Anaerobic Digestion of Food Waste

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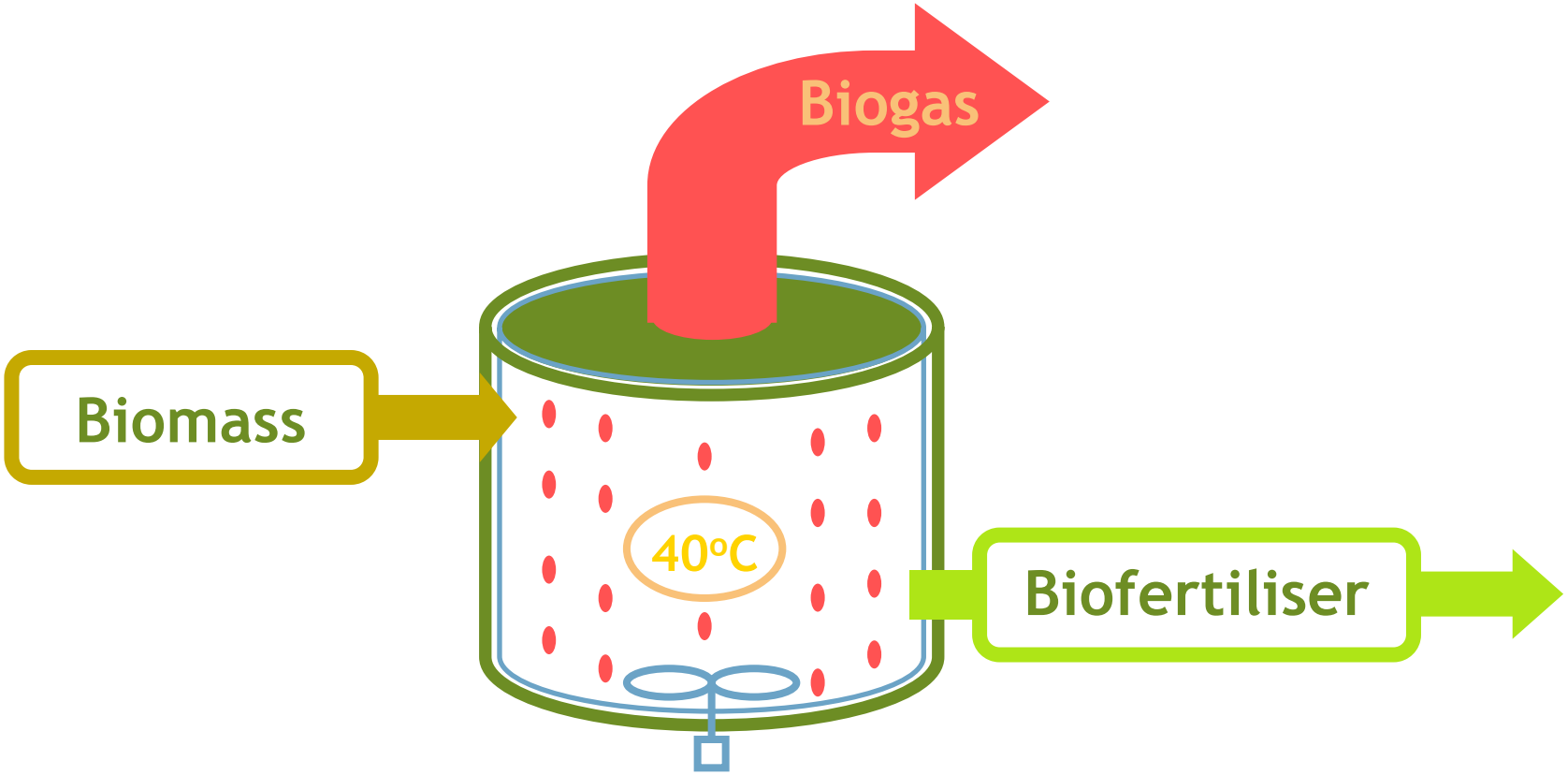
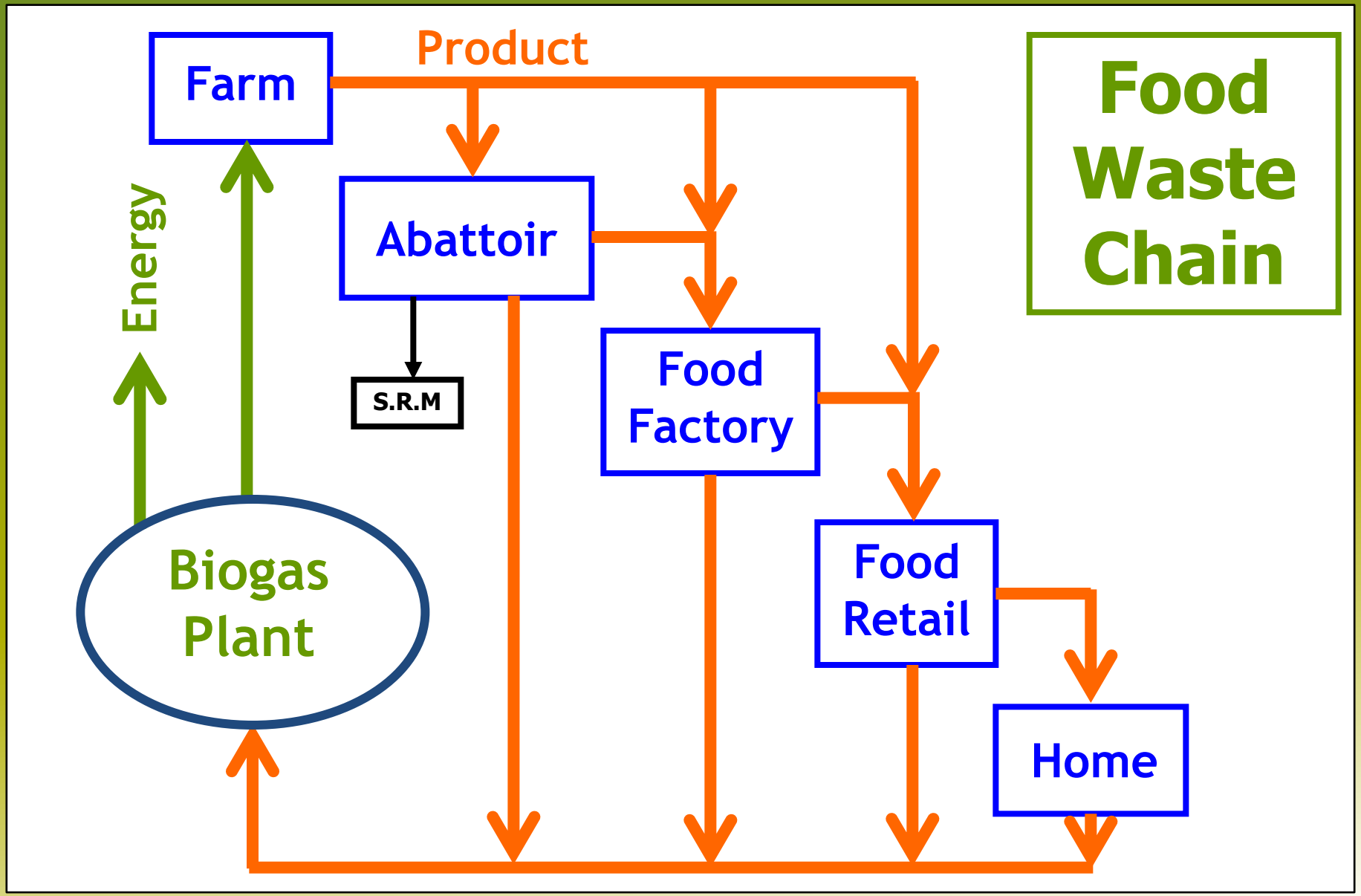
Anaerobic digestion - a natural biological process




Farm
Product
Food Waste Chain
Energy
Abattoir
S.R.M
Food Factory
Food Retail
Biogas Plant
Home

UK Context

- Government estimates that each UK household produces about 250kg of food waste per year, representing one third of food purchased.
- In total households produce 7 million tonnes of food waste per year.
- There is a further 10 million tonnes from commercial catering and from food processing.
- This food waste must be diverted from landfill, and has the potential for the production of renewable energy through AD.

Food Waste

R&D Projects

Anaerobic digester for café-bar – 1996-1998

Results

- The anaerobic digestion of food waste worked.
- It was fun.

Demonstration food waste AD for 1000 households – 1999-2001

Results

- Weekly collection.
- 1000 households.
- Food waste – 3.5kg/household/week.
- Digester capacity – 40m^3
- Digester temperature – 37^oC
- OLR – 3.0$kg_{ODM}.m^{-3}.d^{-1}$.
- BMP – 350$m^3.tonne_{ODM}^{-1}$.
- Biogas – 140$m^3.tonne^{-1}$(wet waste).

Mesophilic/thermophilic research trials – 2001-2003

Food waste preparation

Operation

- 58 week trial.
- Mesophilic temperature – 37^{o}C.
- Thermophilic temperature – 56^{o}C.
- Digester capacity – 1.5m^{3} each.
- Digester feed – 4 times per day.

Results (Mesophilic)

- Mean HRT - 31.5 days; OLR - 4.1 $kg_{ODM}.m^{-3}.d^{-1}$.
- Biogas - 4.4 $m^3 \cdot d^{-1}$; CH_4- 59%.
- Digestate - 5.5%DM, 75% ODM.
- Maximum VFA - 27,400 $mg.l^{-1}$ (after 35 weeks).
- Ammonia - 5200 $mg.l^{-1}$.
- pH - 7.3 to 7.7.
- After 35 weeks some of the digestate recycle was replaced with water to reduce the level of VFA and ammonia.

Results (Thermophilic)

- Irregular loading because of instability.
- VFA - > 40,000 $mg.l^{-1}$ (week 25).
- pH – down to 6.8.
- High VFA and low pH required a reduction in loading but maintaining the HRT (≈30days) by mixing with water.
- Ammonia - 5050 $mg.l^{-1}$, but reduced to 3600 $mg.l^{-1}$ when water was added.

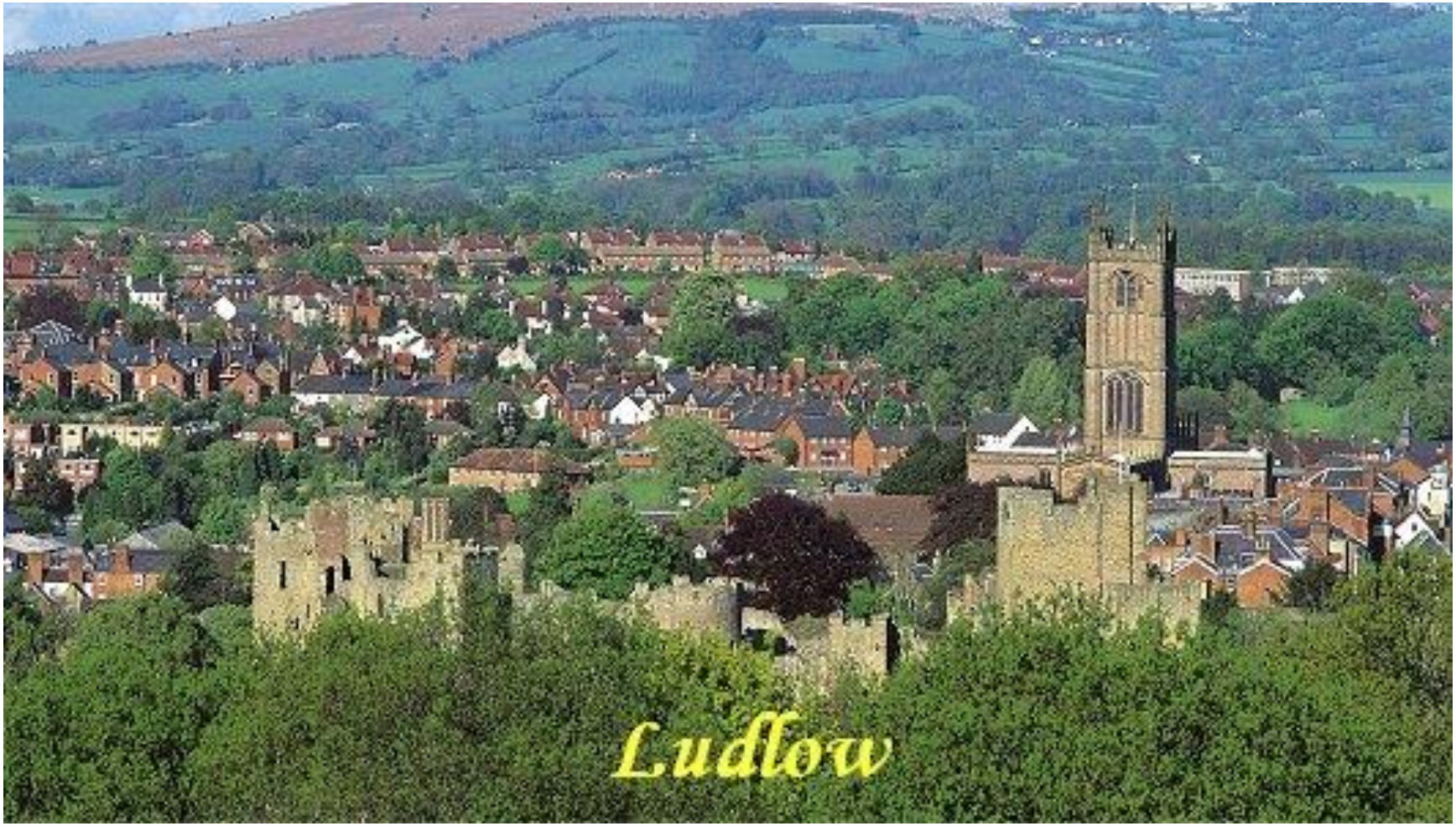
Results (Pathogens)

- Log reduction (Mesophilic) – 1.5 to 3.0.
- Log reduction (Thermophilic) – 4.0 to 5.0.
- Pasteurisation (70^{o}C for 1 hour after AD) eradicated e.coli, faecal streptococci.

Ludlow food waste digester

Ludlow Food Waste Digester

- Partnership between Greenfinch & South Shropshire District Council.
- Constructed June 2005 to February 2006.
- Commissioned in March to July 2006.
- Decommissioned in September 2012.
- Recycled 4000tpa of kitchen waste.
- Operated by community company.


Ludlow


Environment
AD of
Food Waste
Community
Economy

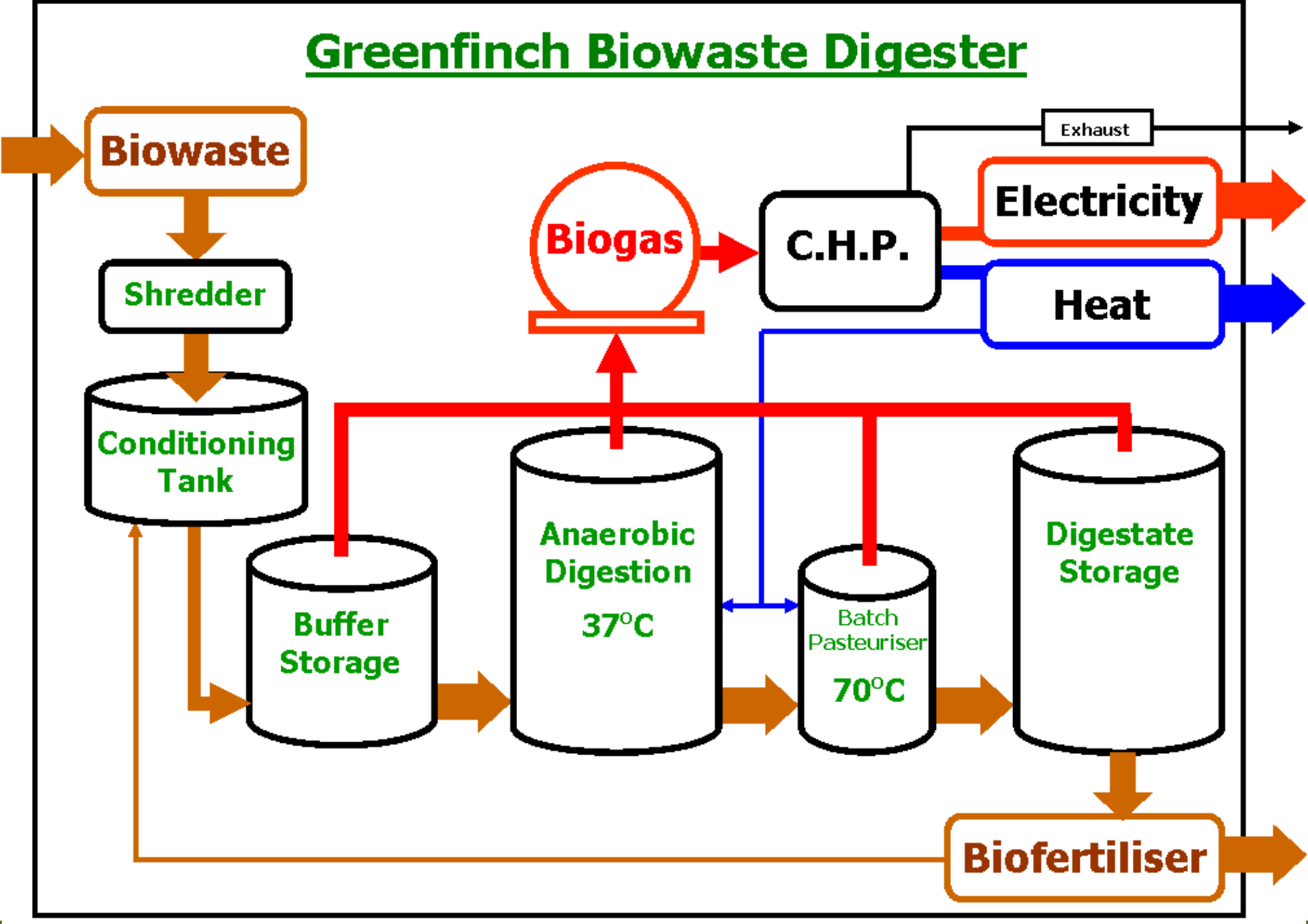
Kitchen caddy, corn starch bags & kerbside bin

Kerbside bins ready for collection in Ludlow

Ludlow biodigester site before construction

Ludlow biodigester under construction

Food waste delivery


Greenfinch Biowaste Digester
Biowaste
Shredder
Conditioning Tank
Biogas
C.H.P.
Exhaust
Electricity
Heat
Buffer Storage
Anaerobic Digestion
37°C
Batch Pasteuriser
70°C
Digestate Storage
Biofertiliser

Food waste in reception hall

Shredded food waste

Process tanks

CHP & boiler

Electric collection vehicle

Liquid biofertiliser

Solid biofertiliser

Results

- Plant operational for 6 years.
- Initial feedstock garden + food waste.
- Changed to food waste only after 1 year.
- Instability after 2 years operation on food waste only.
- Micronutrients added from 2009.
- After addition of micronutrients:-
- VFA reduced from >30000 $mg.l^{-1}$ to <1000.
- BMP – increased from 380 to 420 $m^3.tonne_{ODM}^{-1}$.
- OLR increased to 3.2$kg_{ODM}.m^{-3}.d^{-1}$.

Co-digestion of pig slurry & food waste in Bedfordshire

45,000 tonnes per year food waste AD plant in Northamptonshire

Co-digestion of food waste with cattle & pig manure in Shropshire

10,000 tonnes per year potato digester in Lincolnshire

300 tonne per year community AD plant

Household biogas plant in India

Thank You