

## **“Renewable Energy - More Food for Thought” – South East Midlands Branch Tour revisited**

This is an extended report of the interesting tour of on-farm renewable energy facilities in Northants and Cambs, organised by South-East Midlands (SEM) Branch on 20 May 2014 and summarised briefly in ‘Branch Reports’, in the Summer 2014 issue of Landwards.

The afternoon tour was arranged to coincide with the IAgRE’s Landwards Conference, being held the following day at nearby Cranfield University, as the Branch contribution to IAgRE’s 75<sup>th</sup> Anniversary. A few delegates were able to join local members on the visits and for supper afterwards. The ‘long-distance’ prizes went to visitors from Newcastle in the north and Totnes in the south. Several other new more local faces also joined us and the tour was oversubscribed, reflecting the interesting programme.

The tour built on the excellent introductory presentation on wind and solar power given at a branch meeting in January 2014 by our Vice-Chair, James Hunter. At that meeting, James explained why he had opted for the two different wind turbines installed on their farm. He also described the at-times fraught planning, installation and commissioning processes, as well as the critical issues around site selection, wind speed, costings and pay back periods - and, of course, carbon saved!

Seeing the turbines in-situ and comparing them with a nearby ~14ha/5MW ‘solar panel farm’ and a large anaerobic digestion (AD) plant generating 2.9MW from food waste was illuminating.

### **SEM Branch member Alan Plom provides further details:**



**Photo 1: The party assemble outside the Biogen plant**

First stop was Biogen’s AD plant at Westwood, near Rushden, Northants, where Andrew Needham Biogen’s Commercial Director, explained the process and history of AD and the evolution of Biogen.

Biogen is 50/50 privately-owned by Bedfordia Group and the FTSE 250 Kier Group. Bedfordia has traded since the early 1930’s, and has expanded from agriculture (now 5,500ac arable, pigs and grain storage) into automotive (retailing and after-sales service) and property development, investment and management. Most recently, they have ventured into ‘eco-technology’ by means of Biogen’s anaerobic digestion (AD) business, focusing on waste recycling and renewable energy production.

In 2012, Biogen secured £24.4m of investment from construction and property giants Kier adding to the substantial investment already made by Bedfordia Group. This investment has strengthened Biogen enormously, assisting it to pursue its ambitious growth plans.

The company recognise that food waste is a serious problem, currently some 11 million tonnes are produced in the UK every year. Disposing of it via landfill is no longer acceptable because of the damage it causes to the environment and its contribution to climate change.

Biogen designs, builds, owns and operates commercial-scale AD plants which recycle food waste from the UK food chain and now employs ~9 staff across England and Wales. The company has its head office near Bedford and an engineering, project management and innovations facility in Ludlow, Shropshire.

As Andrew pointed out, Biogen takes what everyone throws away and recycles it via AD to generate renewable energy. Using this method instead of disposing of it in landfill is recognised by UK and other Governments as the most environmentally sustainable method and is helping the UK to achieve its target of producing 15% of electricity from renewable sources by 2020. Each tonne of food waste recycled via AD prevents 0.9 tonne of CO<sub>2</sub> entering the atmosphere. A nutrient-rich biofertiliser is produced as part of the process, which is used on arable farmland and replaces fossil-fuel based fertilisers.

Biogen are now the UK's leading operator of food waste AD plants, with facilities in Bedfordshire, Northamptonshire, Gwynedd and Denbighshire.. Their current combined processing capacity is 140kt pa, approximately 10%-15% of the current UK total of food waste. The company also has a further 4 plants under construction, in Hertfordshire, Warwickshire, Rhondda and Edinburgh.

The Westwood plant we visited is the largest food waste AD treatment facility in the country, processing 65kt of food waste per year, obtained from local authorities and other commercial sources. It was designed, built and funded by Biogen, using UK technology and came on-stream in June 2009. Biogen's Twinwoods AD plant a few miles down the road in Bedfordshire processes a further 35kt of food waste, although that is mixed with 12kt of pig slurry from their own farm.

Biogen have won or been short listed for numerous environmental and recycling awards, including finalists in the 2010 Farmers Weekly 'Green Energy Farmer' Award, and in 2013 the National Recycling Award in the SME's category for 'Recycling and Waste Management Business of the Year'.

### **The AD process**

All types of food waste are accepted, including packaged, unpackaged and liquids. The bulk waste is delivered directly into a sealed building where it passes through a shredder and is processed into a porridge-like mixture. This is fed into a raw waste buffer tank, before being pumped into one of 4 primary digester tanks.

The digester tanks are kept at a constant temperature of 38 degrees C and the feedstock remains in the digester for ~75 days. Natural bacteria in the tanks feed on the food waste and produce a methane-rich biogas. The biogas is stored in a dual membrane gas holder and then converted to electricity and heat. Approx 2,200cu m / 50t of methane gas is burned/day in three ~1500hp engines, together producing just over 2.9MWe. A transformer adjacent to the CHP units connects to the National Grid.



The life-expectancy of the 2 V20 and 1 V16 CHP units is 15yrs/120k hrs. Should any breakdown occur the suppliers are under contract to respond within 4 hours. The buffering capacity for the plant is only 1.5-2 hours, so an emergency flare is available to burn off any excess stored gas.

The process might seem simple to look at but it evidently requires a big investment to set up. A hammer mill pre-processes the food waste before it enters the huge tanks, pumps. Sophisticated systems monitor and control the whole process to ensure smooth trouble-free operation.

**Photo 2: Biogen's CHP units**

The efficiency of the process is also impressive. Over 90% of the renewable electricity produced is exported to the National Grid, the remainder being used in the AD process. The nutrient-rich digestate remaining from the process is pumped to adjacent arable fields where it is injected - mostly on land owned by the Bedfordia Group although some is spread on other land nearby. This reduces the need to purchase, transport, store and apply fossil-fuel based fertilisers.

### **Challenges and opportunities of AD**

Andrew and his colleagues highlighted some of the challenges faced in setting up and running such plants. Apart from the high investment, a high level of monitoring is required to maintain efficient energy production and the extensive measures to comply with their license to operate under Environmental legislation.

A copy of Andrew's informative presentation is available on IAgRE's website

<http://www.iagre.org/sites/iagre.org/files/landwardsextra/BioGenMay2014.pdf>

Further information about Biogen and the AD process is available on their website:

<http://www.biogen.co.uk/> , including an informative introductory film:

<http://www.youtube.com/watch?v=mgociafM8H4>

### **When the sun shines....**



**Photos 3+4 - Stowe Longa solar panel farm**

The sun came out for us just in time for our next visit: to an ~16ha photovoltaic solar panel farm 'planted' on a brown field site - a farm on a former airfield at Stow Longa, just in Cambs. The annual output of the solar farm is ~5,109 MWh, which is equivalent to the annual average electricity consumption of 1176 households of the area. This will also result in annual offsetting reductions in

carbon dioxide emissions associated with conventional power generation equivalent to approximately 3,065 tonnes per year.

It was installed and is managed by a leading specialist solar energy company, Prosolia UK Limited, the UK arm of Spanish solar developer *Prosolia Energía*, based nearby, at Wyboston, in Beds. [More details at: <http://www.prosoliaenergy.com/>].

Farmer/landowner Martin Whitlock and Prosolia's 'Solar Installation Maintenance Engineer' Jason Pomfret, showed us the site and explained the set-up and its performance. Their numbers were again impressive, not least the huge initial investment of around £10 mill, but also the 7-8 year pay-back period claimed.

The installation was funded by a Pension Investment Fund who rent the land. Our host, farmer Martin Whitlock, said he is paid on the basis of ~34ac occupied and the enterprise was a 'no-brainer' opportunity when comparing facing the continuous 'hassle' of growing (+ storing and selling) wheat, or sitting back and watching the cheques come in from the sun - and not weather dependant!

Stow Longa is one of Prosolia's several large-scale UK projects, which currently have a combined generating capacity of around 35MW. Planning approval was given without any difficulties, mainly due to its off-road location on top of a flat plateau of land. The field is also fairly secluded and overlooked by few residential properties. The area had no statutory landscape designation and it already contained industrial and non-agricultural uses. Most importantly, it had a viable route for connection to the 33kV local grid.

The installation consists of more than 22,000 dark-blue anti-glare photo-voltaic (PV) panels (1.65m x 0.992m), set out in long rows running east-west across the site. They are connected in series, joined in 1008 'strings', each containing up to 22 modules. The installation took about 6 weeks to build and wire up, but after some delay, it was connected to the Grid in September 2013.



**Photos 5+6: The party looking at PV panels and an Inverter Unit**

Each panel operates at between 565-820V DC and generates a maximum potential output of 240Wp. The overall output from the whole solar farm falls to nearer 2MW in cloudy conditions, but on average the installation runs at 60-70% of the maximum ~5MW output. ~1,330kWp feeds into each of the 4 inverters (connecting the DC PV generators to the transformer) handles 1.11MW. The AC output from the inverters is then converted to 11KV for feeding into the National Grid, via a new sub-station.

The modules need some of the power for the installation to run itself. They are auto-linked so if there is a major failure, the modules shut off progressively to ensure sufficient power is fed into the system.

Jason highlighted the practicalities of managing such facilities. Routine maintenance consists of monthly cleaning and checking of the panels and cutting the grass between the arrays, but the biggest challenge is finding faults in the miles of cables on site. This can take some time - and needs a lot of patience! Jason is on-call 24/7 but thought it would be possible for one person to manage more than the 3 sites he is currently responsible for, if they were all reasonably close.

Prosolia anticipates that the farm will be dismantled after 25-30 years' service and the land returned to agriculture. Inverters are expected to last up to 40 years, but the working life of PV panels is expected to be ~20 years and string boxes 10 years, although these are replaced every 5.

The cost of PV panels has continued to decline over the past 5 years but at times there have been shortages on the world market due to excess demand - usually due to companies trying to complete installations before further tariff reductions! This caused a problem at another Prosolia site when 400 panels were needlessly damaged during an attempted theft of cables connecting the panels. This was a pointless exercise as the DC wires are not made of copper. There is also the increased risk of electrocution from DC to consider. Not surprisingly, the site we visited was securely fenced, alarmed and closely monitored, 24/7.

### **A fair wind?**

The final stop on our 'Grand Tour' was to see two different wind turbines at Tilbrook Grange Farm in Cams – home of our Branch Vice-Chair, James Hunter.



**Photo 7: James (with clipboard) and his twin brother Gavin (standing extreme left) welcome the party.**



**Photo 8: Aerial view of Tilbrook Grange and Gaia wind turbine**

A short report on James' presentation to the SEM Branch meeting in January 2014 entitled '**Getting the Wind Up**' was included in the Spring 2014 issue of Landwards (Vol 69 No1). James guided us around the 1,200ac arable and beef farm (run with his twin brother Gavin), to see the two wind turbines in-situ and expand on the previous exploration of 'the windmills of his mind'. In typical fashion, we were regaled with a continual stream of facts and personal observations, interspersed with plenty of laconic anecdotes, keeping us all interested and amused to the end.

James described the trials and tribulations of installing their first 11 kW 'Gaia' twin-bladed turbine in December 2011, taking advantage of the 'FIT' ('Feed-In Tariff') system (introduced in April 2010). This also provides power for lighting their buildings, the farm shop and farm houses. The output of this unit

quickly reinforced their opinion of the contribution of wind power, and undeterred by their previous experience, they soon set about the even more challenging process of installing a more ambitious 50 kW 'Endurance' triple-bladed unit, to provide additional electricity for the farm, eg to power 2x18kW grain store fans, and to take advantage of the tariff for feeding a significant quantity into the National Grid.



**Photo 9: The party got a sense of scale as we walked towards the Endurance wind turbine**



**Photo10: Gaia Wind turbine and contented livestock**

James explained - from a farmer's perspective and with plenty of technical detail - why they went for each of these particular turbines and their locations. An obvious pre-requisite is a 'windy' site – in their case an average wind speed of 5+ m/sec- but it is not just a matter of wind speed, as various other environmental and economic factors have to be carefully considered.

For example, the 'Gaia' design was chosen due to its constant and low rotational speed, making it amongst the quietest in its class and ideal for fields where livestock graze. It was also small and compact – a major factor being to avoid 'upsetting the neighbours'. James also described the extensive planning, installation and commissioning process, as well as actual and projected costings and pay-back periods plus, of course, the amount of carbon saved! *[More on that later.]*

The visit to see the turbines in situ confirmed our thoughts after James' verbal presentation earlier in the year. Namely, this was clearly not a project for the faint-hearted! Many of us thought that others would have bent under the pressure of getting approval and managing the build, and standing next to a machine 36m high at the hub brought home the constant challenges and stresses they faced during the construction and commissioning of the turbines.



**Photo 11+12 – Construction of Endurance turbine**

The ability to remain calm and holding your nerve while a 150 ton mobile crane edges across a narrow (and unknown weight capacity) cattle grid (both ways!) or across a ridge-and-furrow paddock in early December were a couple of examples.... Devising a method to bury 225m of very expensive cable using a mole plough (in one go, with no trial run) also demonstrated considerable faith in their own abilities.

It doesn't stop there either.... Whilst the turbines operate most of the time without any problems, things can (and do) go wrong. The more sophisticated 'Endurance' turbine is monitored remotely from Canada and the UK suppliers are informed of problems (and solutions) by email. For example, after a lightning strike, as happened shortly after our visit. It is ironic that naturally occurring electricity burned out a vital component, so the turbine stood idle for a few good energy-generating days waiting for the item to be changed.



**Photo 13: Monitoring performance of the Endurance turbine on-line**

The presentation given by James at our Branch meeting in January is now available on the IAgrE website at: [www.iagre.org/sites/iagre.org/files/landwardsextra/JHWindPowerPVpresentation130114.pdf](http://www.iagre.org/sites/iagre.org/files/landwardsextra/JHWindPowerPVpresentation130114.pdf)

This provides further details and photographs of both turbines, as well as their PV installation. The 'Gaia' installation also features as a case study on their suppliers/installers (Mosscliff Environmental) website: [http://www.mosscliff.co.uk/case\\_study\\_tilbrook\\_grange\\_farm.html](http://www.mosscliff.co.uk/case_study_tilbrook_grange_farm.html)].

James had nothing but praise for Mosscliff but, being a farmer, he inevitably had plenty to say about the 'excessive bureaucracy' and form-filling involved. Bemused, he showed us a list of the 15 companies

involved in connecting the turbines to the National Grid, displayed inside the main control panel cupboard for posterity (and as a warning to others?).

### **Environmental concerns**

Proposals for wind farms usually attract a chorus of protest from local communities and national lobbying organisations, and a proposed large ‘wind farm’ site a few miles away has faced significant objections. However, the Hunters’ individual and relatively small turbines went through ‘on the nod’, so needless to say, James was much more complimentary about his local Council Planning Committee!

Whilst there are obviously widespread and legitimate concerns about the potential adverse visual impact of any of these 3 types of installation ruining ‘attractive vistas’, in the collective opinion of our party, none of the sites we visited were too intrusive in their particular landscapes.



**Photos 13+14: Aerial views (supplied by Prosolia and James Hunter, respectively)**

However, many people believe it is basically wrong to cover good farming land with extensive arrays of solar panels and argue their rightful place is on top of buildings. ....Never one to miss trick, James has done that already too! The Hunter’s turbines and the solar panel farm were certainly much less visually obtrusive than the proposed multiple wind turbine farm nearby would have been.



**Photo 15: Sunset over Gaia**

Apart from the visual impact, other concerns commonly raised about wind turbines are usually about noise and flicker from turbine blades, particularly when the sun is low. On the day we visited, members commented that the noise from the inverters was probably louder than the wind turbines – although this obviously depends upon weather conditions. ‘Flicker’ has not been found to be a problem either.

AD plants run the significant risk of causing water pollution, or releasing unpleasant odours when handling waste materials or during application of digestate in fields if not designed and operated correctly with excellent controls and systems in place. Fears and complaints about AD plants might be understandable, so location is obviously critical to avoid (or at least reduce) objections about smell or



noise. Planning and operational restrictions are also in place to avoid this, eg specifying distance of plants from housing and tight operating parameters, under environmental legislation, etc.

Biogen use various operational measures to mitigate this too, including enclosure of the waste transfer and storage facility and processing machinery. They also work closely with local parish councils and residents, informing any 'near' neighbours when injection of digestate is to take place in fields near properties. They move on to other fields when the wind direction is not ideal and are continually reviewing and improving the machinery used.

### **Handsome profit from renewables?**

Despite a wealth of figures thrown at us by all 3 hosts, it is difficult to compare 'profitability' and other factors – not least their relative 'energy footprint' - to come to a firm conclusion as to which source is 'best'. It is clearly a case of 'horses for courses', each having its advantages and disadvantages.

The most obvious difference between the AD operation and the two other sources was in terms of labour requirement to keep the plant running, and other costly inputs such as waste collection and transport. Efficiency of AD plants is also said to be lower and steps are being taken to recover more of the 30% heat wasted. However, this type of operation is driven more by the targets (and need) to recycle our waste – whether from households, commercial processes and businesses, or farms. All offset by the significant benefit of producing a natural bio-fertiliser.

The Government's aim behind the Feed-In Tariff (FIT) system - also known together as the Clean Energy Cashback scheme - was to "trigger a small scale electricity revolution", by encouraging small scale, low carbon electricity generation. Explanations and further information about 'FIT' and some of the other terms often bandied about are available, eg on the Mosscliff website at:

[http://www.mosscliff.co.uk/feed\\_in\\_tariffs.html](http://www.mosscliff.co.uk/feed_in_tariffs.html) .

Government planning policy also currently supports solar farms as an effective form of generating renewable energy. A 5 year payback period for the energy involved in the production and installation of the solar panels has also been quoted, but the monetary payback is assumed to be far shorter than that – largely due to the current generous 'Feed in Tariff'. However, our resident wind power expert/enthusiast points out that the capacity of a solar farm needs to be three times that of a wind farm to produce the same amount of energy (in the UK that is). Many also believe that 'planting' solar panels on good agricultural land is a waste of our valuable resources when food security is increasingly becoming an issue.

Further information about the future and potential scope of the PV sector is available via the on-line

**'Solar Power Portal'** [ <http://www.solarpowerportal.co.uk> ]. Recent research

[http://www.solarpowerportal.co.uk/guest\\_blog/uk\\_solar\\_pv\\_demand\\_reached\\_520mw\\_in\\_q1\\_2013](http://www.solarpowerportal.co.uk/guest_blog/uk_solar_pv_demand_reached_520mw_in_q1_2013)

has indicated that the renaissance in large-scale solar developments drove record growth for the UK PV sector, which saw 520MW of new capacity added to the grid in the first quarter of 2013. Despite cuts to the 'Renewable Obligation Rate\_'

[http://www.solarpowerportal.co.uk/news/renewable\\_obligation\\_rate\\_drops\\_to\\_1.6rocs\\_2356](http://www.solarpowerportal.co.uk/news/renewable_obligation_rate_drops_to_1.6rocs_2356) the

UK's large-scale PV sector remains an attractive proposition and Prosolia (and other companies) are looking at other large-scale projects across the UK.

However, a recent article posted on the 'Solar Power Portal' (21 May 2014) provides interesting comments on changes in likely future investment. [See <http://bit.ly/1qffPfJ>]. This suggests that the future of the 215 ground-mounted solar farms in the UK hangs in the balance after the Government announced proposals to revise support for solar farms. It is predicted that the proposed changes will drive an increased focus on the small-scale solar farm sector, although the threat of capacity-based limits could curtail excessive deployment.

Although the financial support and tariffs earned for supplying to the Grid also mask the true operating costs and potential income of all 3 sources, the smile on the faces of the solar panel farm landlord, and James and his brother indicate they are happy and believe they have made the right decision for them, financially. As the solar panel installation was funded by and run on behalf of a Pension Fund, the farmer renting the land had no direct concerns about output or density of panels/hectare. He wasn't even contemplating going back into sheep to keep the grass down and avoid the 'hassle' of mowing and spraying around the panels!

It is hard to ignore Prosolia's somewhat less altruistic and higher moral aim of "making our world a sustainable place by the incorporation of clean energy alternatives and through the best design of installations, most suited for specific local conditions". To achieve this they analyse each customers' projects (residential or business), to ensure the best combination (generator mix) and obtain from each installation the most efficient solution. That has got to be a pre-requisite.

As for the Hunters' wind turbines, their actual return on capital for the smaller 'Gaia' unit has been around 20%, and it is calculated to have saved ~23t of carbon in 2 years. A higher return can be achieved by more efficient use of electricity in the house, eg using immersion heaters, converting the heating system to storage heaters and oil-fired Aga to run on electricity. Based on the first 8 months performance of their larger 'Endurance' turbine connected to the Grid, it is anticipated that the tariff received should pay for the handsome new tractor sitting in his barn by the end of its first year of operation! So that level of return is not to be sniffed at.

### **So what did we learn?**

This was really 3 visits for the price of one and we certainly learned a lot about the 3 sources of renewable energy, including the pitfalls of keeping each of the systems running. It was also very useful to see how each one integrated with the agricultural industry and the environment in general, as well as at each farm.

It is projected that there will be £100 billion worth of investment opportunities and up to half a million jobs created in the renewable energy sector by 2020, statistics also not to be sniffed at.

It would be glib to say that we ended our tour 'full of energy' ....but that is exactly what we did. The debate about the relative merits of the 3 systems continued well into the evening over a pint and buffet supper. However, before we retired to James' local pub, he took us to see the turbine's power generation figures. Entirely a coincidence I'm sure, but this information was displayed on a laptop located in the Farm Shop..... And yes, the range of meat from the Tilbrook Grange prize-winning pedigree herd of Devon cattle displayed (entirely coincidentally, of course) next to the laptop in the shop looked delicious, excellent value and too tempting for some of us.

**Footnote:** Unfortunately, there wasn't room in my car (or our freezer at home) for the half-carass on offer, but I can personally vouch for the fact that after a superb taster of alternative on-farm renewable energy sources, the steak tasted superb too. All in all, it was an afternoon and evening well spent!!!

Thanks also go to James Hunter, in particular, for his contributions to this article, helping to organise our grand Tour and our supper. James is willing to provide further information and answer any specific questions about his turbines, and can be contacted via his website: [www.tilbrookgrange.co.uk](http://www.tilbrookgrange.co.uk) .

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