Methane to Markets Partnership

Agriculture Task Force Meeting

Buenos Aires, 7th November 2005

Case Study
7 Cattle Manure Digesters in Scotland

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Development of AD in UK

- Most sewage sludge in the UK is treated by anaerobic digestion primarily for waste management, but energy recovery is becoming more important.
- There are some examples of digesters for food waste and the first UK biowaste digesters are being built.
- A number of farm digesters were built in the 1980's & 1990's, but commercial development has been slow.
- This case study is primarily about 7 digesters built in Scotland in 2004.

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UK Farm Digester (1970s)

UK Farm Digester (1980s)

UK Farm Digester (1990s)

Holsworthy Digester (2002)

Ludlow Biowaste Digester (2005)

Research Project in Scotland

- The Scottish Executive commissioned a research project to investigate how anaerobic digestion (& composting) can control the levels of pathogenic organisms discharged by agriculture into bathing waters.
- 7 full-scale on-farm digesters & 3 composting systems were built on 9 farms in Southwest Scotland.
- The project included a research assessment of environmental, economic & sustainability aspects.

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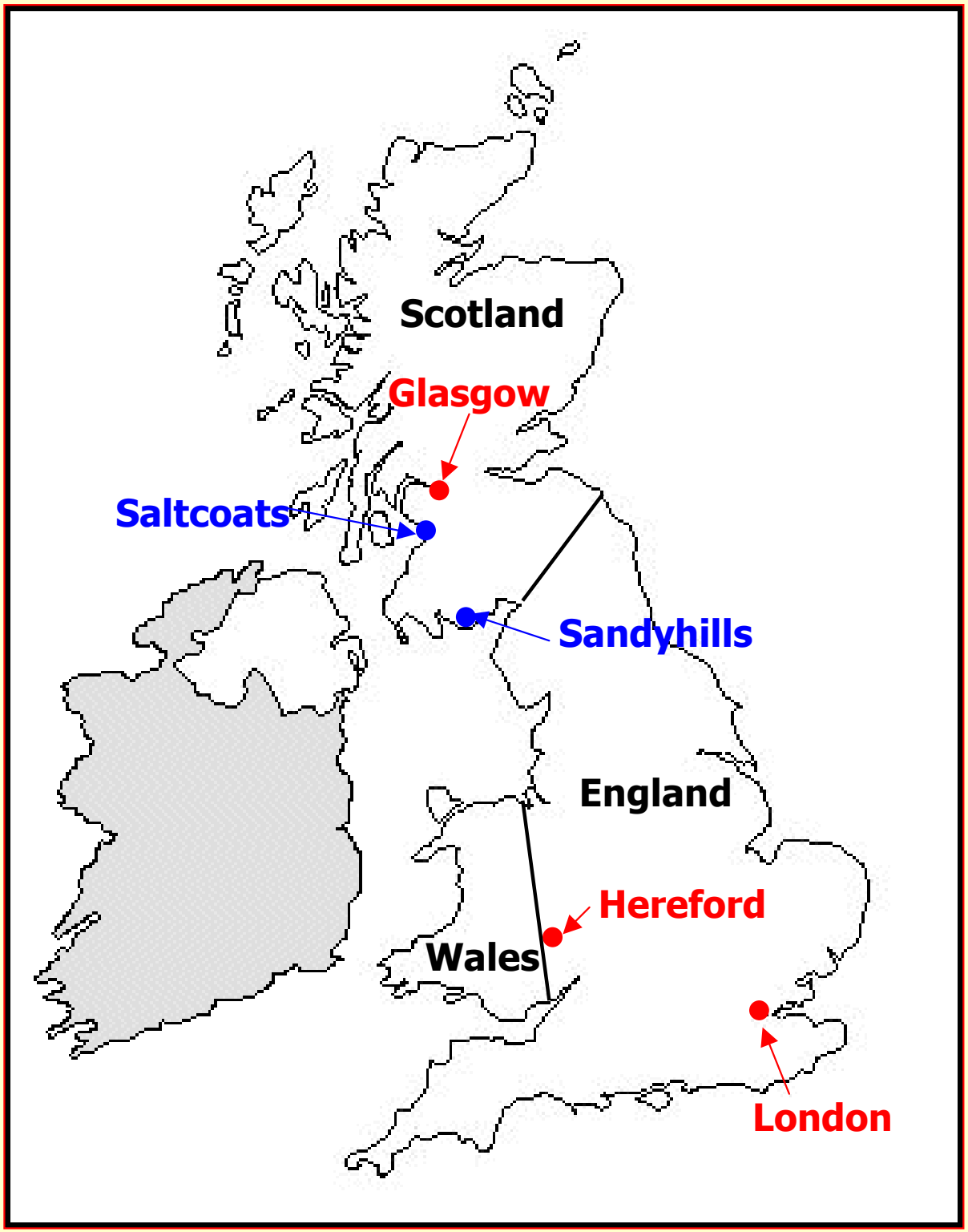
Scotland
Glasgow
Saltcoats
Sandyhills
England
Hereford
Wales
London

Typical landscape

Typical farm


Cattle slurry

7 Anaerobic Digesters

The digesters are continuous-stirred tank reactors (CSTR), able to be operated at mesophilic (37°C) or thermophilic (55°C) temperatures

Sandyhills 1	150 Beef Cattle	80 m^3 Digester
Sandyhills 2	130 Dairy Cows	250 m^3 Digester
Sandyhills 3	180 Dairy Cows	320 m^3 Digester
Sandyhills 4	250 Dairy Cows	480 m^3 Digester
Saltcoats 1	120 Dairy Cows	190 m^3 Digester
Saltcoats 2	250 Dairy cows	480 m^3 Digester
Saltcoats 3	250 Dairy Cows	480 m^3 Digester

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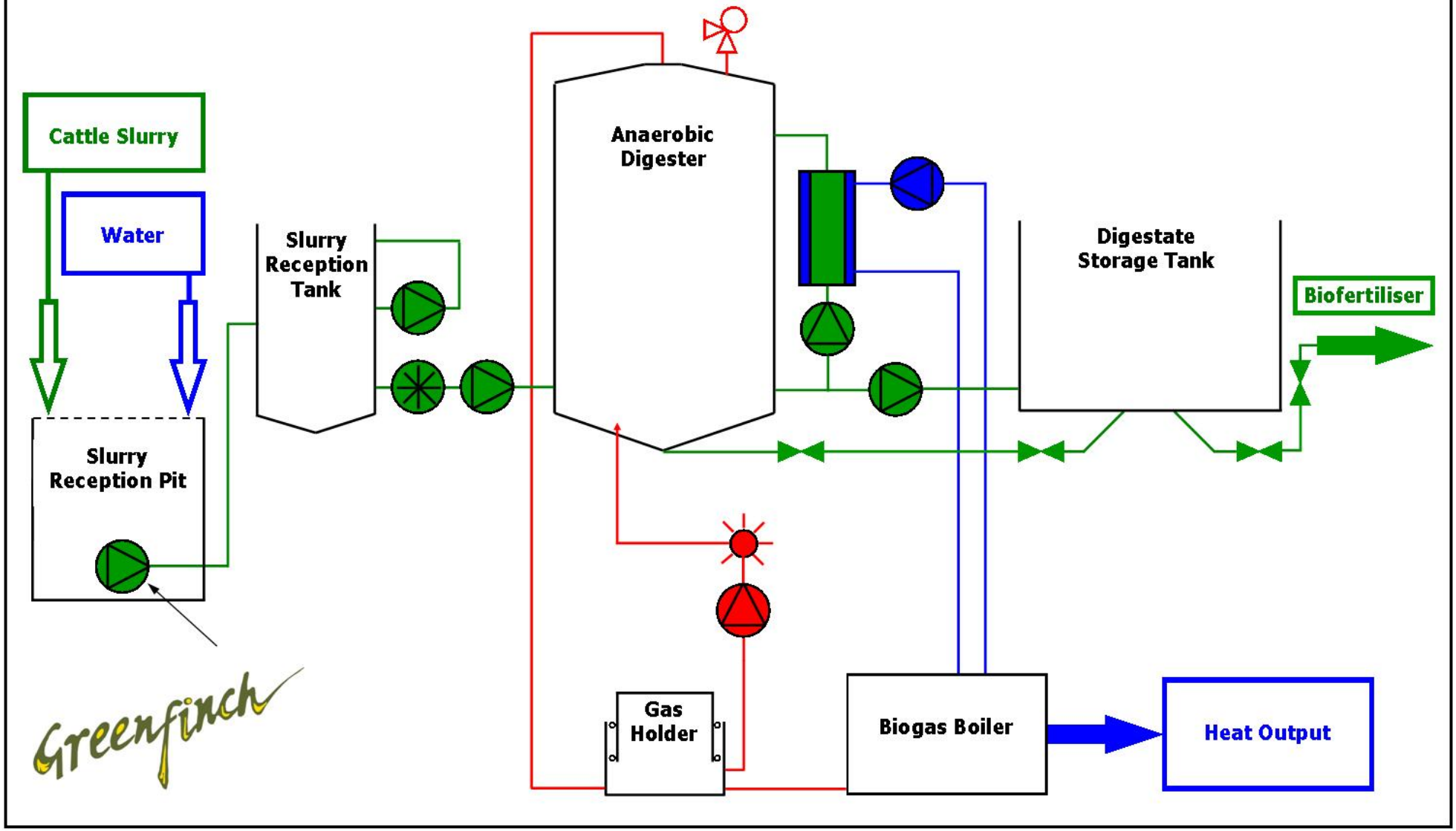
Process Diagram for Anaerobic Digestion Plant




Reception tank
Anaerobic digester
Digestate storage
Plant room
80 m³ biogas plant

3 digesters

in Sandyhills

3 digesters

in Saltcoats

Project Conclusions

- The digesters work reliably, with minimum input from the farmers.
- The reduction of total coliforms from mesophilic AD has been up to $\log_{10}2.7$ (500 times).
- The farmers have found the digestate to have less odour, to be easier to spread and to improve grass yields.
- The farmers have changed their waste management methods after the installation of the digesters.
- The cost of a farm digester is not yet economic, but the economics can be improved by zero-grazing, by co-digestion with energy crops & by utilising heat.

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Economic Assessment

250 DAIRY COWS + 100 FOLLOWERS		A	B	C
Capital Cost of Digester & CHP	£k	140	220	280
Operating & Maintenance Cost	£k / year	3	9	15
Cost of Energy Crops	£k / year	0	0	18
Value of Electricity	£k / year	0	17	43
Value of Surplus Heat (50% use)	£k / year	6	5	13
Value of Fertiliser Enhancement	£k / year	4	8	10
Net Income from Anaerobic Digestion	£k / year	7	21	33
Simple Pay-Back Period	years	20	10	8
Net Present Value (8% Discount Rate)	£k	-80	-40	0

A – Cattle housed for 6 months
B – Zero grazing + CHP
C – Zero grazing + 30 hectare energy crops + CHP

Greenhouse Gas Emissions

- It was concluded that greenhouse gas emissions are reduced in a number of ways:
  - The emission of CH_4 from the uncontrolled decomposition of manure is reduced; however, it is strongly recommended that digestate tanks are covered, both to prevent emissions of CH_4 to atmosphere & to recover additional energy.
  - The use of mineral fertilisers, which require energy for their manufacture, is reduced.
  - Renewable energy, in the form of both heat & electricity, displaces fossil fuels.

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Greenhouse Gas Reduction

250 DAIRY COWS + 100 FOLLOWERS		A	B	C
REDUCTION OF CO_2 EQUIVALENT				
Total potential production of renewable electricity & heat	tonne / y	170	280	720
Reduced emissions of CH_4 from untreated slurry (25% of CH_4 from AD)	tonne / y	250	410	410
Reduced consumption of mineral fertiliser	tonne / y	70	120	120
Increased consumption of fuel & mineral fertiliser for energy crops	tonne / y			(30)
NET BENEFIT OF CO_2 REDUCTION	tonne / y	510	810	1,220

A – Cattle housed for 6 months
B – Zero grazing + CHP
C – Zero grazing + 30 hectare energy crops + CHP

Experience from Older Digesters

- More than 30 farm AD plants were built in the UK in the 1980s & 1990s; of these about 10 are still in operation.
- All farms received capital grant aid, which is no longer available.
- The successful plants are those which were well designed to fit into existing farm waste management practice, and included proper feedstock preparation.
- Of particular importance is the commitment of the individual farmer in operation & maintenance.

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Drivers for agricultural AD

- Reduction of uncontrolled emissions of methane to the atmosphere.
- Production of renewable energy.
- Reduction of odours & water pollution.
- Reduction of mineral fertiliser use.
- Control of pathogens & weed seeds.
- Improvement in ease of handling manure.
- Sustainable agriculture.

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Barriers to agricultural AD in UK

- Farm digesters are not currently economic in the UK; this could be improved by capital grants or other financial / economic incentives.
- Connection to the national electricity grid can be expensive for small generators; this an issue being addressed by the regulators.
- There is market uncertainty about the future value of renewable electricity.
- There is no premium on the production of renewable heat, & little premium for biogas as a transport fuel. These issues were covered in the recently published "Biomass Task Group" report.
- Farmers do not receive financial benefit for climate-change implications of environmental management.

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The Way Forward

- Continue to research the many environmental benefits of farm AD.
- Research how existing farm practices are best adapted for the optimum integration of AD in terms of environmental benefit & sustainability.
- Make the export of renewable electricity easier.
- Recognise the value of renewable heat.
- Continue the commercial development of innovative AD technology to reduce capital costs, increase revenue & improve reliability .
- Provide farmers with a financial incentive to reduce greenhouse gas emissions.

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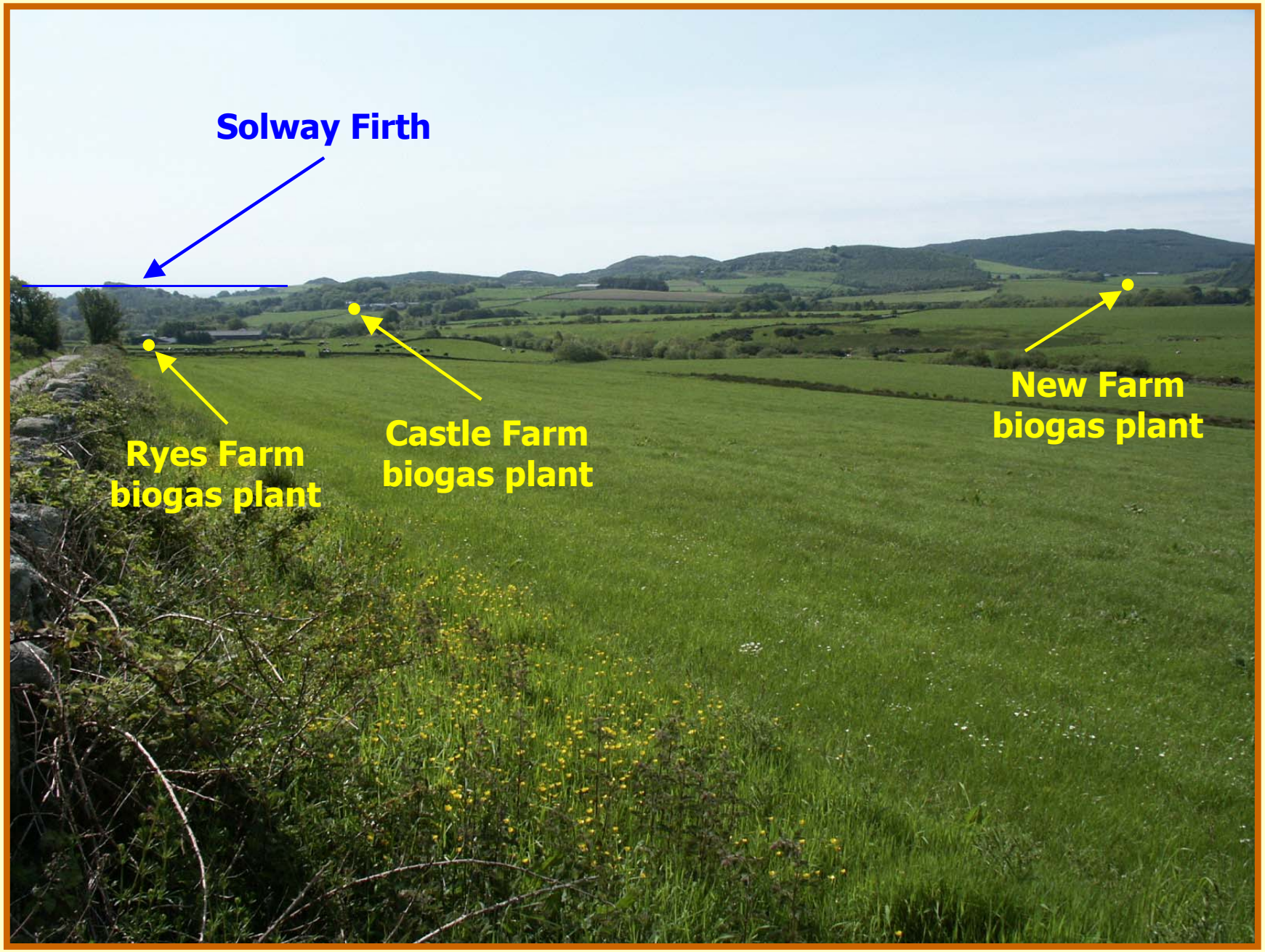
Solway Firth
Ryes Farm biogas plant
Castle Farm biogas plant
New Farm biogas plant

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