VPhase plc
VX1 Energy Savings

The Context
The Climate Change Act 2008 has set legally binding emission reduction targets for 2020 (34% reduction in greenhouse gas emission) and for 2050 (a reduction of at least 80%). *Source: DECC*.

Almost half the carbon dioxide released in the UK in 2008 derived from buildings. Homes alone account for 27% of all national emissions. *Source: www.insidegovernment.co.uk speech by The Right Honourable John Healey MP.*

Electricity within the home accounted for 24% of a home's energy use in 209. Source: EA Technology Report on Domestic Energy Consumption in the UK, September 2010. Lighting and appliances excluding resistive loads (cooking, space heating and water heating) account for 67% of the electricity consumed within the home. *Source: DECC*

Given the proportion of carbon dioxide that is emitted from the energy consumed by lighting and appliances reducing their energy consumption is seen as a major contribution towards helping the Government meet its 2020 and 2050 targets. VPhase is the ideal product as it reduces the energy consumed by lighting and appliances by managing the voltage level within the home and, as it actively manages it keeping it to a set point, typically 220 volts, unless the incoming feed from the energy supplier drops below the set point.

Voltage variability
Voltage in the UK can vary between the statutory limits, a low of 216 volts and a high of 253 volts. EU harmonisation has changed this for appliances to 207 volts minimum and 253 volts maximum equating to a 230 volt nominal supply plus or minus 10%. In reality whilst the UK has agreed to adopt the range and all our appliances are manufactured to meet the EU range, the Government has not changed the supply parameters. Source: *"REO Power Quality Fact Sheet (2004)", BS EN 50160:2000"Voltage Characteristics of Electricity Supplied by Public Distribution System".*

The way the UK electricity network operates, amongst other things requires the voltage supply level to be kept at the upper end of the statutory limits to ensure that voltage sags as load levels change do not allow the voltage at the home to drop below the statutory minimum. In addition the DTI noted that it was preferable for power distribution companies to keep supply voltage as high as possible to minimise current in the supply network.

Work done by the lighting industry federation in 2001 identified that the average voltage level across the UK was 245 volts. Source LF Technical Statement No.15 "European Voltage Harmonisation" Issue number 4, Lighting Industry Federation 2001.

The trial recently concluded with Scottish and Southern Energy ("SSE") as part of the Ofgem CERT Demonstration Action ("CERT DA") identified that the mean voltage across the trial homes was 245 volts and AEA Technology made the following observation: *"The trial measurements confirmed the*

views taken in the trial design and indicated by the electricity network companies that the networks are operated at the higher end of the statutory voltage range so the majority of properties see voltages between 235 volts and 250 volts. No property in the trial saw an average voltage of less than 235 volts whilst the highest average voltage was 253 volts. The average voltage across the trial properties was 245 volts, this matched the UK average utility voltage provided by the Electrical Networks Association exactly."

Impact of higher voltage on appliance operating costs and performance

There are many examples that appliances consume less electricity when the supply voltage is optimised at the lower end of the statutory supply range. The work we have done consistently shows that managing the voltage to 220 volts means that the lighting and appliances in the home use less electricity, thereby saving the home owner money and reducing carbon emissions from their use.

The results by appliance in tests carried out by VPhase consistently show savings examples of which are in the following ranges:

Appliance	**Reduction in electricity consumed**
Central heating pumps	15% to 18%
Microwave ovens	11% to 38%
Incandescent bulbs	13% to 15%
Halogen lighting	14% to 15%
Fluorescent lighting	17%
CFL	10% to 13%
LED	13%
Computing	0% to 5%
Freezers	8% to 17%
Fridges	13% to 15%
Tumble dryers	18%
Washing machines	1% to 15%
Dishwashers	0%
Power Supply Units	5% to 21%
Set top box	2%
TV	2% to 5%
Hair dryer	20%
Fan heater	20%

In addition to the reduction in energy consumed there is also evidence that the life of certain appliances is extended by voltage optimisation. The best example is work carried out by the lighting industry which has identified that a 5% reduction in the voltage supplied to a bulb doubles its life. In addition there is much evidence of the damage caused to induction motors by over voltage, it's no secret that heat kills electric motors. Exceeding the rated operating temperature by as little as 10-deg C (18-deg F) can shorten the life of a three-phase induction motor by half. High voltage on a motor tends to push the magnetic portion of the motor into saturation. This causes the motor to draw excessive current in an effort to magnetize the iron beyond the point to which it can easily be magnetized.

The ability to extend the life of certain appliances is an additional benefit of voltage optimisation which has not been a specific focal point for the Company to date.

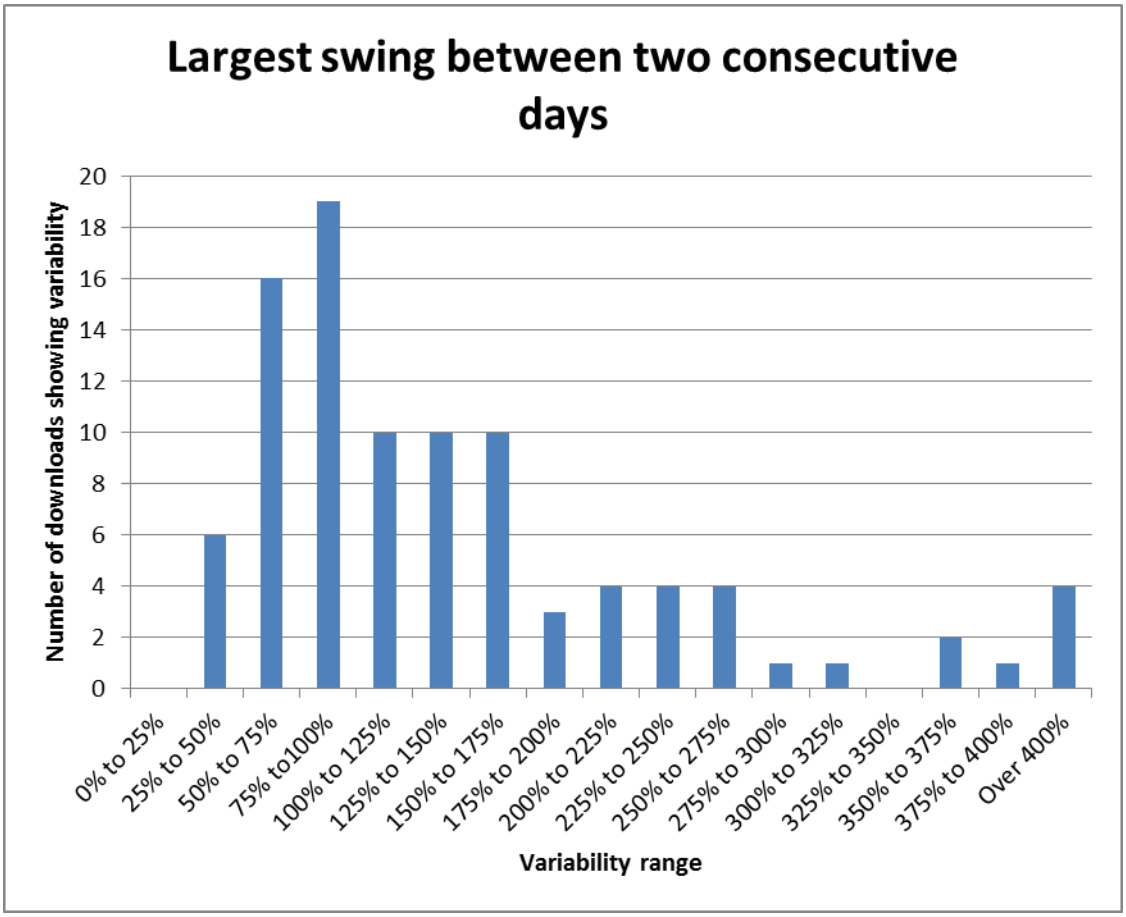
Trial methodology

To assess the benefits of a VPhase we have conducted a number of trials using different methodologies. A description of each method and its pros and cons is set out below:

1. Day on Day off

The device is in regulating mode for one day and then un-regulating or bypass for the following day. This provides a difference between days which can be evaluated to determine energy saving. The benefit of this method is that the logger can hold many days' worth of data making the logistics of collecting the data easier and less costly. However this is the least accurate of the methods in terms of confidence levels (plus or minus accuracy) as a result of the significant changes in load levels that can occur from one day to the next.

Daily loads in homes vary considerably most by more than a factor of 1.75 (75% of the first day's usage), or more, on consecutive days. The largest variation seen in anyone home was from 5.453kWh to 67.442kWH a swing of 12 times. Measuring one day on and one day off whilst sampling every ten minutes does not provide enough granularity in the data to understand what savings are truly being made.



2. 56 minute cycle

Taking a smaller cycle period with 56 minutes regulating and 56 minutes in bypass increases the granularity comparing the 56 minute periods to determine the energy saved. A 56 minute cycle means the corresponding hour each day is not in the same active or inactive state. The benefit is that this results in improved confidence levels; however the downside is that the logger can only hold a maximum of 11 days of data before being downloaded. As these trials were run for up to 60 days several visits had to be made to each property.

3. 10 minute cycle

This is the Company's preferred method for demonstrating the benefit of a VPhase unit as the Company believes it removes most of the issues of load variability giving the most accurate results. The downside is the significant volume of data as the sampling period is 3 seconds (average supply voltage, average regulated voltage and actual energy consumed) this requires daily downloads at the property.

4. Laboratory tests

We have run a test of appliances in laboratory conditions simulating different states of use to identify savings as set out in the table above.

The energy saving impact of these trials

The different methodologies have been trialled with different third party organisations and the results assessed, some in house but more often by EA Technology. The results are set out below:

1. CERT DA

This trial was conducted over 50 sites using the agreed methodology of "Day on Day off". The data was analysed by EA Technology by the application of a number of energy saving algorithms.

Overall the energy saving was found to be 5.2% (6.3% once rebased) with a confidence limit of +/-1.4%

2. Great Places Housing Group

We conducted a trial in three of Great Places terraced houses that were representative of their housing stock. The methodology was 56 minute cycle for 40 days. Whilst these properties had relatively low energy consumption (between 10% and 30% lower than the national average) their savings were in line with expectations.

The savings ranged between 8.5% (+/- 0.6%), 8.7% (+/-0.3%) and 8.9% (+/-0.6%)

These trials were independently validated by EA Technology

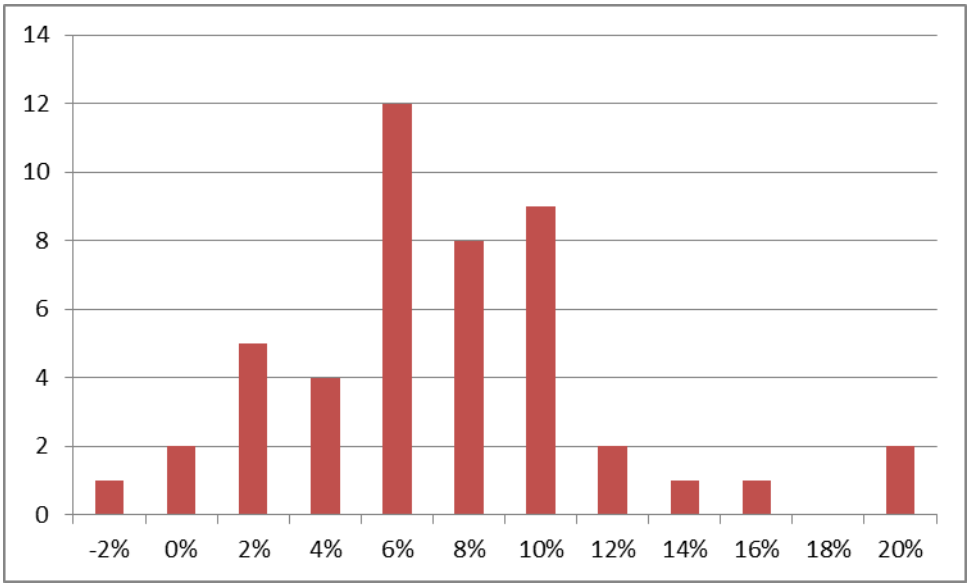
3. Staff home trials

The trials carried out in four of our own staff homes used the 10 minute cycle for around 22 days. Staff homes were ideal for this methodology as daily download of the data was practical. The data was provided to EA Technology who analysed the results

The results delivered savings of between 6% and 12%, 8.1% on average overall with a confidence interval of between 0.4% and 0.6%.

Conclusion

There cannot be a precise "you will save" percentage applied to voltage optimisation as each home's load profile will be different dependent upon mix of appliances, number of occupants, type of property and other factors including distance from substation, and climatic factors. But we consistently demonstrate that voltage optimisation reduces the running costs of appliances and lighting and that homes with voltage optimisation installed will save up to 12% of their electricity consumption, sometimes more. The results from all methodologies are set out in the chart below.



39 out of 52 homes show savings between 4% and 12% (75% of all homes).