BIOGAS IN SOCIETY
A Case Story

ICKNIELD FARM BIOGAS

AN INTEGRATED FARM ENTERPRISE

IEA Bioenergy Task 37

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MISSION AND VISION

This biogas plant with biomethane production, which began operation in 2014, is an integral part of the farm system. The project was led by David Bermingham (a local resident and employee of Scotia Gas Networks). David sought a suitable location for a biomethane facility that could feed into the local gas pipeline, which serves the villages along its route. The farm provided the optimum site. The gas pipeline runs under the 700 ha Icknield Farm, owned by Guy Hildred (a mechanical engineer) and his family. This mainly arable farm operates as a Family Partnership in association with a nearby farm which together form a contract farming business servicing over 3,000 ha of mainly cereal growing land.

PLANT DESCRIPTION

The plant (figure 1) consists of 2 x 28m diameter digester tanks sunk 5m below ground to minimise any visual impact in this Area of Outstanding Natural Beauty. Three silage clamps are used to store maize and hybrid rye through the year. The digestate is stored above ground in two ultra-flexible polyethylene gas storage bags. The biogas upgrading unit is housed in containers adjacent to the CHP engine and control station. The annual biomethane output is sufficient to supply 4,000 homes along the Thames Valley. The biogas is produced from a total input of 34,000 tonnes, all locally sourced.

An EnviThan polymer membrane is used for the first time in the UK to clean the biogas (figure 2). This produces approximately 99% biomethane at a pressure sufficiently high to inject directly into the grid without an additional compression process. This innovative technology exploits the smaller size of the CO_2 molecules which can migrate quicker through the membrane. This simple and environmentally friendly treatment is cost effective as there is no need for further processing, chemicals or water. This process produces 4.4 million m^3 of biomethane (47.3 million kWh) annually for injection into the gas pipeline. This is eligible to receive payments through the Renewable Heat Incentive. A containerised 360 kW CHP engine provides all the heat and power needed to operate the plant (Table 1). Any surplus is exported to the electricity distribution network.

Table 1: Inputs and outputs of Icknield Farm

Input		Output	
Pig manure	10,000 t/a	Biogas	9.2 million m^3/a
Cereals/ Screenings	11,000 t/a	Biomethane	4.4 million m^3/a
Maize/Rye	13,000 t/a		47.3 million kWh/a
Other cereals if required		CHP	360 kW

IMPACT ON THE FARM BUSINESS

The installation of biogas/biomethane plant introduced a diversification which forms an integral part of the whole farm management system. Prior to the biogas development the farm had a three-crop rotation of oilseed rape, wheat and barley. This has been replaced by a four-crop rotation consisting of: maize as a spring crop; wheat; rye for silage; and turnips. The latter provide winter grazing for 2,000 ewes from a neighbouring farm. This has the advantage of trampling and dunging the mainly gravel soils. The installation of the plant has changed its output from oil for margarine and cereals for bread to bread, meat and energy. Guy Hildred also reports that the addition of the biogas/biomethane plant has brought changes which have led to a number of farm improvements:

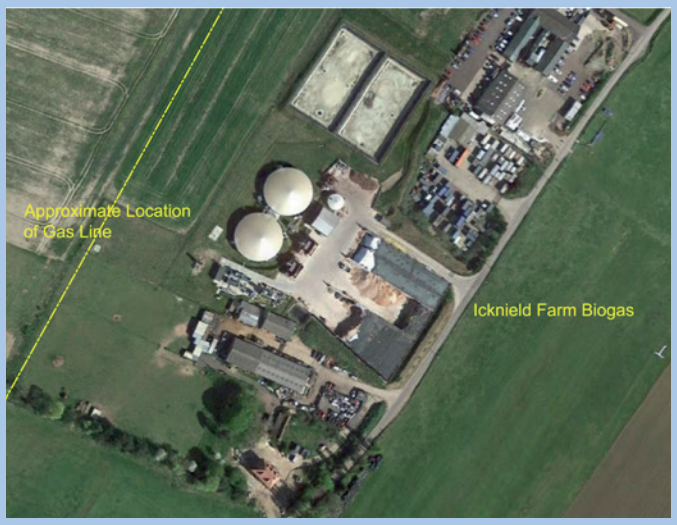


Figure 1: Icknield Farm

Figure 2: Biogas upgrading system. Photo Envitec Biogas (UK) Ltd

- The introduction of maize and turnips into the rotation has significantly reduced the survival of black grass which quickly establishes itself in the stubble after the cereal harvest. This noxious weed, the seeds of which contaminate the grain at harvest is considerably reduced as the maize canopy stifles further growth. Production costs per ha are reduced by cultivation changes and by both the type and quantity of chemicals needed.
- Application of digestate, especially in summer, benefits crops from the high moisture content and organic matter returned to the soil. This has increased crop yield. This may also be attributable to the presence of growth promoting bacteria in the digestate.
- Avoided costs of total N purchases and the benefits of trace elements in the digestate have been experienced.
- The gross margin per hectare has increased as a consequence of increased crop yield and lower production costs.

In addition to the benefits already noted above the new enterprise provides a regular guaranteed income from energy sales for the lifetime of the plant and a land rent for winter grazing on turnips for the neighbour's 2,000 ewes.

FUNDING

The plant was 100 % funded using equity from private individuals obtained under the UK Government's Enterprise Investment Scheme which promotes investment in start-up businesses. The total capital cost of the plant was approximately £ 7 million, and a further £ 1.2 million was spent in 2016 to increase the size of the upgrading capacity.

LESSONS LEARNED FOR A SUCCESSFUL PLANNING APPLICATION

The planning application is a two-part process which incurs very considerable time, effort and cost; even greater because Icknield Farm is situated in an Area of Outstanding Natural Beauty. Any development in such areas is strictly controlled in relation to the physical factors such as soil and underlying geology (chalk with overlying gravel), position on the water catchment and risks of pollution. Strict regulations apply to the type and function of any land use change (excluding crops) and landscape appearance.

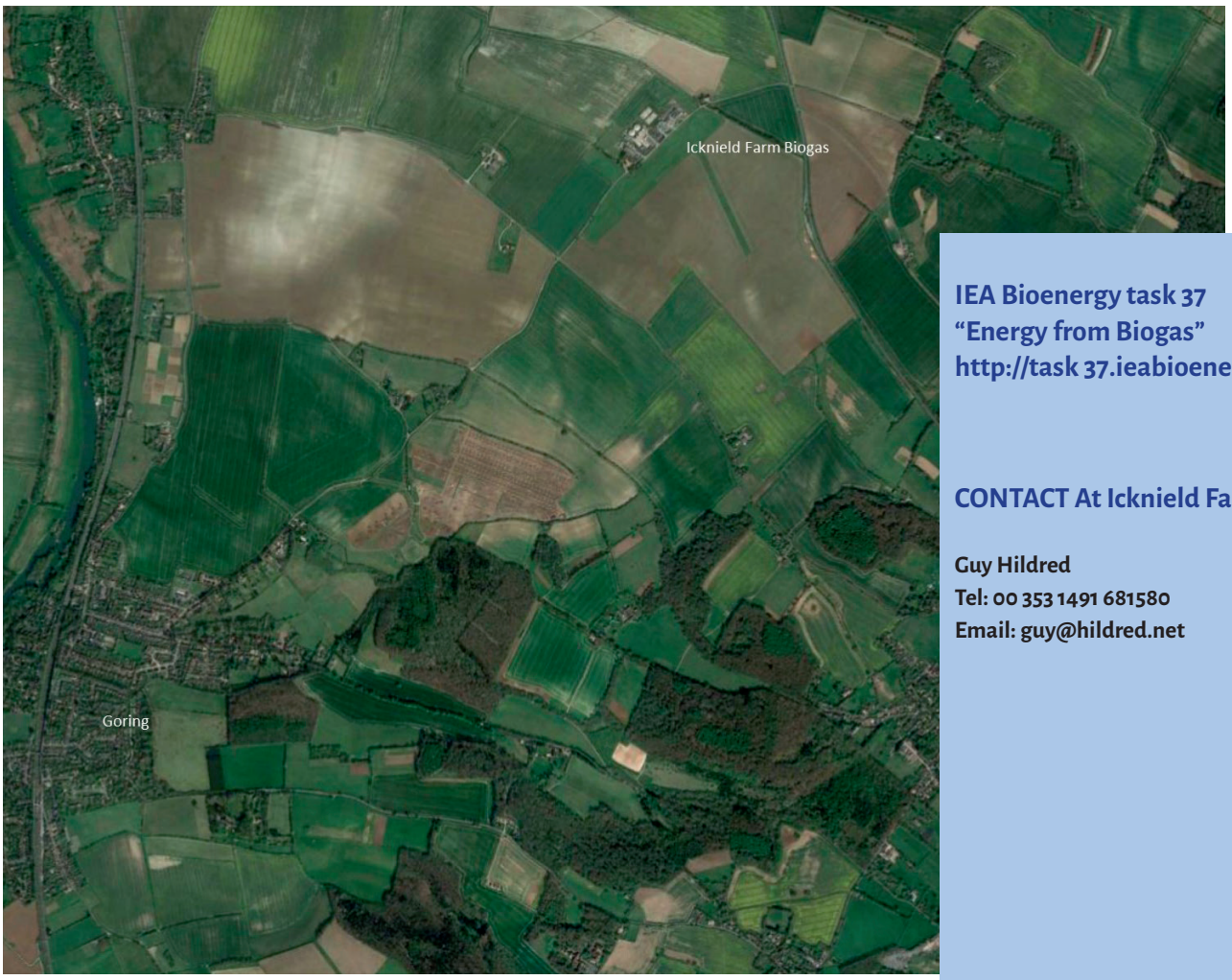
Prior to the submission of the Planning Application, the project managers contracted Fisher German to prepare the feasibility study. This work entailed not only the plant design and financial aspects but also consultation with the local authority officers, Environment Agency and County Highways Department. Opinion leaders and other local interest groups as well as local authority staff were offered the opportunity to visit operational plants. The latter was **absolutely crucial** as an educational process for local authority, government agencies, non-governmental organisations and the local residents for the successful outcome for the planning application for four reasons:

- See a biogas plant in operation and gain an understanding of the process;
- Address and reduce existing misconceptions of odour nuisance, land, air and water pollution, noise and congestion on rural roads;
- Reduce anxiety about potential visual intrusion in the landscape;
- Help to dispel the many myths and scare stories that appear in the media.

The consultation process was underpinned by studies of detailed flora, fauna, archaeological remains, wildlife and environmental issues of noise, odour, traffic and other concerns. All the information which was gathered was assembled into reports which formed part of the application itself. This preparatory work is an essential part of the planning application and incurs approx. 2% of the £7 million capital cost of the plant.

THE FUTURE

All parties involved with this development have drawn attention to the unique set of circumstances which have led to the success of the plant. The farm has an optimum location in a deep natural hollow, screened from view by the steep slopes of the Chiltern Hills and is situated over a km from the nearest village. The biogas plant and biomethane production unit could be located within 70 metres of the gas pipeline. This avoided the very high gas and electricity grid connection charges experienced by many other biogas/CHP/biomethane plants. It has eliminated the concept of waste and replaced it with a local circular production system.



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IEA BIOENERGY

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