Live Energy Generation

National Curriculum
Maths – Handling data, calculations, problem solving,
English – Reading
IT – Research
Science – Using evidence, looking at variables

Teacher's Notes
This activity is based on the information available on the Beaufort Court website. Since the refurbished low carbon head office building was opened in 2003 the data has been collected from each of the 5 different renewable technologies on site. It is possible to download graphs and spreadsheets of data to use with your students.

Beaufort Court was designed to use a combination of complementary renewable energy sources and to illustrate that no single source is a silver bullet to the problems of energy security and climate change.

Students can compare wind with solar or biomass for any given year either as a graph or as a spread sheet. They might notice that wind power generally is best in the winter and solar in the summer.

The 49kW biomass boiler is fired with wood pellets. (The carbon dioxide generated by the boiler will be absorbed from the atmosphere by the new trees as they grow).

In the summer we pump up water at 12ºC from the chalk aquifer and pass it through beams in the ceiling, which brings it into close proximity with the air. The cool water takes some of the heat out of the air and we use this hotter water (18 ºC) to irrigate the biomass crop.

Our wind turbine is a Vestas machine which can produce 225kW. It is 36m to the top of the nacelle and the diameter of the rotors is 29m. Each blade is 14m long and the hub is a meter wide. If the wind speed drops below 4m/s (approx 9mph) then the turbine will automatically stop as there is not sufficient wind to generate electricity. If the wind speed exceeds 25m/s (59mph) then the turbine will slow down and stop to protect the gearing. The nacelle can turn through 360 degrees in either direction so that the rotor always points into the wind.

We have 22 solar panels that produce hot water and 7 that also produce electricity. The photovoltaic cells have the potential to produce 5.25kWp. (kWp = kilowatt peak). The hot water we produce is stored in a thermal heat store in summer and is used to pre-heat the air entering the office in the autumn. The cloud cover and sunshine hours directly affect how much energy we have available from these sources.

In general, our PV generates more of its potential capacity in the summer, whereas our wind turbine generates more of its potential capacity in the winter. This is nothing to do with efficiency, just the availability of the sun and the wind, which are both free!

Aim

- To encourage the students to use and interpret live data from the Beaufort Court website.

Resources

Laptops or notebooks or ICT suit, copies of the activity sheets displayed on an interactive white board.

Timing

1 hour

Outcomes

Each student will have an understanding of the way we power the building here at Beaufort Court by handling real live data.

Task

Using either the Live Links (the data/graphs are all downloadable) or the internet website www.beaufortcourt.com the students are using the data to answer specific questions. The answers to some of these questions will change depending upon the season so these questions have been left unanswered in the Teacher's Notes.

Differentiation

More able students will understand that we need a variety of different power sources and thermal heat sources, for if the wind turbine is not working or if it is not sunny then we have no power. The average student will see that we use different forms of renewable energy to supply the energy we need for the building.

Answers

Energy generation

1. Beaufort Court derives its electricity from the solar photovoltaic (PV) array and also from the wind turbine.
2. The heat from the solar PV panels is used to heat water, which is stored in a thermal heat store, until needed to heat the building in the autumn.
3. Cool water is passed along chilled beams, which removes heat from the adjacent warm air.

Wind Turbine – see website

Renewable Energy Sources

1. The swept area is: 3.142 x 14.5 x 14.5 = 660.6055m^2
2. The hot water generated by the solar thermal panels is stored in a large swimming pool sized tank until needed to heat the building in the autumn.
3. The water used to cool the building in the summer comes from the Chalk Aquifer.
4. We use the heat from the thermal store; additional heat is provided by the biomass boiler.

Energy Data – energy production by source

- Wind speed
- Strength of sunlight (influenced by the time of day and year) and cloud cover

Energy Data – energy comparison charts

1. January and May saw the most energy from the wind.
2. In 2011 May saw the most energy from the sun.
3. In the winter we use the biomass boiler the most.
4. We used borehole cooling the most during the summer.

Energy Production from 2004

The overall patterns are roughly the same apart from solar PV. The reason for this is the solar PV was not commissioned until late Sept 2004.

4. Live Energy Generation: WORKSHEET

Go to www.beaufortcourt.com

Energy Generation
Click on Energy Generation.

1. How do the offices at Beaufort Court generate electricity?

2. What happens to the excess heat generated by the solar thermal panels in the summer?

3. How is the building kept cool in the summer?

Wind Turbine
Now scroll down and click on the blue circle (wind turbine) to see live energy generation.

1. At the moment the turbine is producing _____ kWh
2. At this rate how much energy will the turbine produce in a day?
3. How much energy will the turbine produce in a year?

Record the live energy generation for:

Solar PV		Biomass	
Solar thermal		Heat store	

Renewable Energy Sources
Now click on Renewable Energy Sources. Read the information about the different renewables on site.

1. The diameter of the turbine blades is 29m. Can you calculate the swept area? ($A = \pi r^2$)

2. What happens in the summer to the hot water that is generated by the solar thermal panels?

3. Where do we get the water that is used for cooling the building in the summer?

4. How do we heat the building in the winter?

Energy Data
Now click on Energy Data and move along to energy production by source.

Make a list of all the variables that could possibly affect the data gathered.

Energy Data
Now click on Energy Data and move along to Energy Comparison Charts.

1. When is the wind strongest?

2. When do we get the most energy from solar power?

3. When do we use the biomass boiler?

4. When do we use borehole cooling?

Energy Production
Now click on Energy Production since 2004.

Do these graphs support your answers to the previous question?