EUROPEAN COMMISSION
Community Research

Biogas from energy crops and biowastes

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Old technology - new application

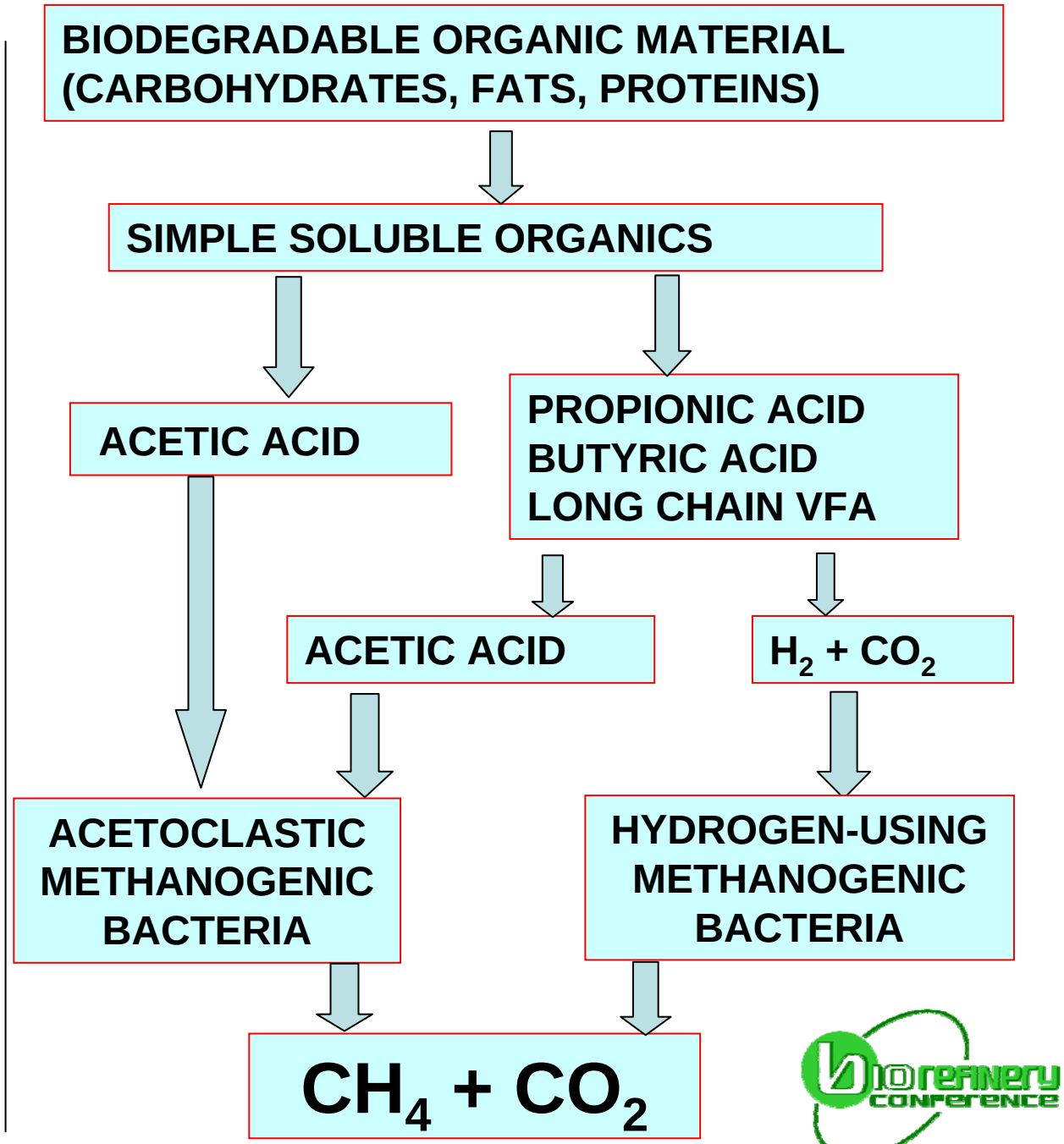
- **The technology of biochemical methane generation is well established**
- **Traditionally it has been used for waste stabilization**
- **Current focus is on energy production**
- **To be cost-effective in this role may require**
  - **engineering and technical improvements to increase conversion efficiencies**
  - **Selection and production of biomass feedstocks from a variety of sources**
    - **including novel and multi-use crops and agro-wastes from integrated farming systems, commercial and industrial wastes and by-products.**

HYDROLYSIS

ACID FERMENTATION

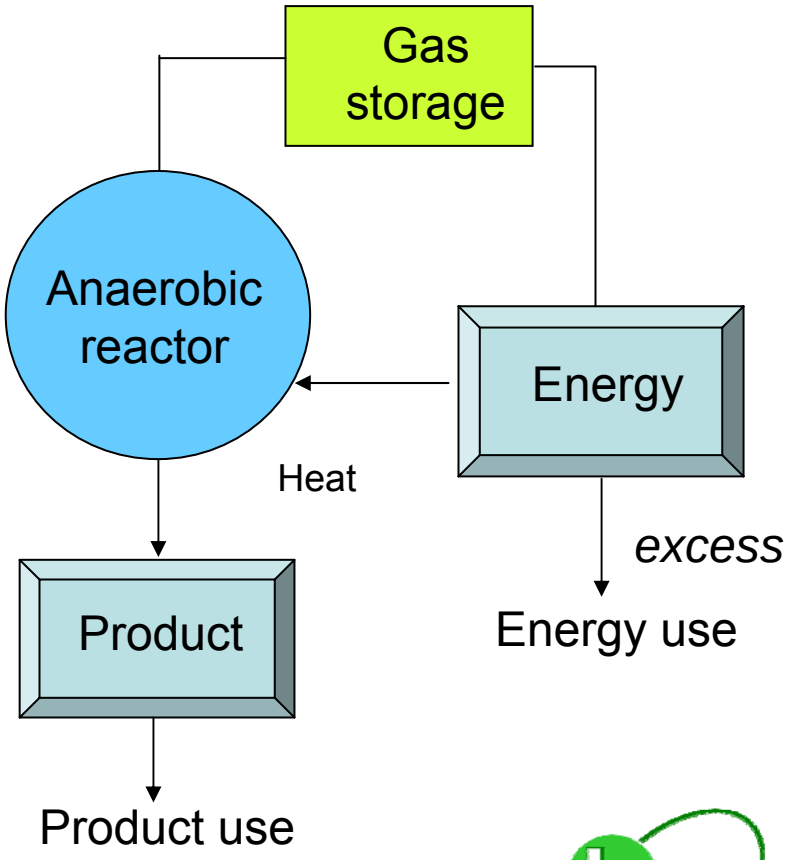
ACETOGENESIS

METHANOGENESIS

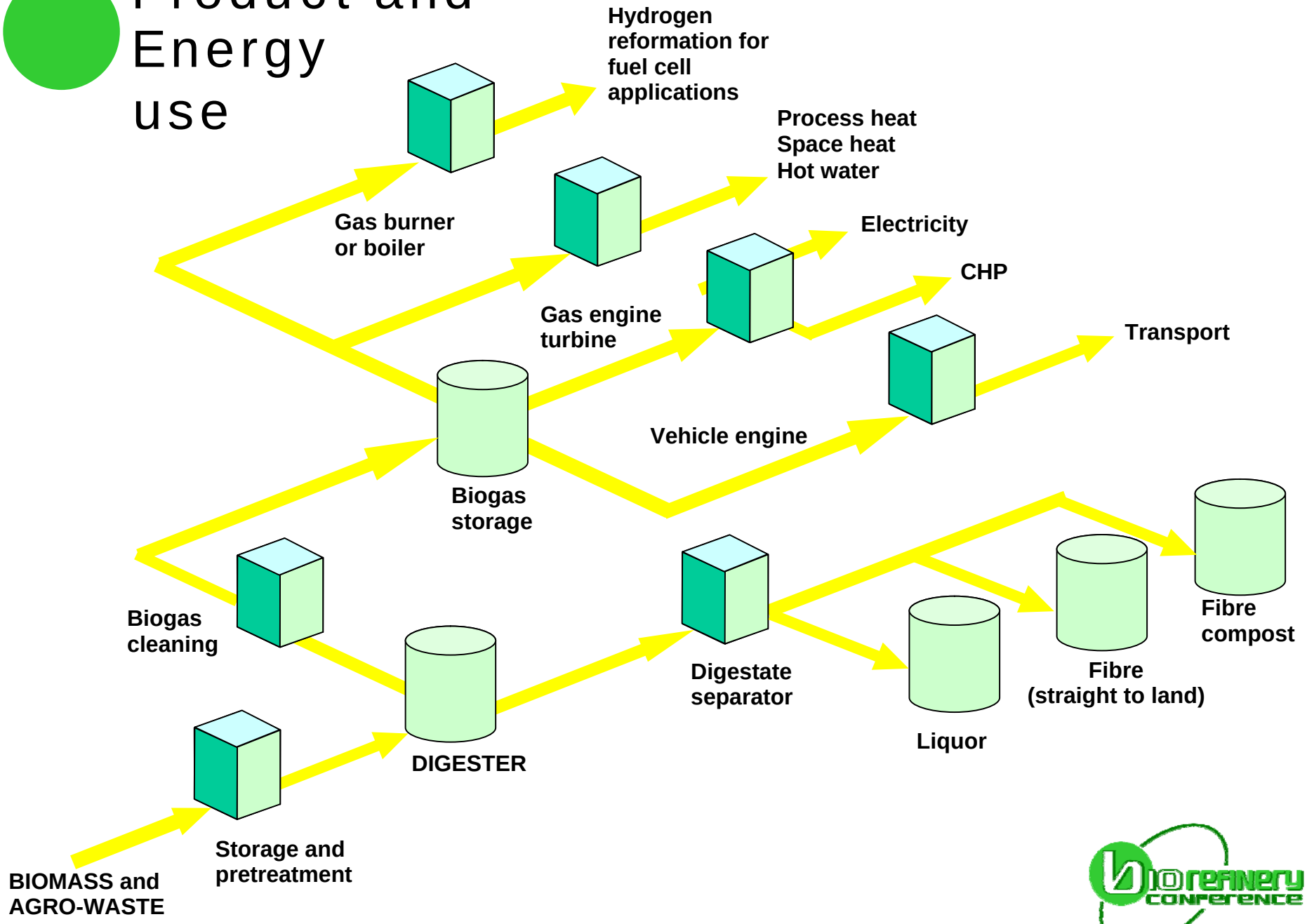


Anaerobic digestion in its simplest form

- **Closed reactor**
- **System of gas collection**
- **Production of biogas**
- **Production of digestate**



Product and Energy use



Process types

Wet

One stage

Mesophilic

Dry

Multi-stage

Thermophilic

Process differences

Wet Process

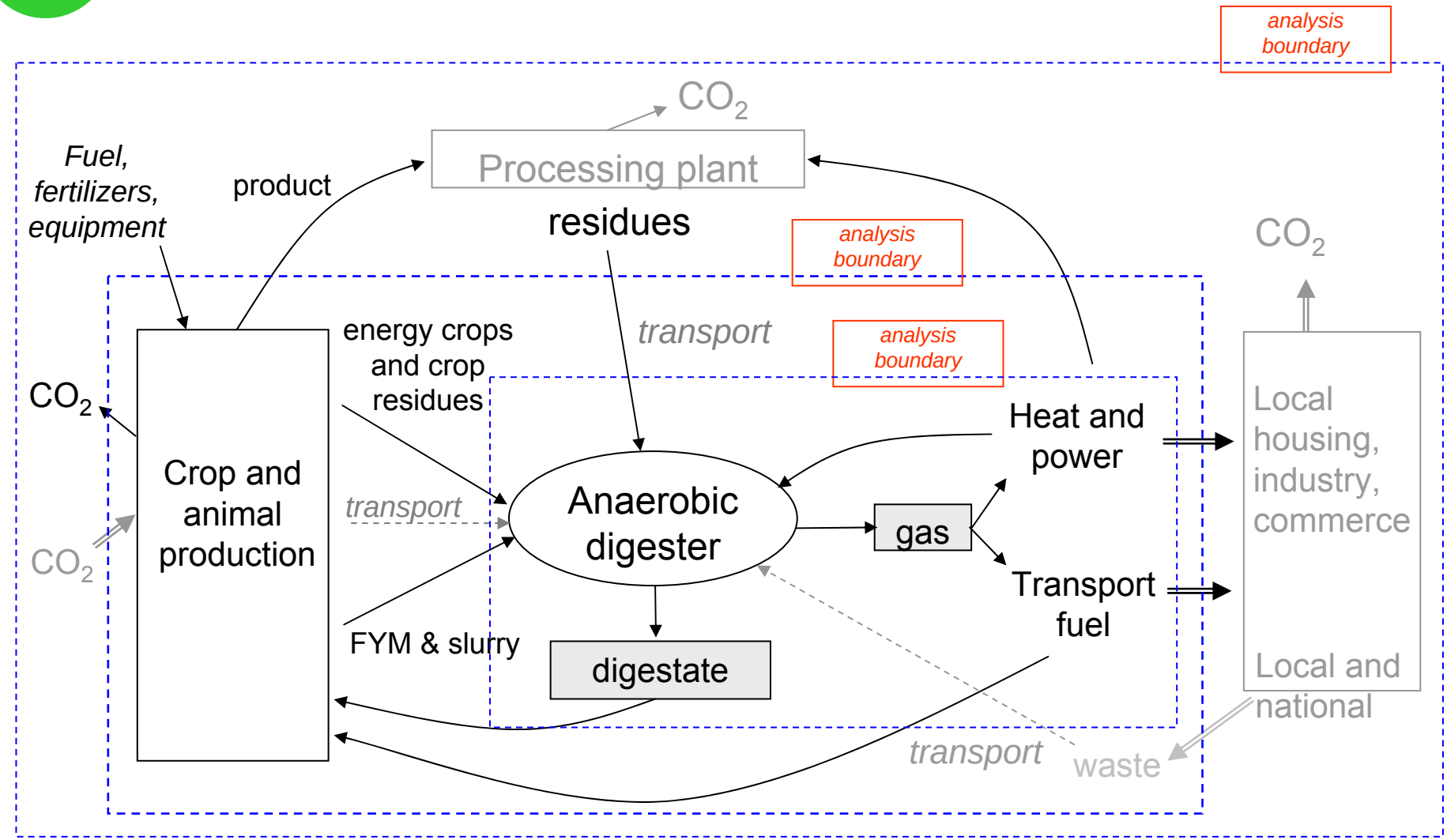
- less than 15 % feedstock solids concentration
- one or several stages
- usually operate at 35^{o}C
- requires water addition or recycle
- larger reactor
- proven technology for sewage sludge digestion
- more applicable to co-digestion with other waste

Dry Process

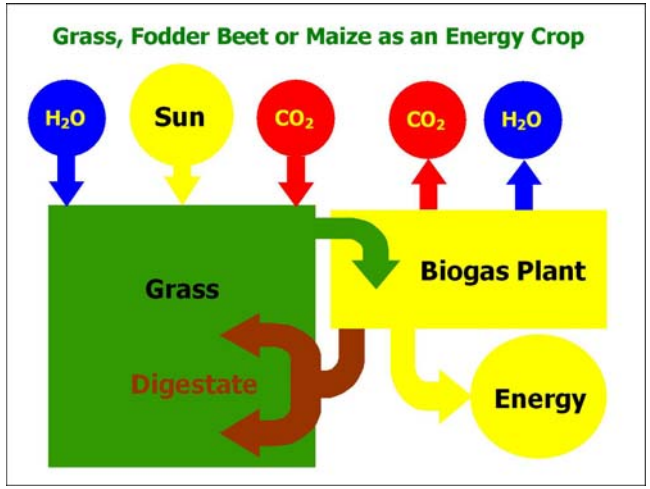
- more than 15% feedstock solids concentration
- usually one stage
- can operate at 35^{o}C or 55^{o}C
- minimal water addition
- smaller reactor
- becoming most popular choice for MSW
- more data and reference plants needed

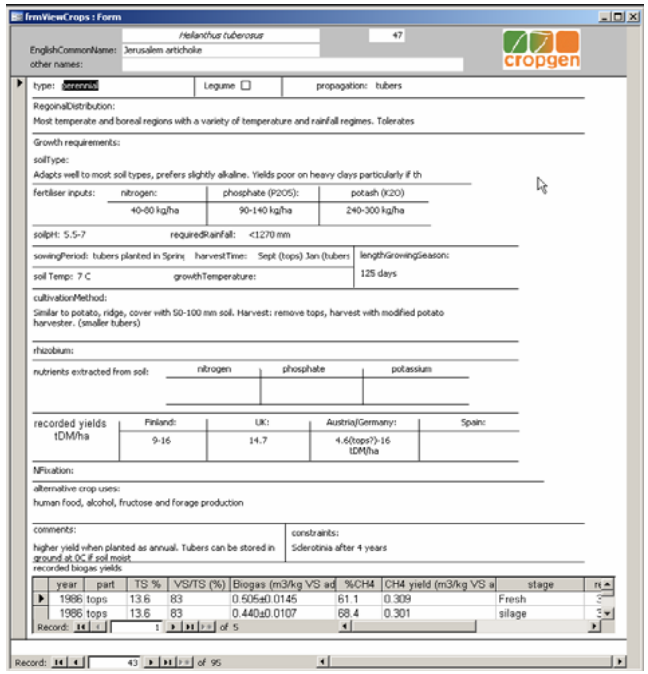
Instantly recognisable!

Biogas as a renewable energy source



Energy models

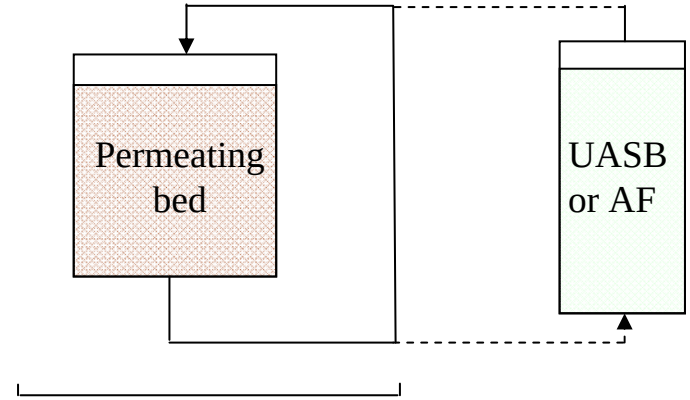




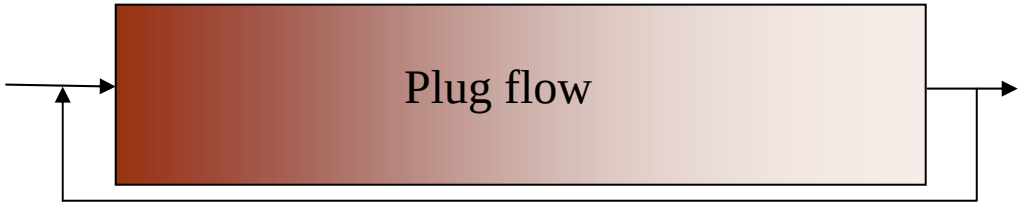
- **Database of energy inputs into the cultivation of different crop types established**
- **Factors affecting energy use in the process have been identified**
- **Equations developed to account for energy usage in the digestion process**
- **Energy usage model developed based on typical anaerobic digestion plant configurations and substrates**

Phase separation innovations

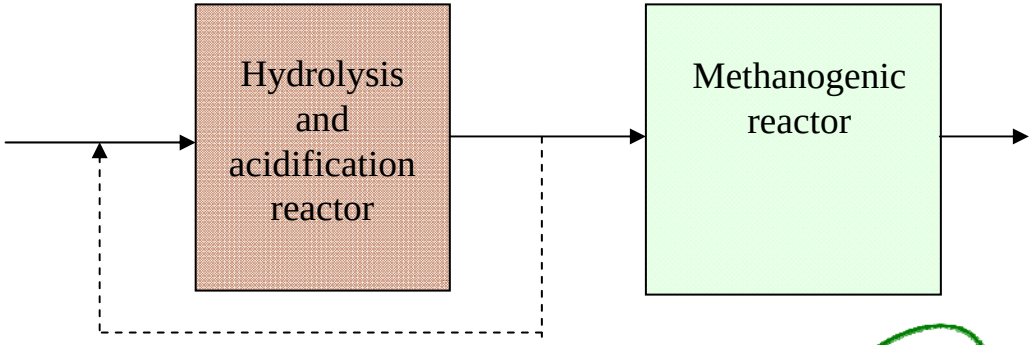
Permeating beds



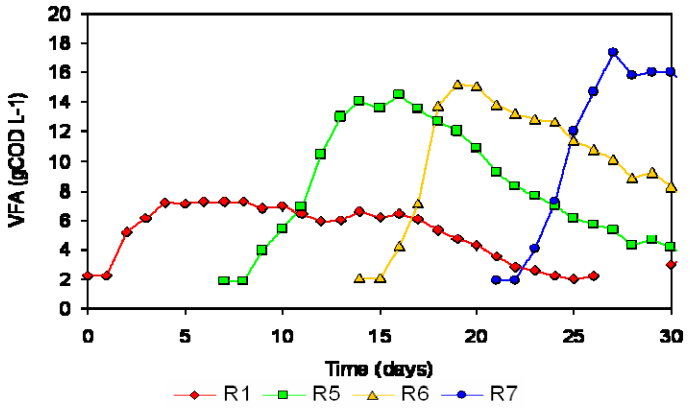
Plug flow reactors



Two phase systems (coupled and uncoupled)

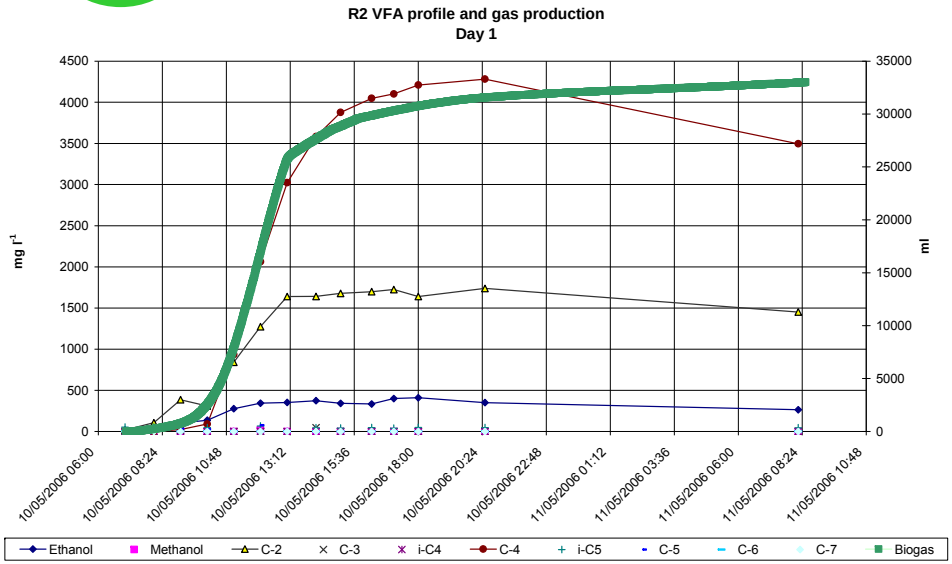


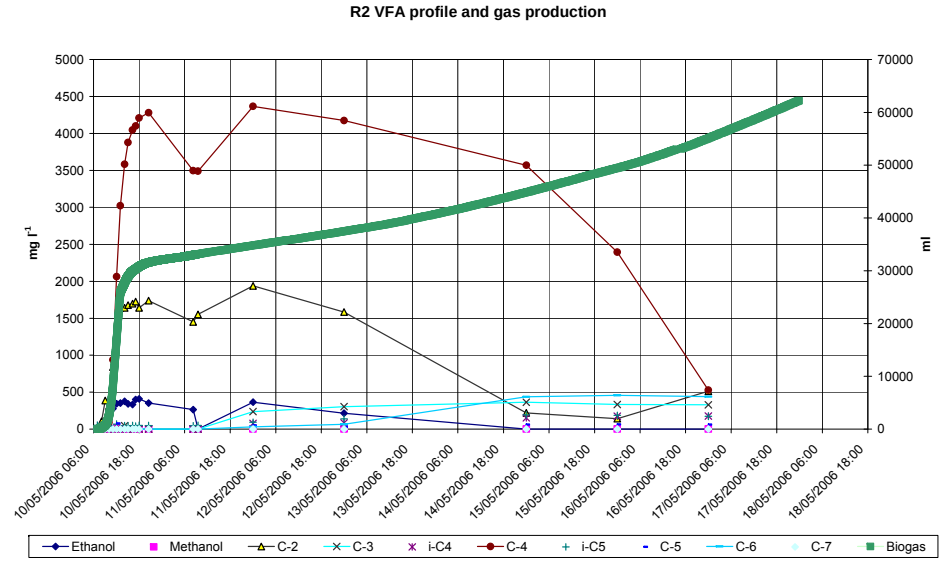
Permeating bed reactors



- **Single bed systems using grass and maize have given poor results even with pH control**
- **Permeating bed with second stage high rate methanogenic reactors gives greater potential for stable operation and biogas production**
- **May be some potential for certain crop types but preliminary results indicate that overall process efficiency is likely to be poorer than for single phase mixed reactors**
- **Potentially an interesting mix of fermentation products**

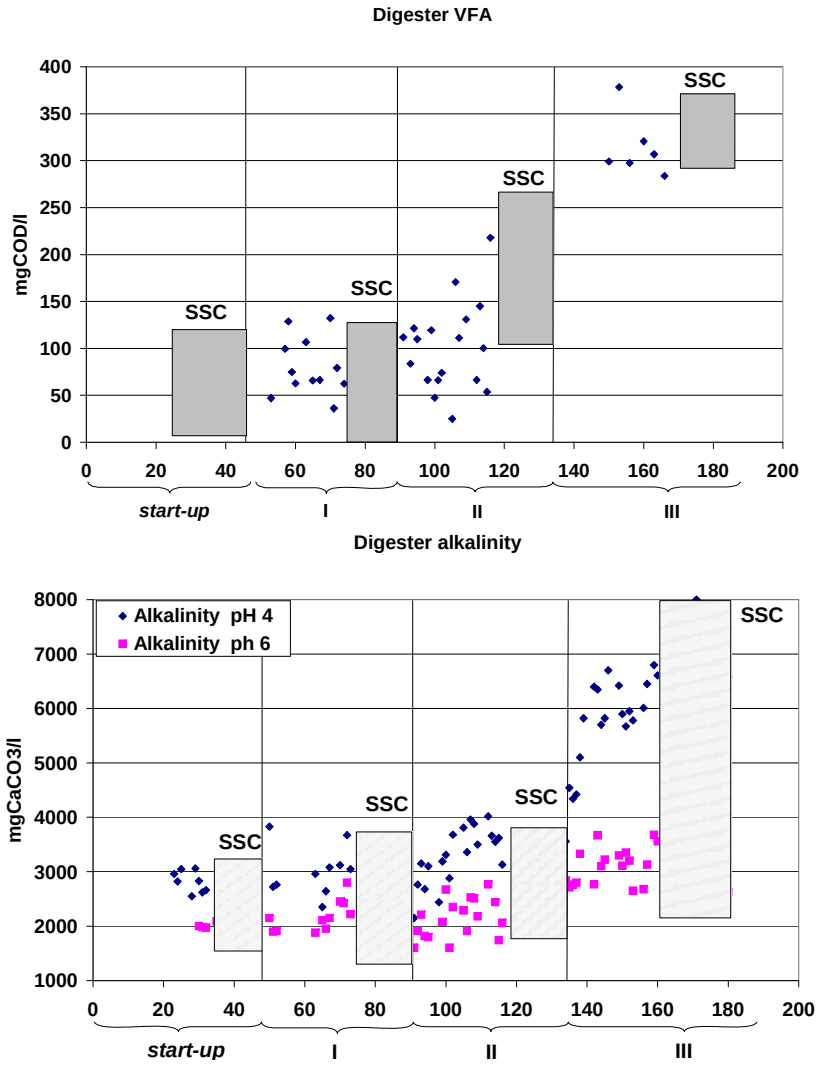
Plug flow systems





- **Result from a high initial loading in the reactor**
- **Plug flow may limit the overall loading that can be achieved**
- **Interesting gas and acid production profile (H_2)**
- **May have potential for certain waste types and concept could be further exploited for refined fuel production and biorefinery intermediates**
- **Still to explore very high solids systems with high recycle rates**

Two phase systems



- **Overall performance for the treatment of market wastes at thermophilic temperatures and the loading used shows no advantage in process stability or performance compared to single phase controls**
- **Uncoupling of solids and liquids retention time in a first phase mixed reactor using maize as a substrate failed to improve rates of hydrolysis and solids destruction**

Acknowledgements - Current project

Acronym: **CROPGEN**

Title: Renewable energy from crops and agrowastes

Contract: **SES6-CT-2004-502824**

Duration: 1 March 2004 – 28 February 2007

Total cost: 2.5 M€ EC funding: 2.1 M€

website: www.cropgen.soton.ac.uk