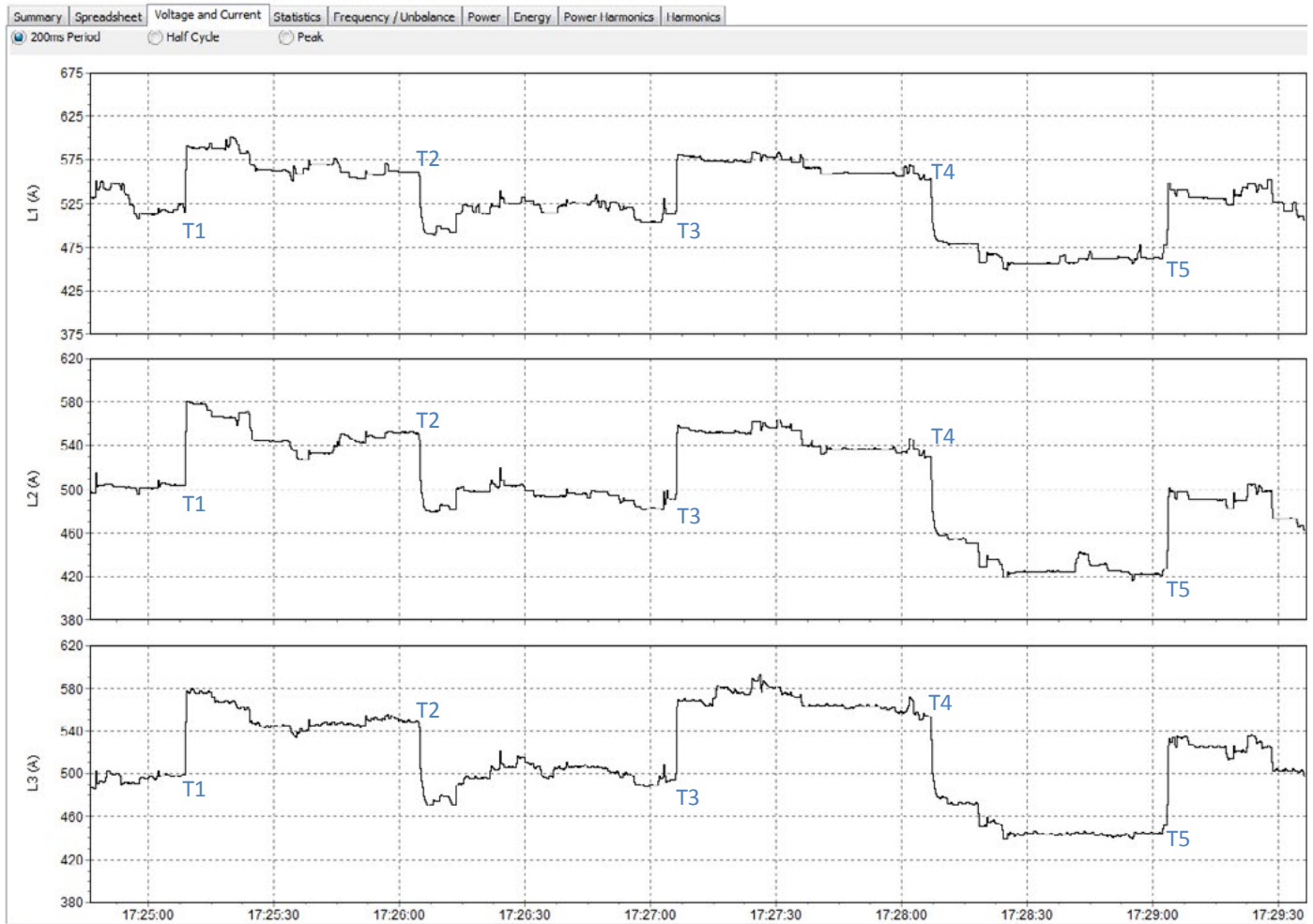
The charts below shows the change in real power kW per phase and in total kW when the pPiQ is taken in and out of line i.e. mains to active pPiQ. The step changes in kW can be clearly seen resulting in an **average change/saving of 13.46%**.



Test	Total kW change	
T1 = Active pPiQ to Bypass (mains)	370	405
	+9.46%	
T2 = Bypass (mains) to Active pPiQ	398	351
	-11.81%	
T3 = Active pPiQ to Bypass (mains)	364	412
	+13.19%	
T4 = Bypass (mains) to Active pPiQ	397	340
	-14.36%	
T5 = Active pPiQ to Bypass (mains)	323	375
	+16.10%	
T6 = Bypass (mains) to Active pPiQ	351	312
	-11.11%	
T7 = Active pPiQ to Bypass (mains)	313	365
	+16.61%	
T8 = Bypass (mains) to Active pPiQ	375	322
	-14.13%	
T9 = Active pPiQ to Bypass (mains)	342	390
	+14%	
T10 = Bypass (mains) to Active pPiQ	403	352
	-12.66%	
T11 = Active pPiQ to Bypass (mains)	349	400
	+14.61%	

TEST 2 Current per phase

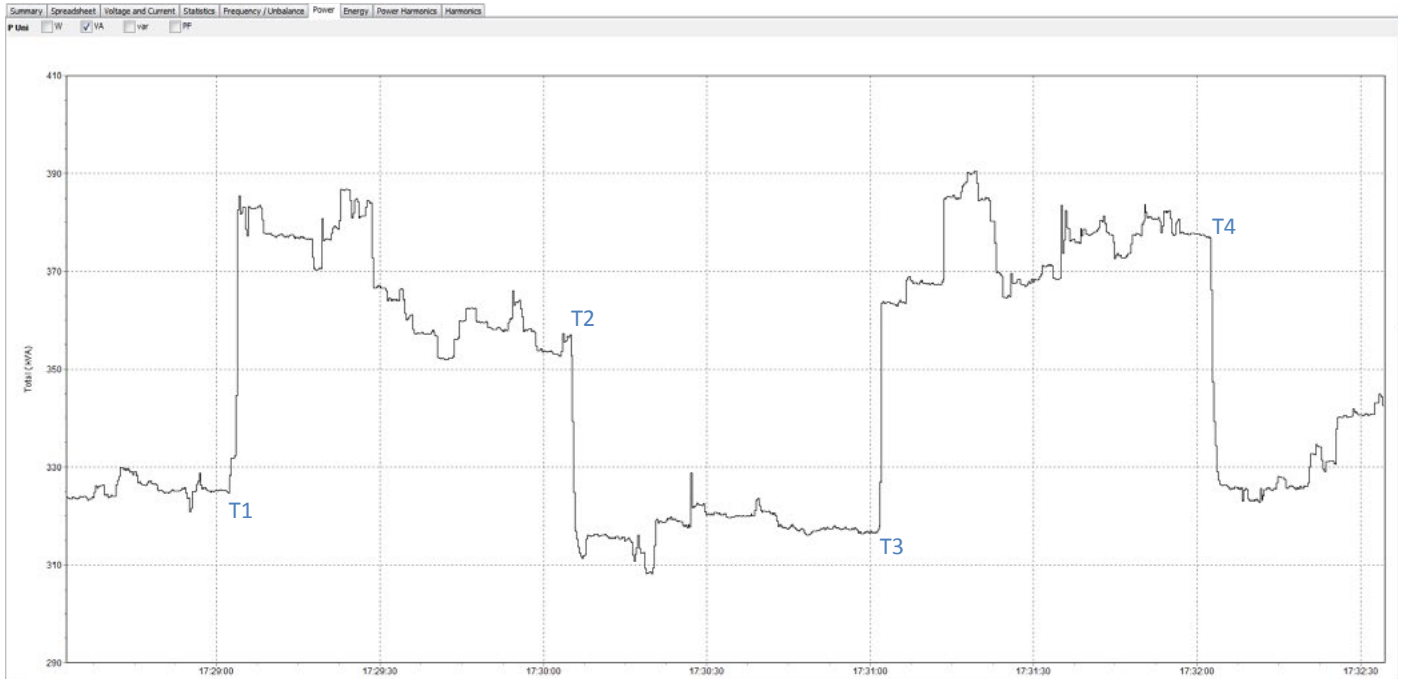
Each phase shows a **change/saving in current (amps) of approx. 12%** as the pPiQ is taken from active to bypass mode.



Test	L1 Amps	L2 Amps	L3 Amps	Average change in Amps
T1 = Active pPiQ to Bypass (mains)	520	504	503	
	570	550	550	
	+9.60%	+9.13%	+9.34%	+9.36%
T2 = Bypass (mains) to Active pPiQ	561	552	548	
	522	500	500	
	-7%	-9.42%	-8.76%	-8.39%
T3 = Active pPiQ to Bypass (mains)	513	491	494	
	573	551	570	
	+11.7%	+12.22%	+15.38%	+13.1%
T4 = Bypass (mains) to Active pPiQ	553	530	554	
	479	450	472	
	-13.38%	-15.1%	-14.8%	-14.42%
T5 = Active pPiQ to Bypass (mains)	463	422	444	
	531	491	524	
	+14.68%	+16.35%	+18%	+16.34%

TEST 3 Total kVA

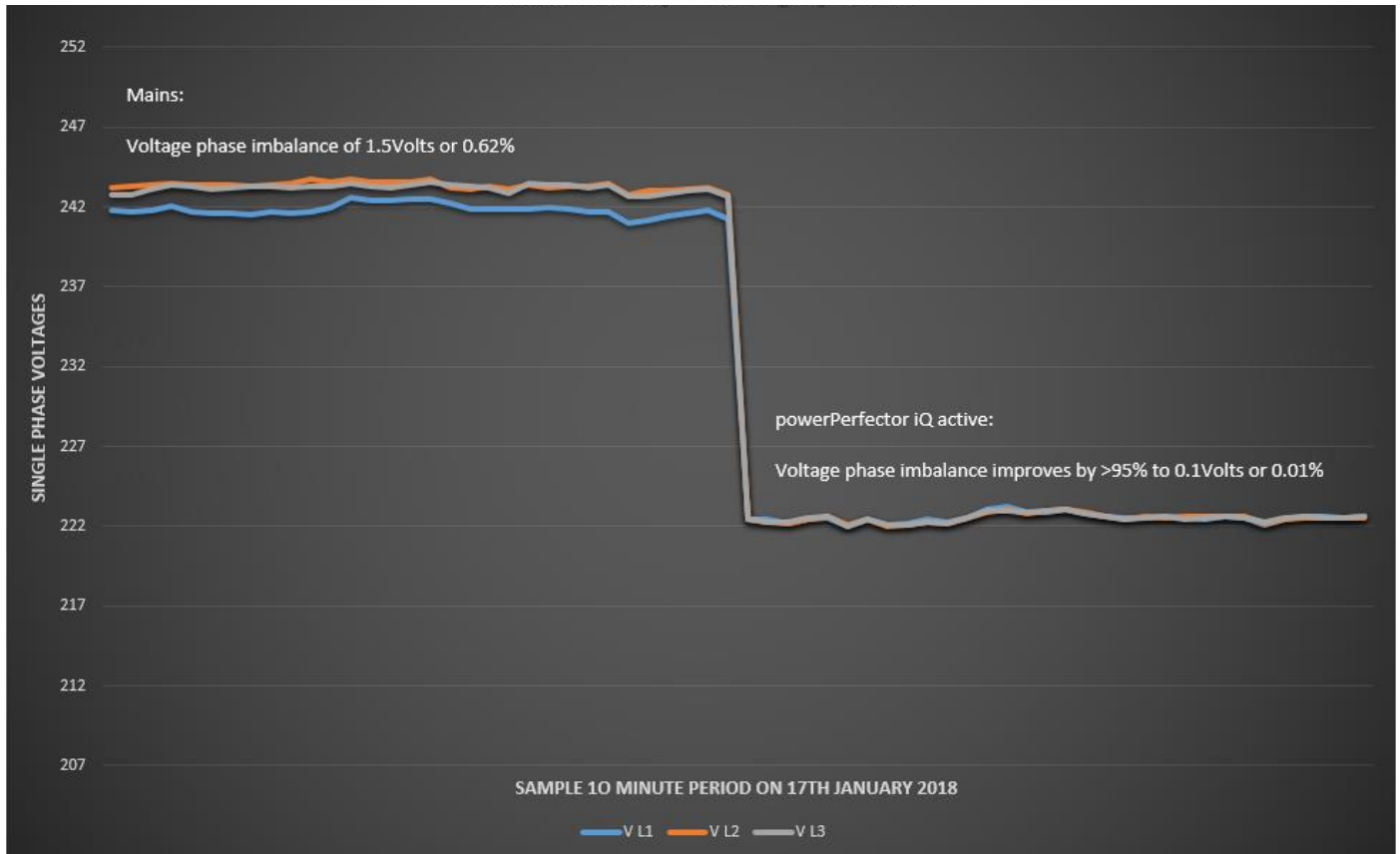
The chart below shows the change in apparent power kVA (real power plus re-active power) as the pPiQ is bypassed / activated. This demonstrates the ability of the unit to **reduce maximum demand and reactive power**.



Test	Total kVA change	
T1 = Active pPiQ to Bypass (mains)	325	375
	+15.38%	
T2 = Bypass (mains) to Active pPiQ	355	317
	-10.7%	
T3 = Active pPiQ to Bypass (mains)	317	368
	+16.1%	
T4 = Bypass (mains) to Active pPiQ	377	325
	-13.79%	

TEST 4 Voltage Profile analysis

Single phase voltage readings were recorded on the input and output side of the pPiQ every 10 seconds and plotted to demonstrate the significant improvement in voltage imbalance when the iQ unit is active.



Importance of balanced voltages

An unbalanced voltage imposed on a motor will result in a current increase and overheating. Moreover, the power consumption will increase and the efficiency, torque, and output of the motor will drop. Then the life of the winding may be shortened and the vibration and noise of the motor may increase because the motor will be partially overheated. Therefore, it is said that the motor should be driven by power with the voltage unbalance ratio suppressed to 2% or below.

If voltage unbalancing occurs, the current will be greatly influenced. It is said that an unbalanced voltage will have the following influence. A voltage unbalance ratio of 1% will result in a current unbalance ratio of approximately 10%.

Source: https://service.daikin.com/newweb/air_conditioner/Members/tech/news/PDF/E-06026.pdf

Conclusion

The report uses data collected from a Power Quality Analyser that was fitted on the grid side of the powerPerfactor iQ unit and therefore replicates the DNO half-hourly meter from which the client is billed. The powerPerfactor iQ is saving the site 13.46% of its electrical.

This reduction equates to approximately:

171,895 kg

of carbon dioxide emissions

315,403 kWh

of energy

£28,386

of annual financial savings
(using 9pence/kWh)

The pPiQ upgrade has afforded the site greater functionality including the option to take the unit in and out of line. This has allowed us to demonstrate the improvements to kW, kVA and Amps that optimising the 3 phase voltages creates.

Other benefits include

- Existing powerPerfactor savings are improved by up to 30%
- Voltage instability and fluctuations are eliminated
- Site equipment benefits from a highly stable voltage
- Reacts to supply voltage changes within 250ms
- Equipment efficiency is maximised due to active 3 phase balancing
- The site is protected against harmful voltage dips, sags, intervals and swells
- Precise output voltage control is provided across the whole site
- Wi-Fi remote monitoring & intelligent control

How to choose between the standard unit and the pPiQ

Not every business will require the added benefits of the powerPerfactor iQ. This will very much depend on current usage and the improvements achievable through the installation of a power optimisation unit.

For each and every customer we undertake a full analysis of the energy consumption to establish which unit would be best suited, with the payback period clearly in mind. Therefore, we always recommend an initial conversation with our team to help clarify which is best for your business.

Contact our friendly team and they will be able to help you.

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