TAA East Anglia meeting at
University of East Anglia
Monday, 16th September, 2013.

When the chips are down …..

About twenty TAA members and friends attended a meeting at the University of East Anglia, Norwich, for a tour and presentation on "***UEA Combined Heat and Power: the way ahead***". We met outside the Biomass Building at two o'clock, and were shown round by Martyn Newton of the University. Martyn is the Assistant Director of Estates and Buildings (Risk and Sustainability). Later, over coffee, he gave us a comprehensive presentation on the UEA energy systems and the role of the new Combined heat & Power (CHP) plant.

The Biomass Building contains a wood chip reception area with automatic unloading and store-filling equipment. The chips are Corsican pine, and come from local woodlands within a fifty mile radius. Saw mill waste is another possible source, and supply contracts may be put in place, once continuity of consumption is established. When the plant is fully operational, about ten lorry loads a day of wood chips will be needed. The wood chips, on receipt, are usually in the range of 30 to 50% moisture content. They are dried to 20 to 25% moisture content by a large fluid bed drier, using low grade heat from the plant's heat recovery system. The wood chips are stored in large hoppers, and elevated, as required, to high level by auger.

The gasifier is tall, cylindrical, and of stainless steel construction, within a structural steel rectangular frame. It is lined with refractory brick to withstand temperatures in excess of 1,300 degrees C. After filling with wood chips through air restricting doors, it is ignited by two large gas pokers. Partial combustion, pyrolysis, takes place with limited amounts of air admitted. Being down-draught technology, the gas is drawn off below the combustion cone by 2 to 3 millibars negative pressure. At this point the gas temperature is about 500 degrees C, when passing out of the gasifier into a centrifuge and cooler. Char, a charcoal-like bye-product, drops to the bottom of the cylinder, and is discharged via a rotary valve. The volume of char is around ten per cent of the wood chips consumed. It has a number of uses, including soil improvement. The gas drawn off is a mixture of carbon monoxide, hydrogen, methane, and other similar gases. The gas enters a water scrubber to remove tars and particles. The gas temperature is cooled to about 50 degrees C, to increase density before entry into an electrostatic separator. This operates at 40 kV. Further fine particles are removed, without explosion, as no oxygen is present.

The gas is then fed into a large V20 Jenbacher spark ignition engine driving an alternator. The engine displacement is larger than used for an equivalent power natural gas generator, as natural gas has five times more energy than the gas from the gasifier. The engine produces 2.2 megawatts (MW) recoverable heat output, and the alternator being driven produces 1.7 MW electrical output. 300 kW is required to run the electrical load within the CHP plant room, so the net electrical output is 1.4 MW. This energy is used on the UEA campus. Surplus electrical energy may be supplied to the National Grid, as switch gear allows synchronisation with the grid. A gas boiler is also installed within the building to provide hot water at 90 degrees C. The boiler is available when electricity is being supplied to the Grid. In the event the Grid has a fault, and either voltage or Hertz go out of range, the Jenbacher engine is immediately taken off load by the automatic protection equipment. However, the gasifier will continue operating, as combustion cannot be stopped instantly. The gas from the gasifier is flared off until the gas boiler is started, or gas supply changed over, thus allowing continued output from the gasifier.

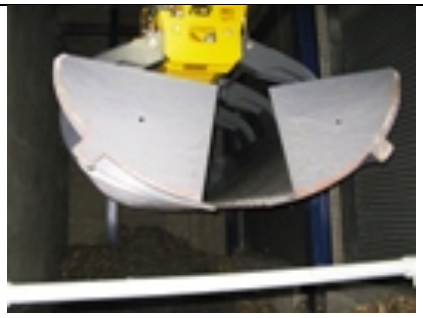
Construction of UEA commenced in 1960s, and has been expanding steadily. Presently it has 14,500 students, of which 3,500 live on the campus. The present annual heat demand is 42 million kilowatt-hours (kWh), and annual electricity demand is 36 million kWh. Three combined Heat and Power plants, located in other buildings but not seen, have been installed for many years, and run at about 86% efficiency. However, the main fuel used currently is natural gas, consumed by a number of engines and boilers. The challenge now is to achieve a 25% reduction in carbon emissions, by using a secure locally-available fuel source, wood chips, rather than North Sea gas, or indeed Russian gas when our North Sea reserves become depleted.

The planned use of gasifiers within the CHP system should achieve this. The calculated pay-back period is five years. The plant is thought to be the largest down-draught gasifier ever constructed. It was supplied by a relatively small company. Presently there are some technical problems with running the gasifier, which severely restrict the operating periods. Martyn and his team are attempting to rectify the problem. UEA has been successful with a number of energy saving developments over the years, and we look forward to seeing this innovative gasifier plant becoming fully operational soon.

Hugh Back

Author Note: *Hugh Back is an agricultural engineering consultant and member of TAA, who lives in Norwich. He himself has experience of successfully planning the establishment of a wood chip gasifier plant in Uganda, to provide heat and power for a tea estate. Eucalyptus wood was provided by the tea estate.*

A selection of Photographs has been posted on the TAA Pics dropbox

	
Gas boiler	Gasifier
	
V20 engine	Biomass Building
	
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