# CAN SMALL SCALE ON FARM ANAEROBIC DIGESTION BE ECONOMICALLY VIABLE

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ANAEROBIC DIGESTION ENGINEERING

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# MAY BE NOT IF IT IS AS COMPLEX AS THIS

# OR THIS

# OR AS SIMPLE AS THIS

# AD IS A 3 PRODUCT PROCESS

**Most renewable energy and bioenergy technologies do only one thing – produce energy**

- AD is a waste management process
- AD is a nutrient recycling process
- AD is a renewable energy process

As such it has tended to get lost in policy making

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# APPLICATIONS OF AD

Manure

Sewage Sludge

Biodegradable Waste

Energy Crops

- Reduce Odour
- Improve Nutrient Management
- Diversion from Landfill
- Renewable Energy Production

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# ECONOMIC VIABILITY OF ON FARM ANAEROBIC DIGESTION

- Capital Cost is project specific, depending on many factors including feedstock & current infrastructure.
- Economic viability influenced by:
  - Number of stock and length of time housed
  - Availability of other farm products as feedstocks, e.g. store potatoes
  - Cost of energy crop production
  - Ability to utilise heat and power on-site
  - Utilisation of digestate and reduction of mineral fertiliser imports

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# WHAT NEEDS TO BE ADDRESSED ?

- Project Objectives
- Feedstock
- Biogas Utilisation
- Digestate Utilisation
- Plant design & technology provider
- Plant operation
- Permitting

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# WHAT ARE YOUR OBJECTIVES ?

- Make money
- Diversification
- Enhance existing slurry management
- Import nutrients
- Energy production
- Self sufficiency
- Green credentials

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# FEEDSTOCK

- Type & quantity of feedstock?
  - On farm wastes & products
    - slurry- how long are animal housed?
    - what are the animals bedded on?
    - energy crops- do you have sufficient ground to grow in addition to animal feed?
    - what is the cost of crop production?
  - Imported feedstocks
    - ABP?
    - availability & seasonality?
    - feedstock guarantee & contract?
    - cost or gate fee?

# BIOGAS UTILISATION

- CHP
  - Electricity- used on site or exported to the grid?
    Price per kWh?
  - Heat- is their a use on site or could it be exported?
    Price per kWh?
- Upgrade to biomethane
  - connection to gas grid - contract for biomethane, price per kWh
  - use as a vehicle fuel

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# DIGESTATE UTILISATION

- Where will the digestate be utilised?
  - Is there enough land locally?
  - How much will the haulage cost?
  - When will the digestate be applied?
  - What storage is required?
  - Is a permit required for its application to land?
  - What cost is offset through less requirement for imported fertilisers?

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# DIGESTATE BENEFITS & NUTRIENT VALUES

- Valuable fertiliser
- Safe product for application to land
- Easier to pump
- Integrate use into farm – high nutrient use crops
- Enhanced crop compatibility
- Significantly reduced odour – 80% reduction

- Nitrogen - 2.3 - 6.2 kg/tonne
- Phosphorus - 0.2 - 1.5 kg/tonne
- Potassium - 1.3 - 5.2 kg/tonne

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# PLANT DESIGN AND TECHNOLOGY PROVIDERS

- Plant design
  - Tank design
    shape, material
  - Mixing system
    mechanical, gas, liquid recirculation
  - Heating
    external / internal
  - Digester feeding & discharge
    pump, auger, gravity
  - Gas collection
- Budget costs
- Tendering process

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# PLANT OPERATION AND MAINTENANCE

- Pretreatment of feedstocks
- Level of plant automation
- Operate with current labour units
- Employ additional labour units
- Contract out specialist maintenance
- Contract out plant operation & maintenance

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# ‘On-Farm’ Case Study - 25kWe

- **Feedstock**
- 3,070 tpa slurry from 150 dairy cow housed 365 days
  - 8% dry matter
  - 80% organic dry matter
  - 16kWe
- 200 tpa energy crop
  - 32% dry matter
  - 92% organic dry matter
  - 8 kWe

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# ‘On-Farm’ Case Study 25kWe

- **Outputs**
- Digestate
  - 480 tpa fibre
  - 3,350 tpa liquor
- Biogas
  - 164 tpa
    - →Electricity: 25kW (Net 163 MWh/yr) @ £150 / MWh
    - →Heat: 50kW (Net 250 MWh/yr) @ £30 / MWh
- Income
  - Electricity value £24,000
  - Potential heat value £7,500
  - Digestate value zero cost

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# ‘On-farm’ case study 25kWe

- **Costs**
- Capital Cost
  - Approximately £150,000
  - Excluding additional silage clamps, digestate storage & utilities connection
- Operating Cost
  - Approximately £14,000
    Labour (rot c3% of capital cost inc machinery)
    Digester maintenance (rot c4% of capital cost)
    CHP maintenance (0.8 to 1.2 p per kWe)
  - Feedstock Cost £4,000

Simple Payback

Approximately 14 -15 years (assumes income value only from electricity sales)

Simple Payback

Approximately 6 - 7 years (assumes income value from electricity sales, heat and enhanced digestate value)

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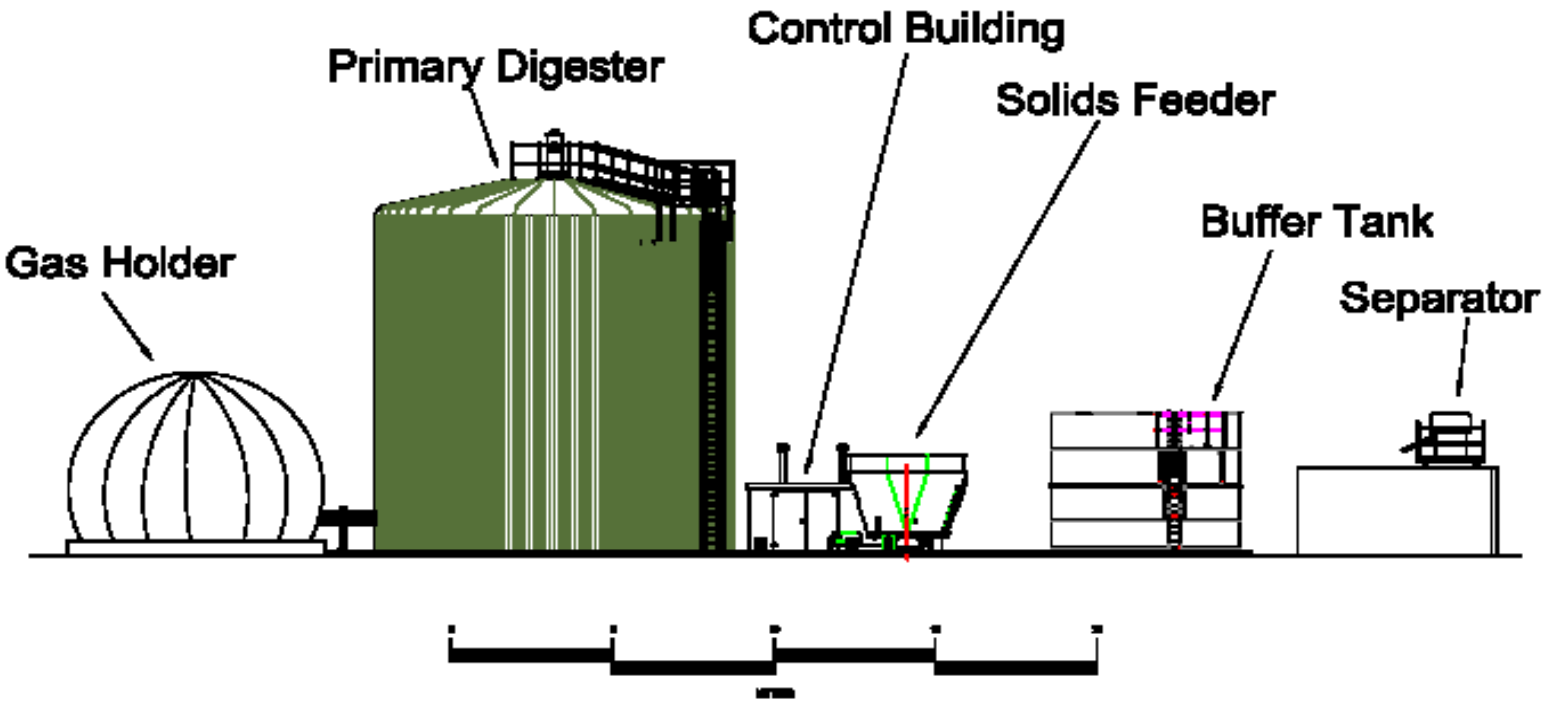
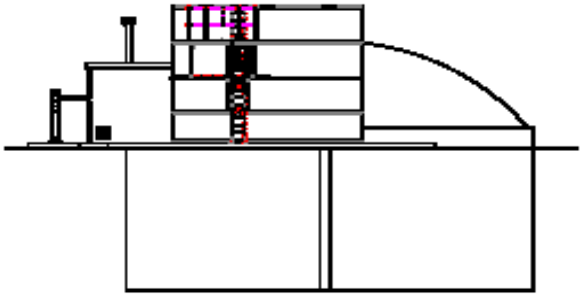
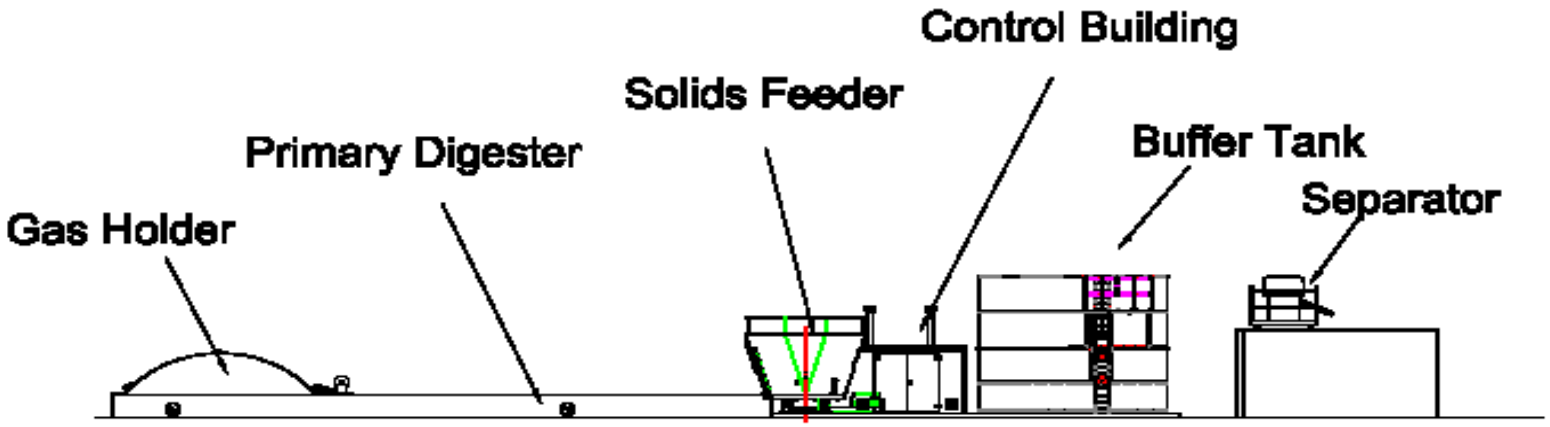
# Above Ground
# Continuously Stirred Tank Reactor




| Rev. | Issue Details | Date | Scale | Client |
|---|---|---|---|---|
| A | Issued for Information | 12.04.18 | 1:200 A4 | REASEHEATH COLLEGE |
| | | | Drawn RM | Project ANAEROBIC DIGESTION PLANT |
| | | | Checked | Title CSTR ELEVATION 2 |
| | | | Approved | Drawing No. A |

# Marches Biogas Plug Flow Digester
# Above or below ground application



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| | | | Drawn RM | Project ANAEROBIC DIGESTION PLANT |
| | | | Checked | Title PLUG FLOW ELEVATION 1 |
| | | | Approved | Drawing No. A |

# Marches Biogas Plug and Play Anaerobic Digester under Construction

- 100m3 effective volume
- Internal heat exchanger
- Gas recirculation mixing
- Fabricated in a factory
- Shipped to site
- Craned into position
- Connected up
- Potential to produce 25kWe depending on feedstocks.
- Designed to be connected in multiple units.

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# THE ECONOMICALLY VIABLE FARM BASED ANAEROBIC DIGESTION PLANT WILL

- Process material arising on the farm, e.g. slurries, manure, energy crops & vegetable waste.
- Have land available for beneficial use of digestate.
- Use a proportion of the surplus heat benefitially
- Fit into the existing infrastructure.
- Be operated by well trained committed staff.
- Range from 10kW to 1.0MW.
- Cost from £100k to £2.0m.
- Cost between £400 to £700 per m3 digester volume.
- Cost between £2000 to £6000 per kWe
- Annual income typically from £22k to £1.2m.
- Revenue costs depend on feedstock.

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# THANK YOU

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