In-situ Biomethanation Pilot Plant Operation

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How do we accommodate increasing amounts of intermittent renewable electricity in the grid?

- Smart grid;
- Electricity storage;
- Power-to-gas.

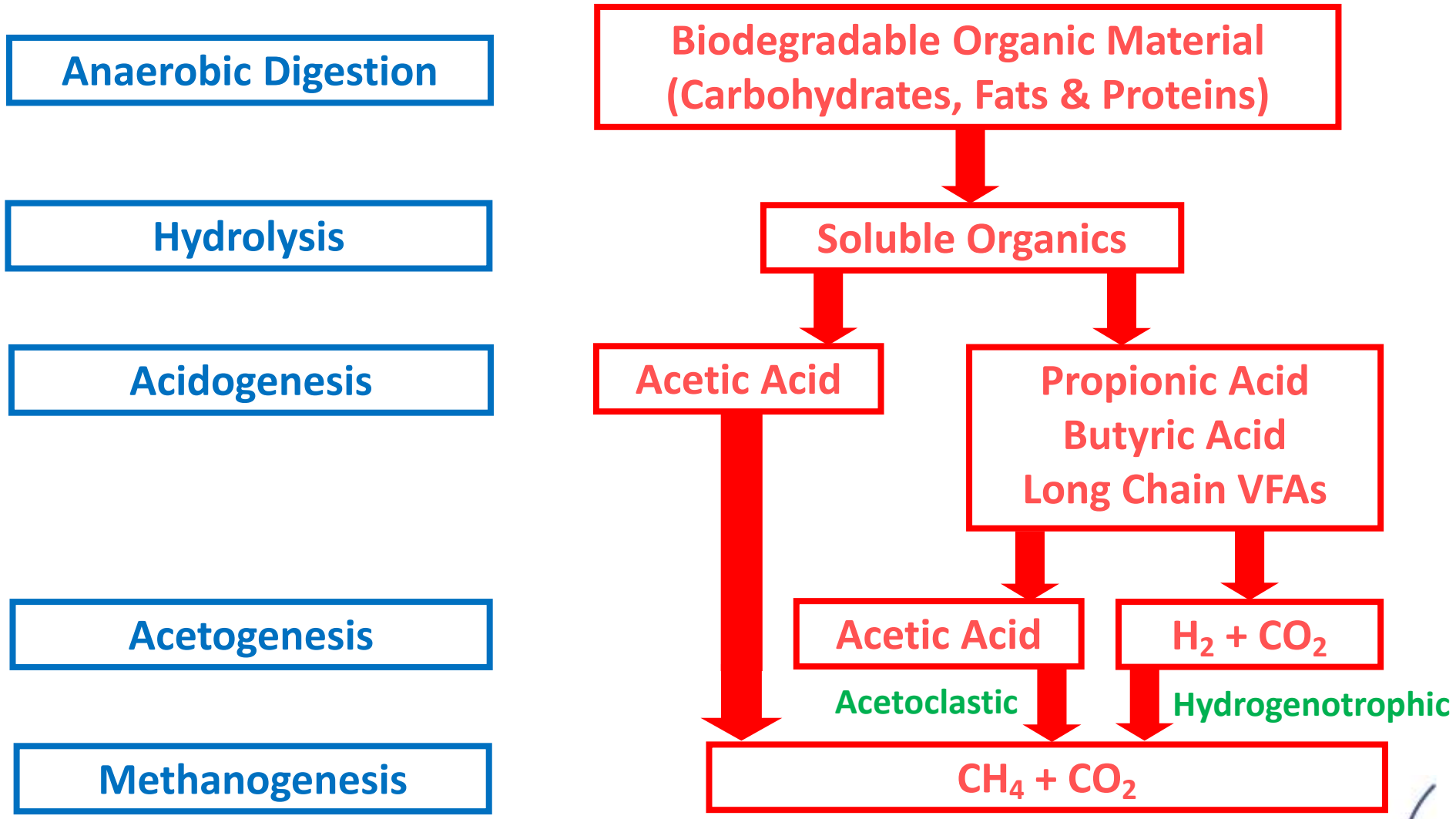
Power-to-Methane has two process steps:

- The electrolysis of water to hydrogen and oxygen.

$$2H_2O + \text{electricity} \rightarrow 2H_2 + O_2 + \text{heat}$$

- The biomethanation of hydrogen and carbon dioxide to methane.

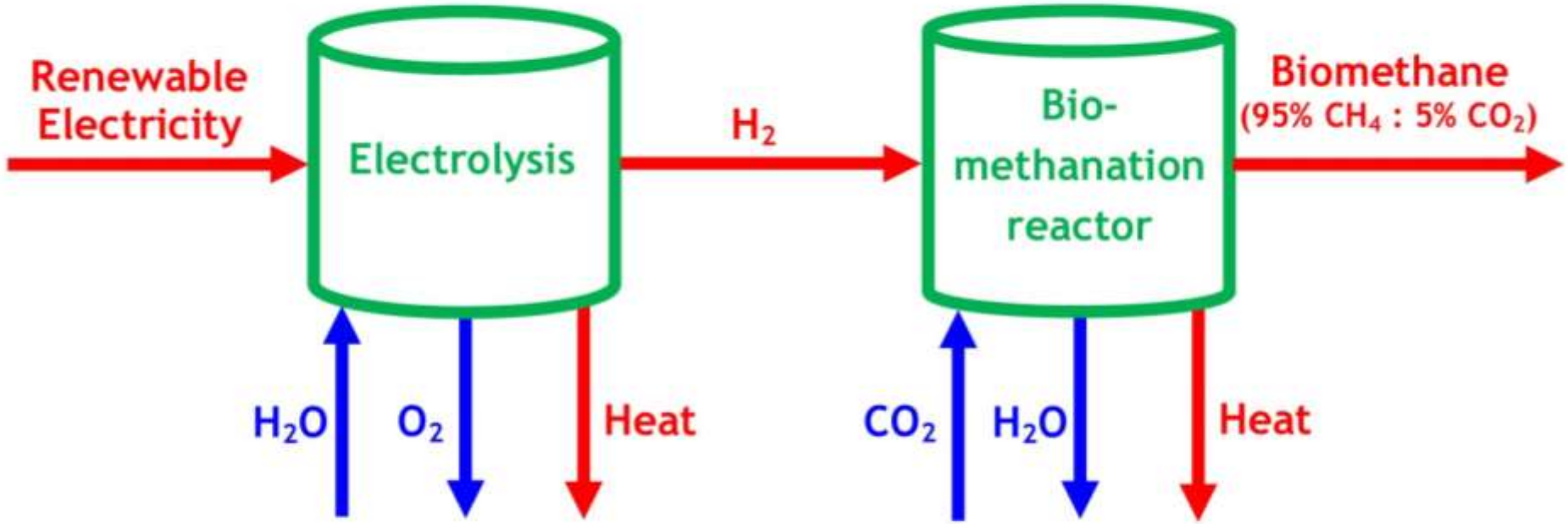
$$4H_2 + CO_2 \rightarrow CH_4 + 2H_2O + \text{heat}$$


Anaerobic Digestion
Hydrolysis
Acidogenesis
Acetogenesis
Methanogenesis
Biodegradable Organic Material
(Carbohydrates, Fats & Proteins)
Soluble Organics
Acetic Acid
Propionic Acid
Butyric Acid
Long Chain VFAs
Acetic Acid
$H_2 + CO_2$
Acetoclastic
Hydrogenotrophic
$CH_4 + CO_2$

There are two alternative biomethanation processes:

- Ex-situ biomethanation:- the injection of hydrogen and carbon dioxide into a high-rate anaerobic reactor populated with hydrogenotrophic microbes; or
- In-situ biomethanation:- the injection of hydrogen into a working digester.

Power-to-Methane ("ex-situ")



$2H_2O + electricity \rightarrow 2H_2 + O_2 + heat$

$4H_2 + CO_2 \rightarrow CH_4 + 2H_2O + heat$

$4H_2O + CO_2 + electricity \rightarrow CH_4 + 2O_2 + 2H_2O + heat$

MicrobEnergy

Microorganisms (archaea) in watery ambience (40-70°C)

Methanation

$4\ H_2 + CO_2 \rightarrow CH_4 + 2\ H_2O$

- CH_4-level > 98 %
- High tolerance in purity of input gas
- Fast and flexible load cycles
- Low temperature & low pressure
- Small units – decentralised use possible

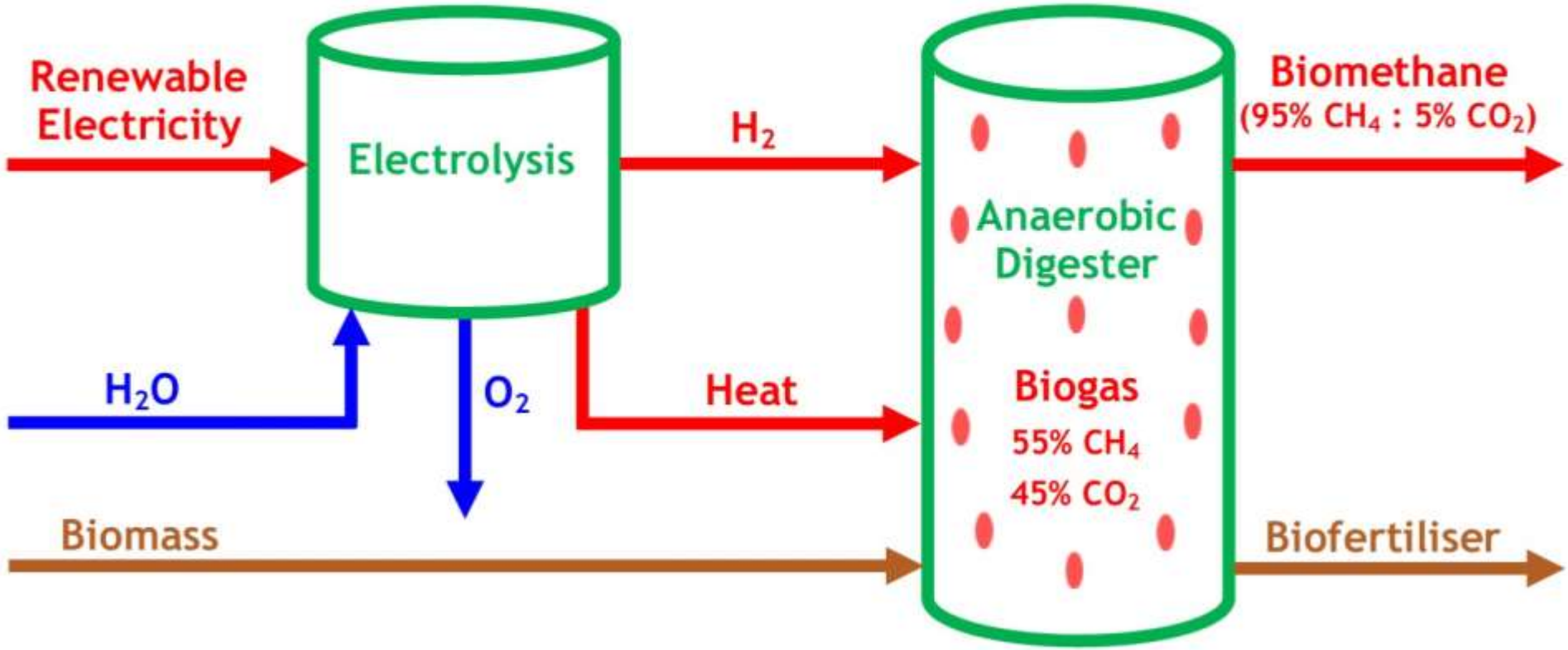
MicrobEnergy
Allendorf Demonstration Plant

BioPower2Gas

H2AD

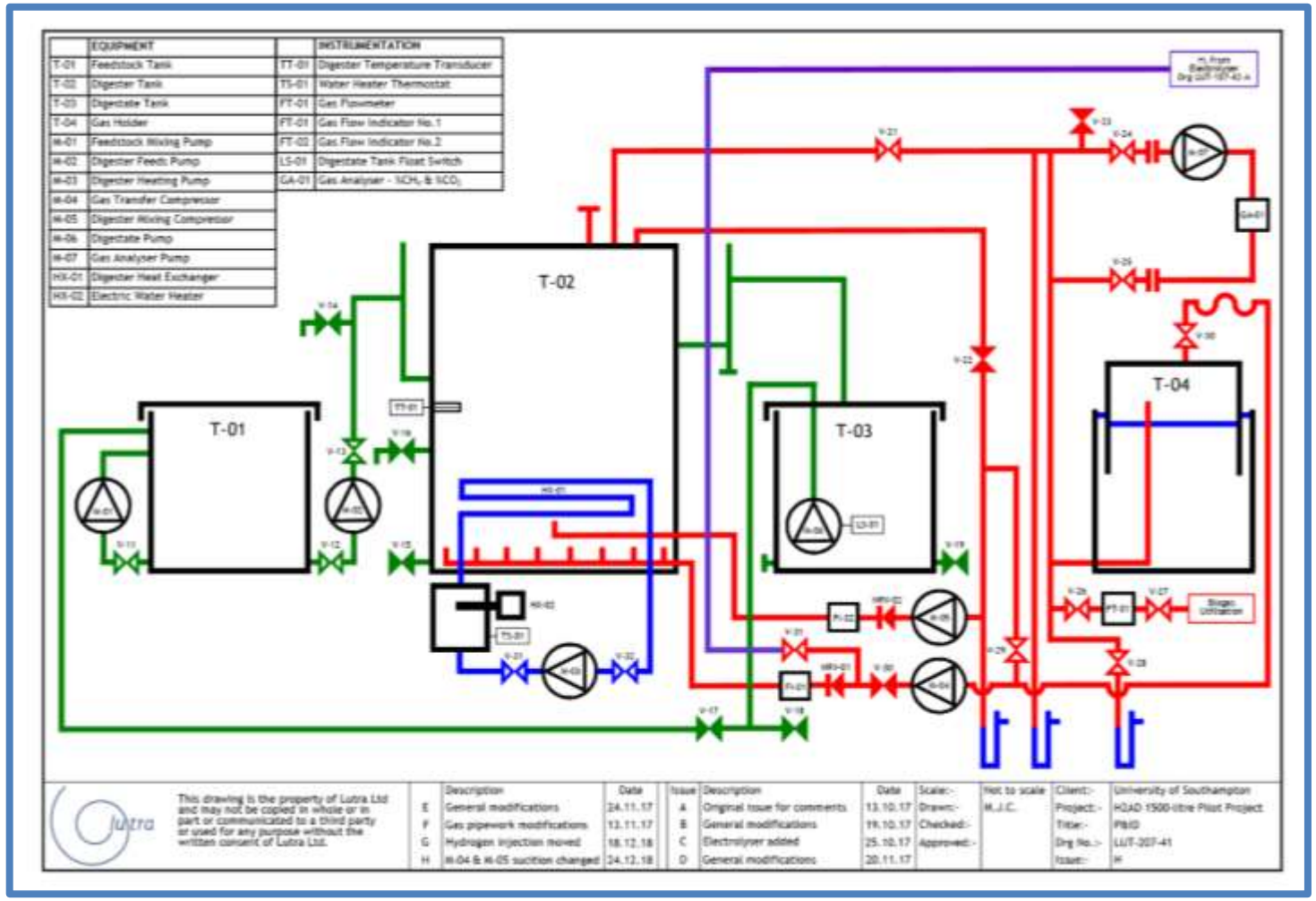
lutra

Power-to-Methane ("in-situ")



Lutra 1500-litre in-situ pilot H_2AD

Lutra 1500-litre in-situ pilot H_2AD



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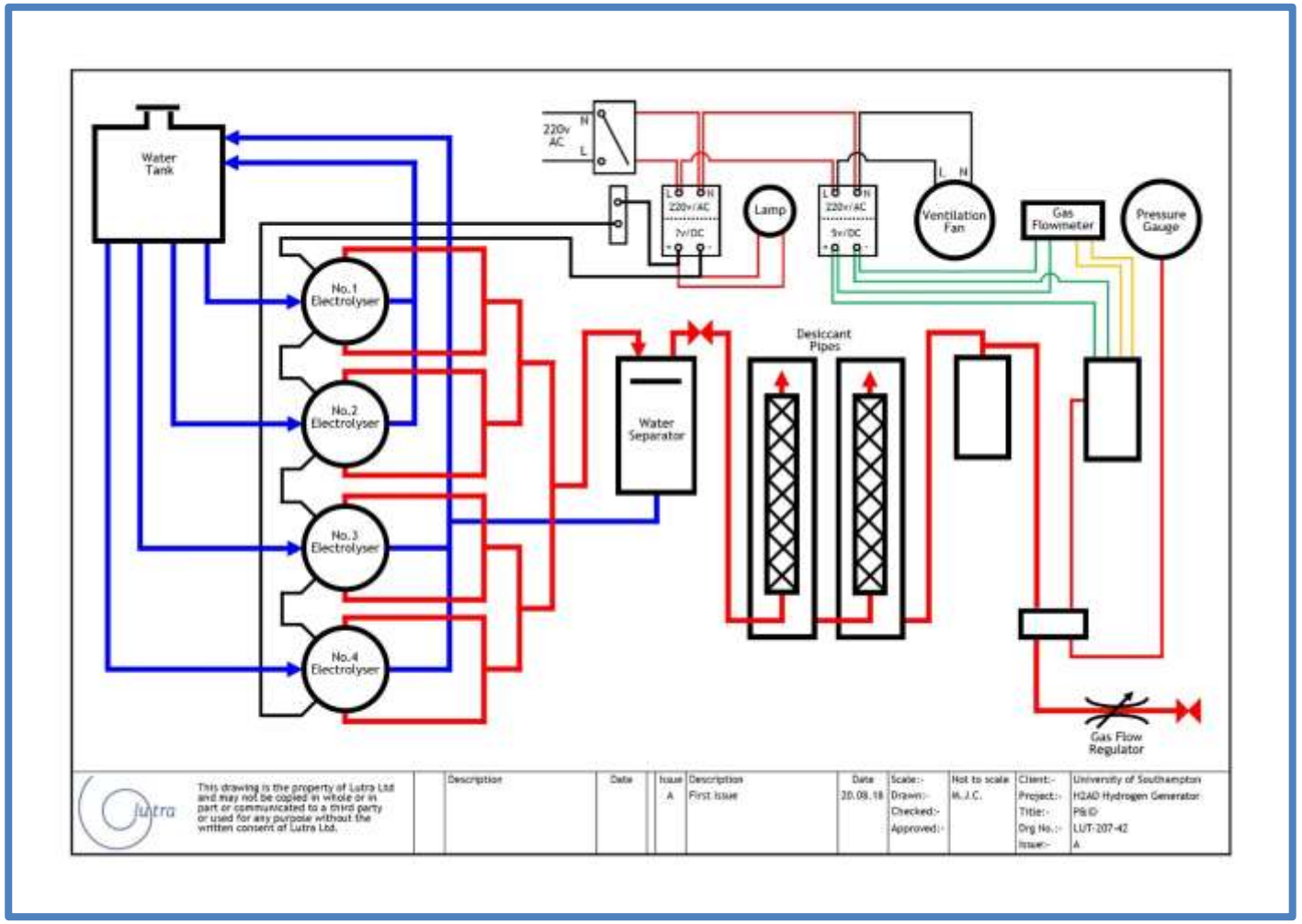
Electrolyser

Electrolyser



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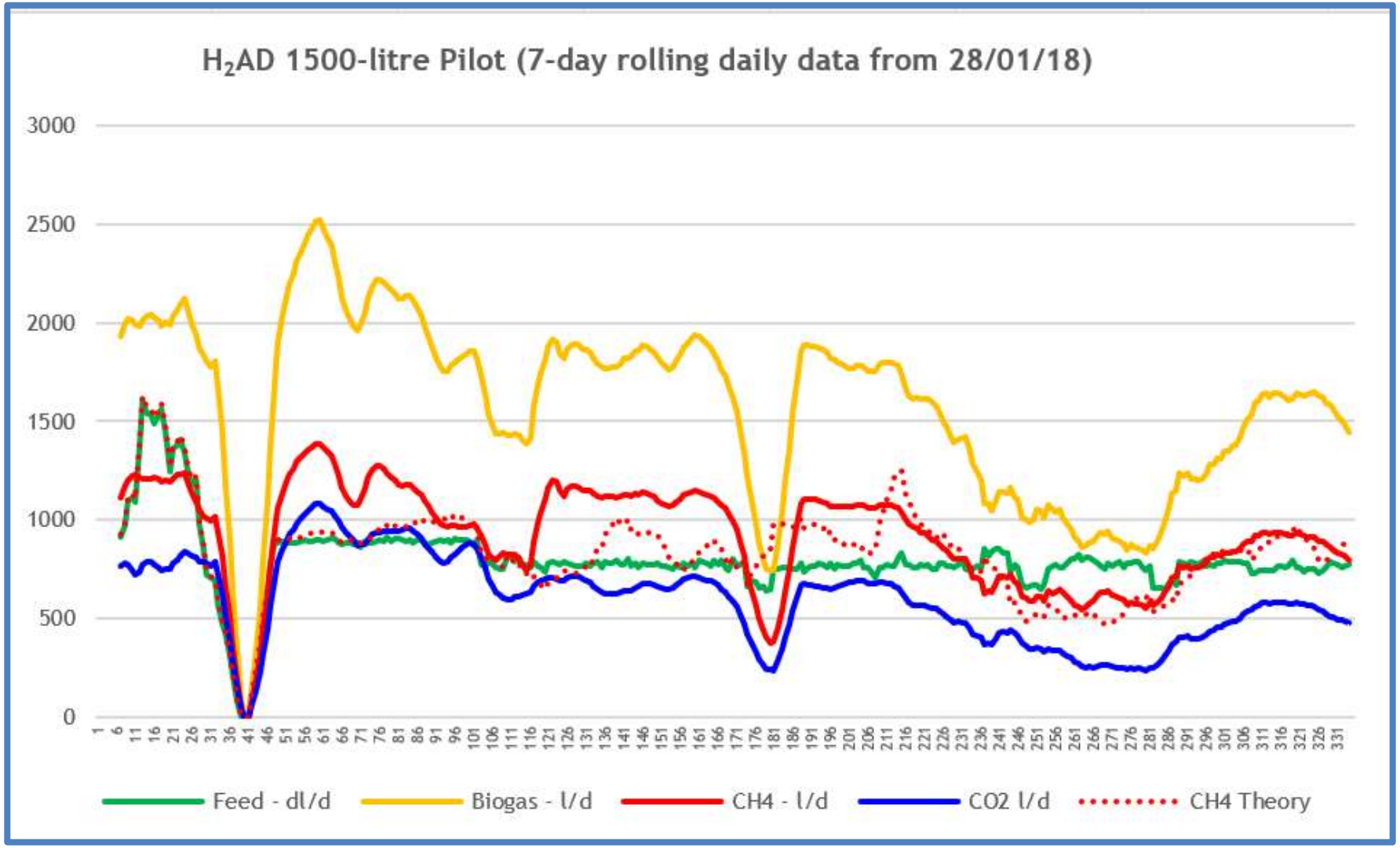
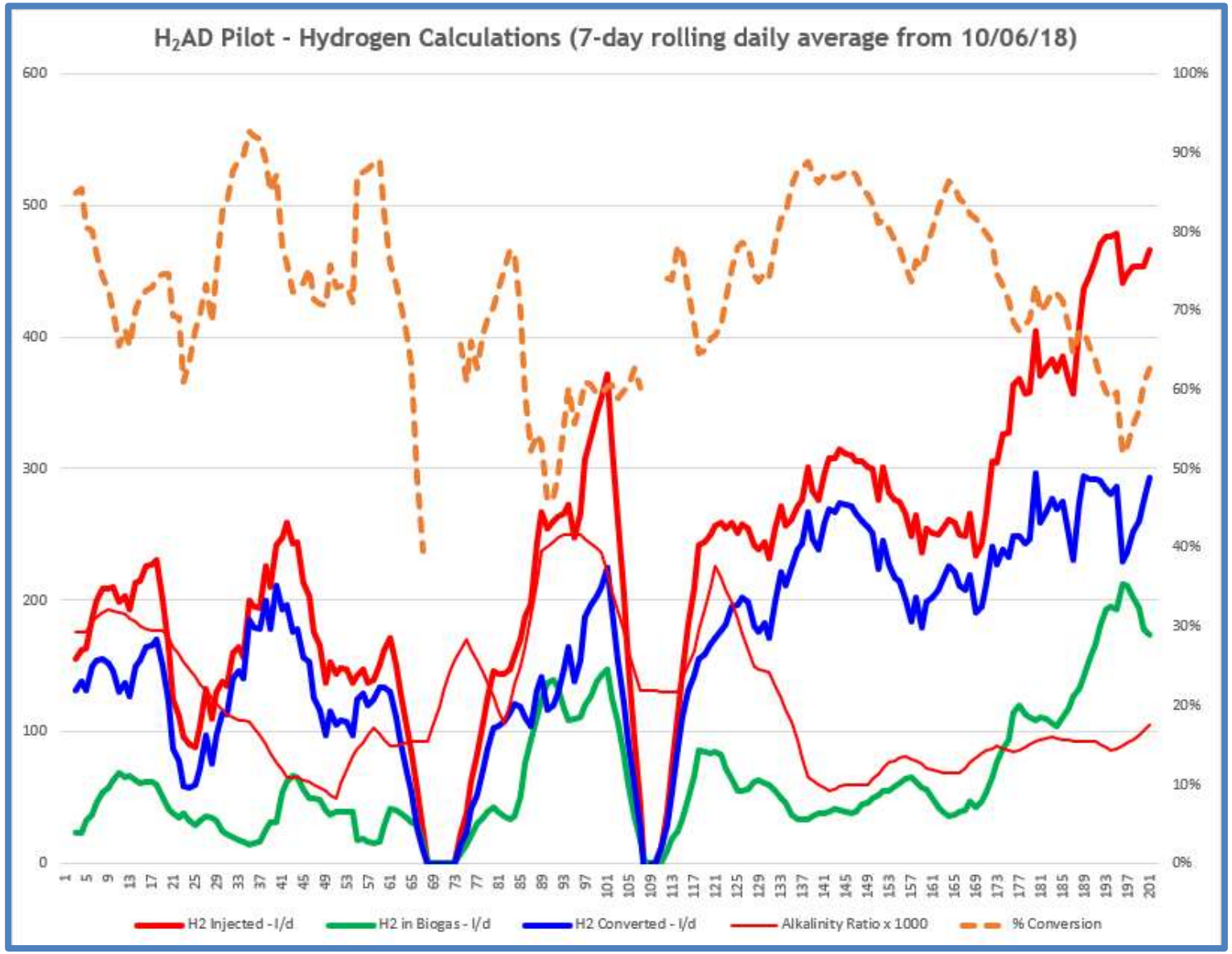
Gas Monitoring

Control Panel


H2AD 1500-litre Pilot (7-day rolling daily data from 28/01/18)
3000
2500
2000
1500
1000
500
0
Feed - dl/d
Biogas - l/d
CH4 - l/d
CO2 l/d
CH4 Theory



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IBCat H_2AD


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ITM POWER
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