SP ENERGY NETWORKS

Ashton Hayes Smart Village

going carbon neutral Ashton Hayes

ASHTON HAYES SMART VILLAGE REPORT – ISSUE 2 – November 2011

Introduction

Background

Throughout the course of 2011 SP Energy Networks installed **Sub.Net power monitoring devices** in the four secondary substations that feed the village of Ashton Hayes. These devices measure a number of parameters, including power quality and electricity consumption, over 140 times a day, every day before sending data directly to ScottishPower staff. This data, coupled with our knowledge of the Ashton Hayes Low Voltage Network, has allowed us to produce the following graphs and explanations that summarise the electricity usage of the village during the month of November.

Aims of Research

From our study into the electricity usage of Ashton Hayes we hope to provide the residents of the village with a means of understanding how individual properties contribute to the overall demand for electricity. We intend to a give an insight into how the community can move to adopt renewable resources and green technology and help progress the village towards its carbon neutral goal. We also hope that it will give us insights into how a Low Voltage network performs when innovative technology, such as electric vehicles, heat pumps and solar panels, are connected.

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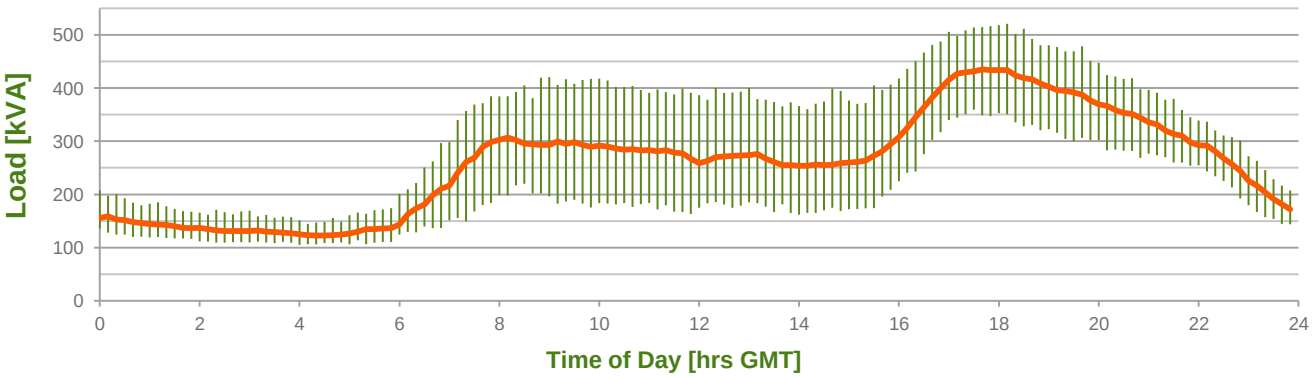
Ashton Hayes **electricity demand – November 2011**

Average, Maximum and Minimum load



What does the graph tell us?

The orange line on the graph shows Ashton Hayes' demand for electricity throughout a typical day in November. From it we can see that the maximum demand occurs at around 1800hrs and is 425kW. This is 75kW higher than the October peak which was expected as a result of the shorter days and colder weather. The vertical lines illustrate the maximum and minimum demands experienced at that time of day through out the month. Once again the demand profile is closely related to our behaviours, for example the peak at 0700 is due to people waking up and using kettles, toasters and power showers etc. as they get ready for work.

Why is this important?

As more Low Carbon technologies such as electric vehicles and heat pumps are added to the network the peaks in the demand curve will also increase. This is because these technologies will be utilised most at these peak times and hence will put more demand on the network. However there is a limit to what the network can supply and hence it is important that demand does not exceed the capacity of the network. It is therefore important to monitor demand and where possible shift it to quieter parts of the day so that large peaks do not occur.

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A Low Carbon case study

A possible reduction of around **1 tonne in the daily carbon dioxide emissions** could be achieved by the installation of four **100kW wind turbines** and **one 14kW** wind turbine in addition to the solar panels on the pavilion and the school.

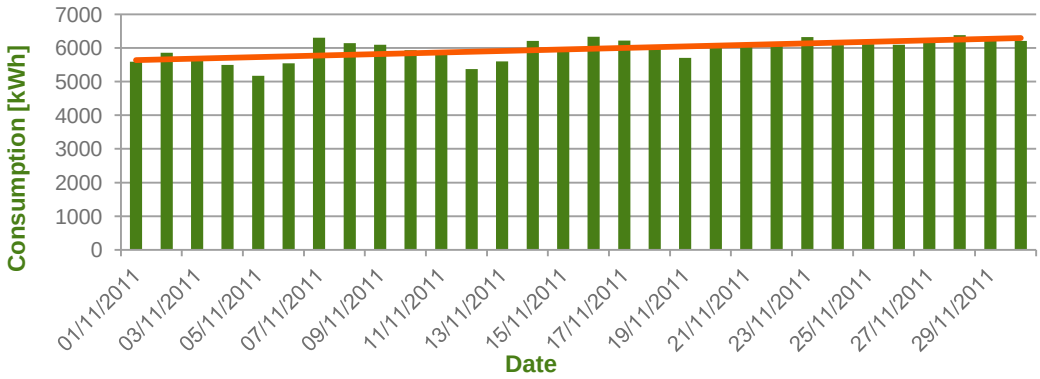
This would result in around **35%** of the village's electricity supply coming from renewables.

The total carbon production for November was **94 tonnes.**

The above solution would reduce this to **64 tonnes.**

Ashton Hayes electricity consumption - November

Ashton Hayes **total electricity consumption**



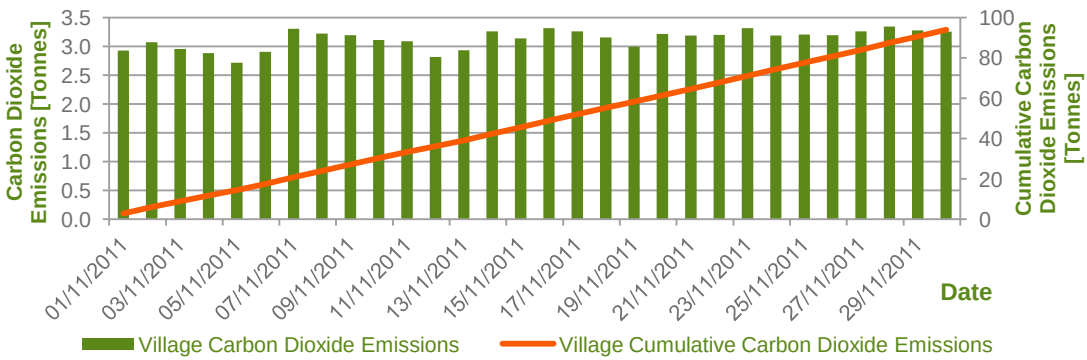
What does this graph tell us?

The graph shows the total electricity used each day in November 2011 in Ashton Hayes. We can see that the average is now around 6,000kWh, an increase of 1,000kWh from October. This additional consumption is the equivalent of each of the village properties using a 2kW electrical heater for 1hr 20min each day. The orange line indicates the overall trend in electricity usage throughout the month; as expected it increases with the onset of winter.

Why is this important?

Electricity consumption is linked directly to the quantity of carbon dioxide emitted as the majority of British power stations combust carbon based fuels to produce electricity, creating carbon dioxide as a by-product. Therefore in order to become carbon neutral the village must reduce the quantity of grid supplied electricity it consumes. This can be done in two ways; by reducing our overall demand through using less power and increasing energy efficiency and by using local renewable resources. In reality it will take a combination of these two approaches to become completely carbon neutral. This is due to the intermittency of renewable resources and the lack of a means for storing electricity that is produced when there is no demand for it.

Ashton Hayes **total and cumulative carbon dioxide emissions**



What does this graph tell us?

The graph shows the carbon dioxide emissions for each day of the month. From this we can see the average is around 3 tonnes of Carbon Dioxide per day. This is equivalent in emissions to using a 3kW immersion heater for 1,906 hours. The orange line is the cumulative total quantity of carbon dioxide emissions released through the month.

Note: carbon conversion factor used is 0.52462 from '2011 Defra/DECC 's GHG Conversion Factors for Company Reporting' Version 1.2'

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Carbon facts

A web search
0.0075kg
carbon dioxide emissions

2kW heater on for 1 hour 20 minutes
1.4kg
carbon dioxide emissions

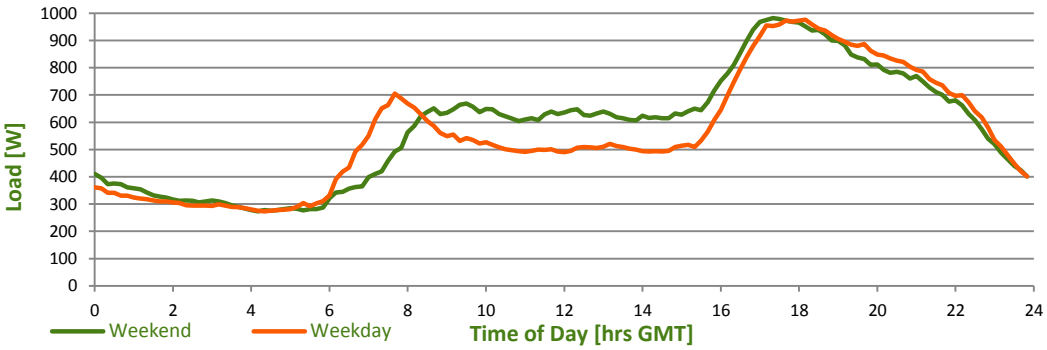
9kW hob and oven on for 1 hour
4.7kg
carbon dioxide emissions

An increase in village consumption of 1000kWh
524.62kg
carbon dioxide emissions

A return transatlantic flight
1424kg
carbon dioxide emissions

Average Property contribution for November

Weekend and weekday usage for an average property



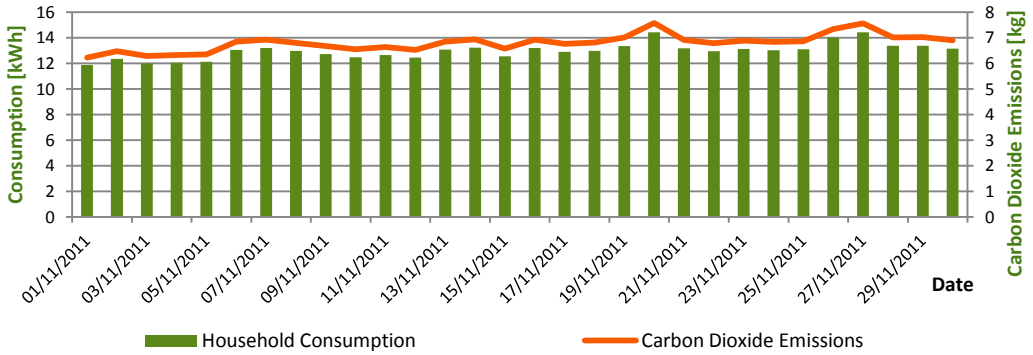
What does this graph tell us?

The above graph shows the electricity demand for an average property at the weekend and on a weekday. It highlights the difference in these load trends, for example the load between 0900 and 1500 is lower on a weekday than at the weekend. This is because on a weekday the majority of people are at work or school and hence not using appliances at home. At the weekend the load in this period is higher because people are at home and hence using appliances.

Why is this important?

Understanding when we use the most electricity is a key part to reducing our overall demand and being able to shift load to another part of the day. From this information you can relate your peak demand to the appliances you have on at the time and this allows you to understand which use the most electricity and hence produce the most carbon dioxide emissions. You can then make educated decisions on how you use your appliances and perhaps consider upgrading to a more energy efficient model.

Electricity consumption / carbon dioxide emissions per domestic property



What does this graph tell us?

The graph shows the daily electricity consumption for an average property in Ashton Hayes. It also shows the daily carbon dioxide emissions for an average property in the village. From this we can see that the average household uses around 13kWh of electricity a day, producing around 6kg of carbon dioxide*. This electricity consumption is equivalent to running a 3kW immersion heater for 4 hours and 20 minutes.

Why is this important?

As more renewable generation is added to the Ashton Hayes network, we will be able to calculate how much carbon dioxide is offset per property i.e. how big the reduction in carbon dioxide emissions is for each household.

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The predicted annual electricity consumption for Ashton Hayes equivalent in energy to:

An **Immersion Heater** on continuously for 663,333 hours (72 years)

An **Electric shower** on continuously for 234,118 hours (26.7 years)

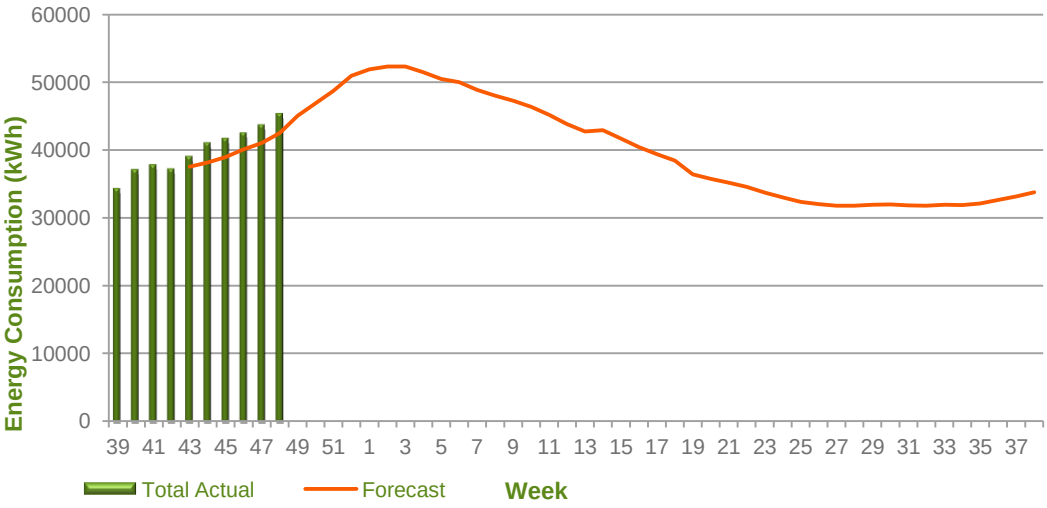
Powering a **football stadium on match day** continuously for 462.8 hours (19.3 days)

The output of a typical **combi-boiler** on continuously for 82,916 hours (9.5 years)

North Hoyle Wind farm running at max output for 33.2 hours

Future electricity consumption prediction

Electricity consumption: Actual *v.* Forecast



What does this graph tell us?

The graph above shows the electricity consumption for each week in Ashton Hayes mapped against the forecasted consumption for each week in the coming year. This is calculated from the weekly consumption data collected from monitors in the village and from data collected from other parts of the network. The graph illustrates how overall consumption will fluctuate due to the changing conditions around us, for example the increase from weeks 43 to 3 can be related to the coming of winter. From the graph we can also predict a value for the villages consumption for one year. The current prediction, taking into account the latest data, is 1.99GWh (1,990,000kWh).

Generating this quantity of electricity would produce 1,086 tonnes of carbon dioxide emissions which is equivalent:

- In emissions to those released by a bus travelling 518,606 miles (nearly 21 times round the equator)
- In emissions to those released by powering an 100W light bulb for 20,700,698 hours continuously (2363 years)

Why is this important?

In order for the village of Ashton Hayes to go carbon neutral one of it's challenges will be to reduce carbon dioxide emissions due to electricity consumption to 0. This will therefore require the village to generate 1.99GWh' of electricity from carbon neutral resources. Understanding how the village consumption is closely linked to the prevailing climatic conditions is key to gaining a clear picture of the different variables that affect our electricity usage. By understanding these variables we can then act to reduce our overall consumption and hence reduce the quantity of renewable generation required to progress Ashton Hayes towards carbon neutrality.

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