Stoke Bardolph Energy Crop AD (Anaerobic Digestion) Plant

by
Martin Dent

In supplying over 2 billion litres of drinking water to around 8 million customers living in the midlands and mid-wales, Severn Trent Water uses a huge amount of electricity - circa 900 Gwh each year, at a cost of around £50million. To try and reduce its need for importing electricity, as well as implementing energy efficiency plans, the company is intent on producing as much electricity it can from renewable, sustainable sources. Severn Trent is currently constructing the UK's first industrial scale energy crop AD plant on its estate at Stoke Bardolph, Nottingham at a cost of £15million.

Internal view of one of the secondary digestion tanks showing the timber roof support construction *Courtesy of Severn Trent Water*

Work on this project started in 2007 when Severn Trent became aware of the development of Energy Crop AD plants across mainland Europe. The company commissioned its own feasibility studies to assess the potential of this technology for deployment at its own farms. Severn Trent is the largest producer of electricity from sewage gas in the UK, which is generated at its 36 main sewage sludge treatment centres. The company recognised that many synergies exist between with the anaerobic digestion of sewage sludge and energy crops and the biomethane from both processes can be used to power combined heat and power plants (CHP).

Sited adjacent to Severn Trent's existing sewage works serving the city of Nottingham, the Energy Crop AD plant has been designed to generate approximately 15GWh of electricity each year. This is equivalent to supplying around 4500 residential properties.

Currently the sewage works imports around 1MW of electricity from the national grid, but once the Energy Crop AD plant becomes operational, all the sewage works electricity demand will be satisfied and approximately a 1MW surplus will be exported to the grid. This will mean that the sewage works will become a net exporter of electricity.

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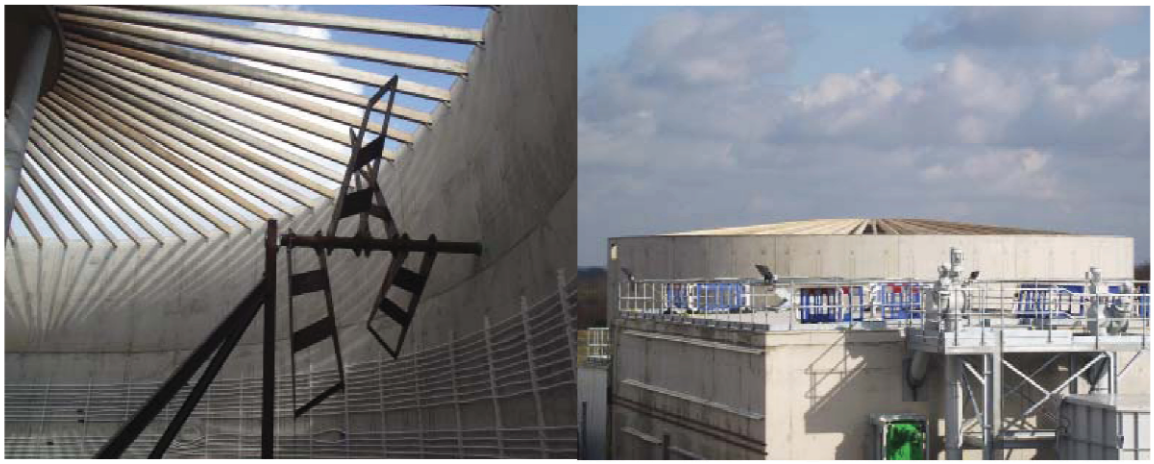

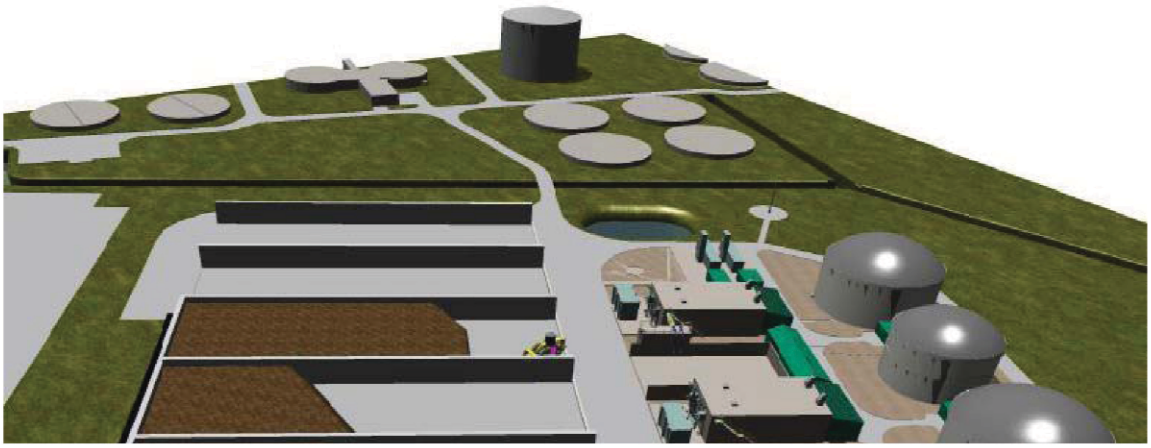

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Severn Trent's landholding in the area, surrounding the sewage treatment works, extends to around 750 hectares. This land is classed as dedicated land and has been used for the safe recycling of sewage sludge for over 120 years. The land potentially contains elevated levels of heavy metals and this places certain restrictions on what the land can be used, but it is is extremely fertile and is suitable for the cultivation of maize.

The estate is expected will produce around 35,000 tonnes of maize and around 2000 tonnes of wheat which will become the primary feedstock for the energy plant. An independent study was commissioned to report up on the environmental impact of mono-cropping maize (growing maize year after year after year). The report concluded that maize is one of only a few crops which is suitable for mono-cropping with positive environmental benefits to be had for allowing the land to be left as stubble over the winter months providing habitats for hares and lapwings amongst other species.

As the Energy Crop AD plant uses entirely crop silage for energy production (i.e. no waste material) the plant will not require an Environmental permit to operate, from the Environment Agency.

In 2008 the outline design of the plant was completed with assistance being provided by German process specialists Schmack Biogas GmbH. Schmack were selected as the preferred process supplier, having already designed and constructed over 230 biogas plants worldwide, and had successfully scaled up this technology in a 10MW gas plant constructed at the company's headquarters in Schwandorf, Bavaria.

Each day approximately 100 tonnes of crop silage will be fed into the plant at a dry matter content of around 32%. Recirculation liquors will also be used to help transport the crop silage through the various process tanks. The overall retention time of the plant is around 60 days over which time all of the biogas potential of the crop silage will be collected to help power 2 number 1MWe CHP engines.

In June 2009 a design and build contract was let to Interserve Project Services Ltd. Interserve who were already one of Severn Trent's main AMP4 contractors were specifically selected for their excellent approach in managing health and safety and their ability to integrate with new specialist process suppliers.

By May 2010, construction of the 2MWe Energy Crop AD was completed on programme with the plant ready for the commencement of the commissioning phase. The multiple digestion tanks were filled with around 6000 tonnes of imported farm yard manure and the temperatures within the tanks were gradually raised to the 40°C digestion temperature. The biology of the plant was closely monitored during this process to ensure that a healthy biomass was produced.

In order to ensure that there was a sufficient quantity of maize available to feed in the plant, in April 2009 Severn Trent set aside around 400 hectares of land for maize production and in October 2009 around 20,000 tonnes of maize was harvested. This maize is now stored on the site and ready for feeding into the plant from June 2010. The project remains on programme to achieve full electrical production by December 2010.

As well as producing electricity, the Energy Crop AD plant will also generate around 20MW of heat and around 30,000 tonnes of digestate each year. Some of the heat will be used in the process for maintaining the 40°C digestion temperature but it is expected that surplus heat will be produced and available for use on the adjoining sewage works. The digestate produced at the end of the process is essentially digested plant silage. As it retains a high NPK (nitrogen, phosphorous, potassium) content it is suitable for use as a natural fertilizer. It is intended that some of this digestate will be reapplied onto the Stoke Bardolph estate which will save around £30k each year on imported fertilizer costs and the remainder is available for export to agriculture.

In 2009/10 Severn Trent generated 183GWh (equating to 20% of its electricity needs) from renewables but this new project at Stoke Bardolph is an important part of the company's investment programme aimed to increase the company's production of electricity from renewable technologies to 30% by 2015.

Note: ***The Editor & Publishers thank Martin Dent, Renewable Energy Development Manager with Severn Trent Water, for preparing the above article for publication.***■

Photo taken from the top of one of silage clamps showing the primary and secondary digestion tanks ***Courtesy of Severn Trent Water***

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