power Perfector
energy saving and security like no other

T. +44 (0) 207 164 2271
E. enquiries@powerperfector.com
W. www.powerperfector.com

# SAVINGS ANALYSIS

## Costco Wholesale, Derby, Derbyshire

powerPerfector iQ Voltage Power Optimisation®



# Executive summary

A 690kVA / 1000Amp powerPerfector with a 8% optimisation setting was installed at Costco Derby in February 2013. Since this original installation powerPerfector technologies have evolved with the in troduction 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 ad vancement upgrades a standard powerPerfector unit to a 'powerPerfector iQ' (pPiQ). In 2016 the powerPerfector unit at this site was upgraded with an iQ to provide the following benefits:

**Improved savings**
Existing powerPerfector 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

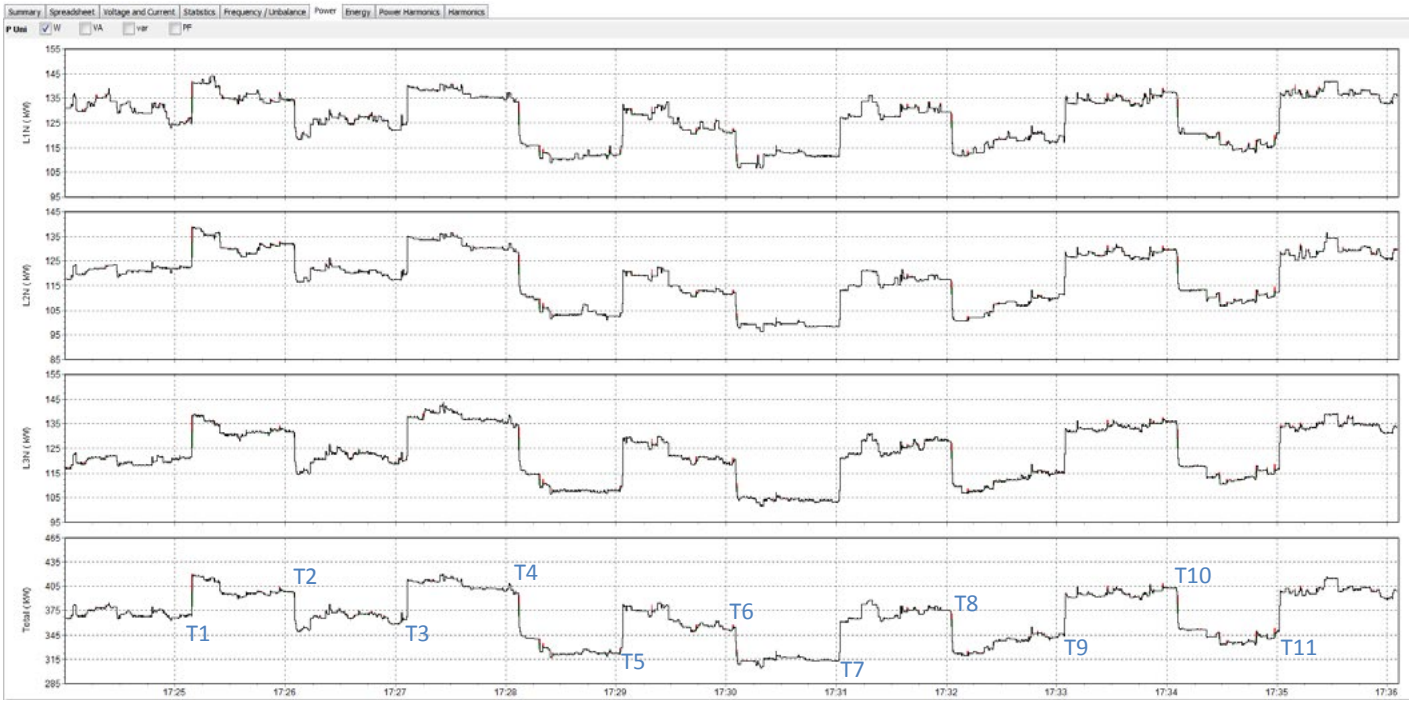
**315,403 kWh**
of energy

**£28,386**
of annual financial savings (using 9pence/kWh)

## pPiQ installation

# **TEST 1** kW per phase and Total kW

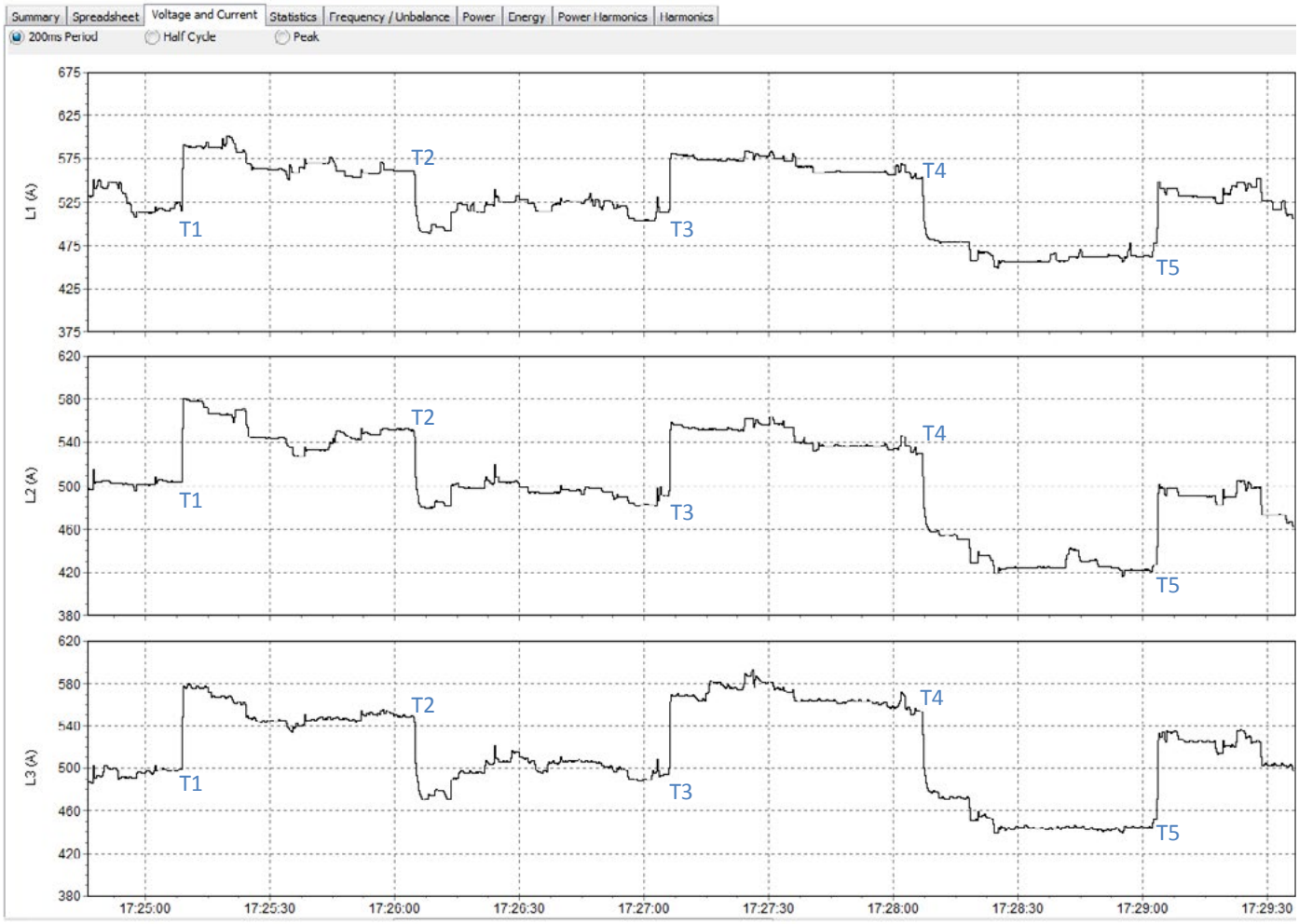
The charts below shows the change in real power kW per phase and in total kW when the pPiQ is taken in and out of line i.e. mains to active pPiQ. The step changes in kW can be clearly seen resulting in an **average change/saving of 13.46%**.




| 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

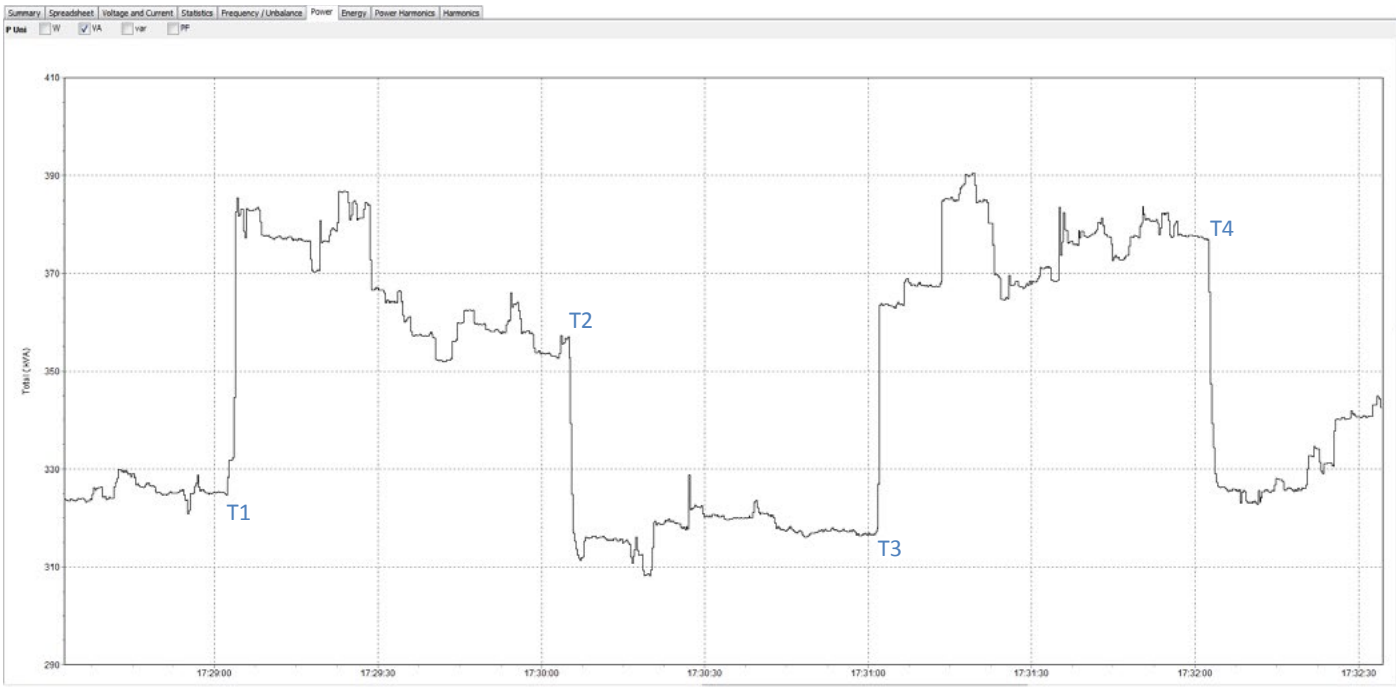
Each phase shows a **change/saving in current (amps) of approx. 12%** as the pPiQ is taken from active to bypass mode.




| 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

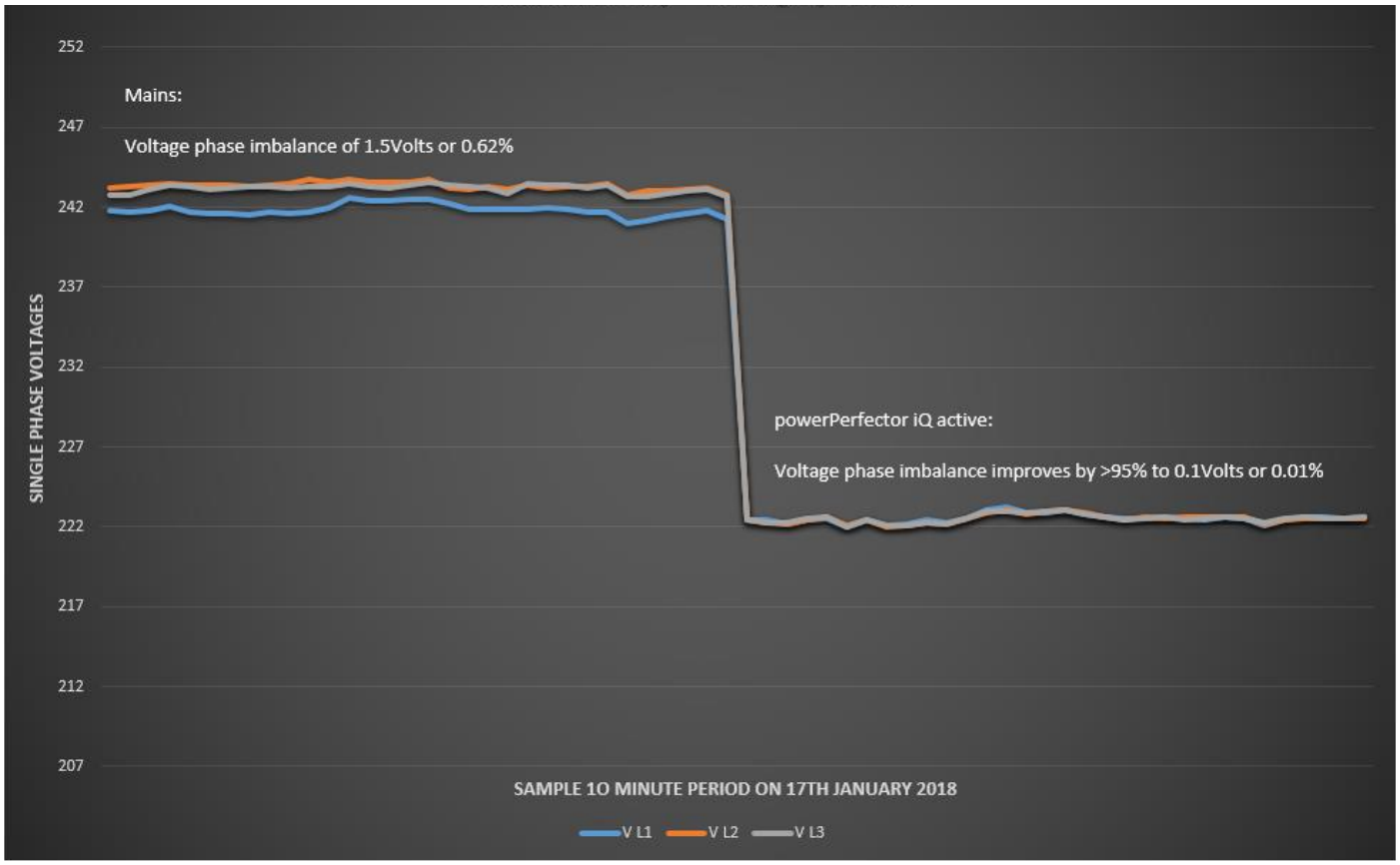
The chart below shows the change in apparent power kVA (real power plus re-active power) as the pPiQ is bypassed / activated. This demonstrates the ability of the unit to **reduce maximum demand and reactive power**.




| 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 over-heated. 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 powerPerfector iQ unit and therefore replicates the DNO half-hourly meter from which the client is billed. The powerPerfector iQ is saving the site 13.46% of its electrical load.

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 powerPerfector 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 powerPerfector 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.

T. **+44 (0) 207 164 2271**
E. **enquiries@powerperfector.com**
W. **www.powerperfector.com**