Biomass for Energy

Challenges for Agriculture

Bruges, 25th September 2006

The Prospects for Commercial On-Farm Co-Digestion Plants in the UK

Michael Chesshire

Greenfinch Ltd

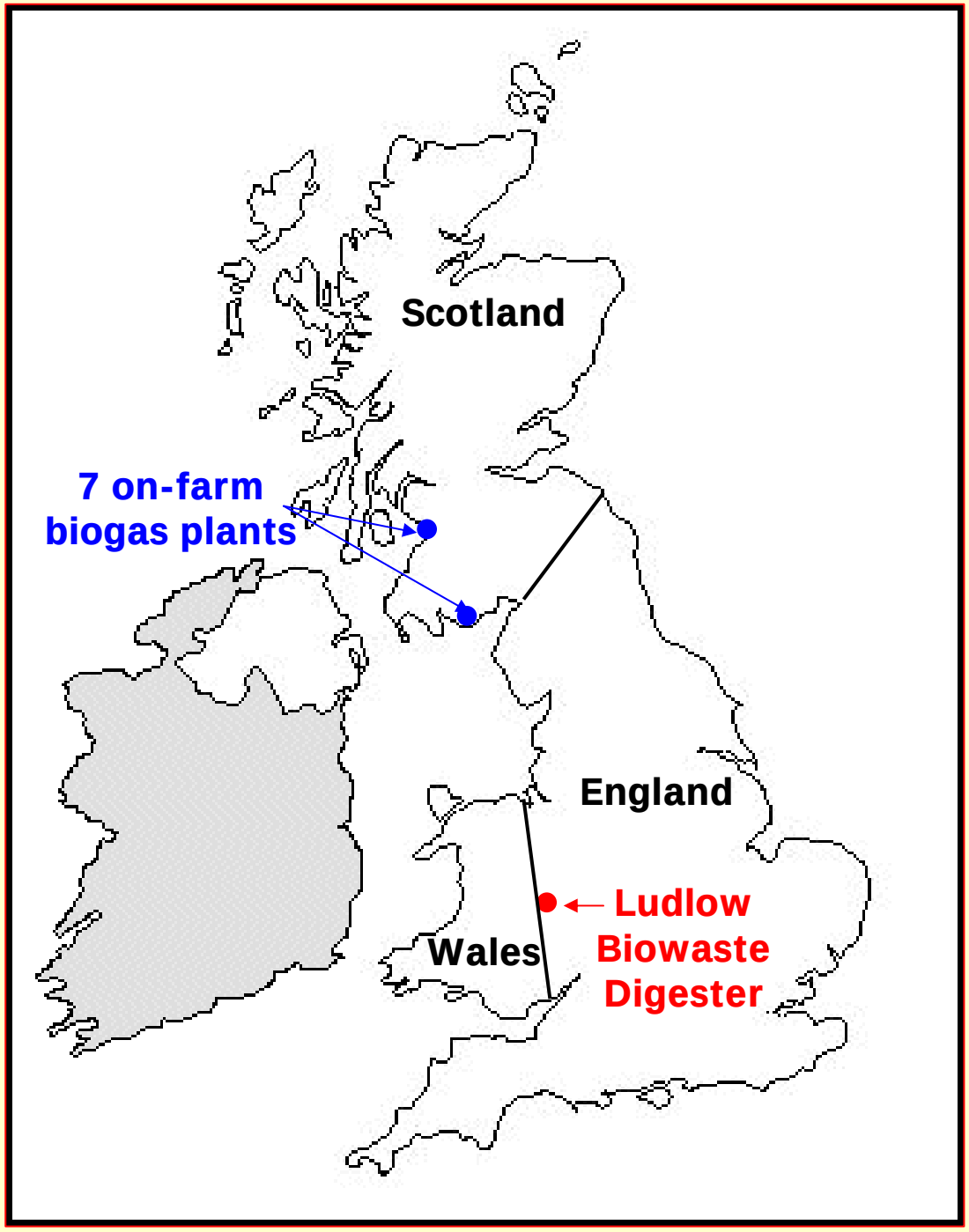
cropgen

Greenfinch

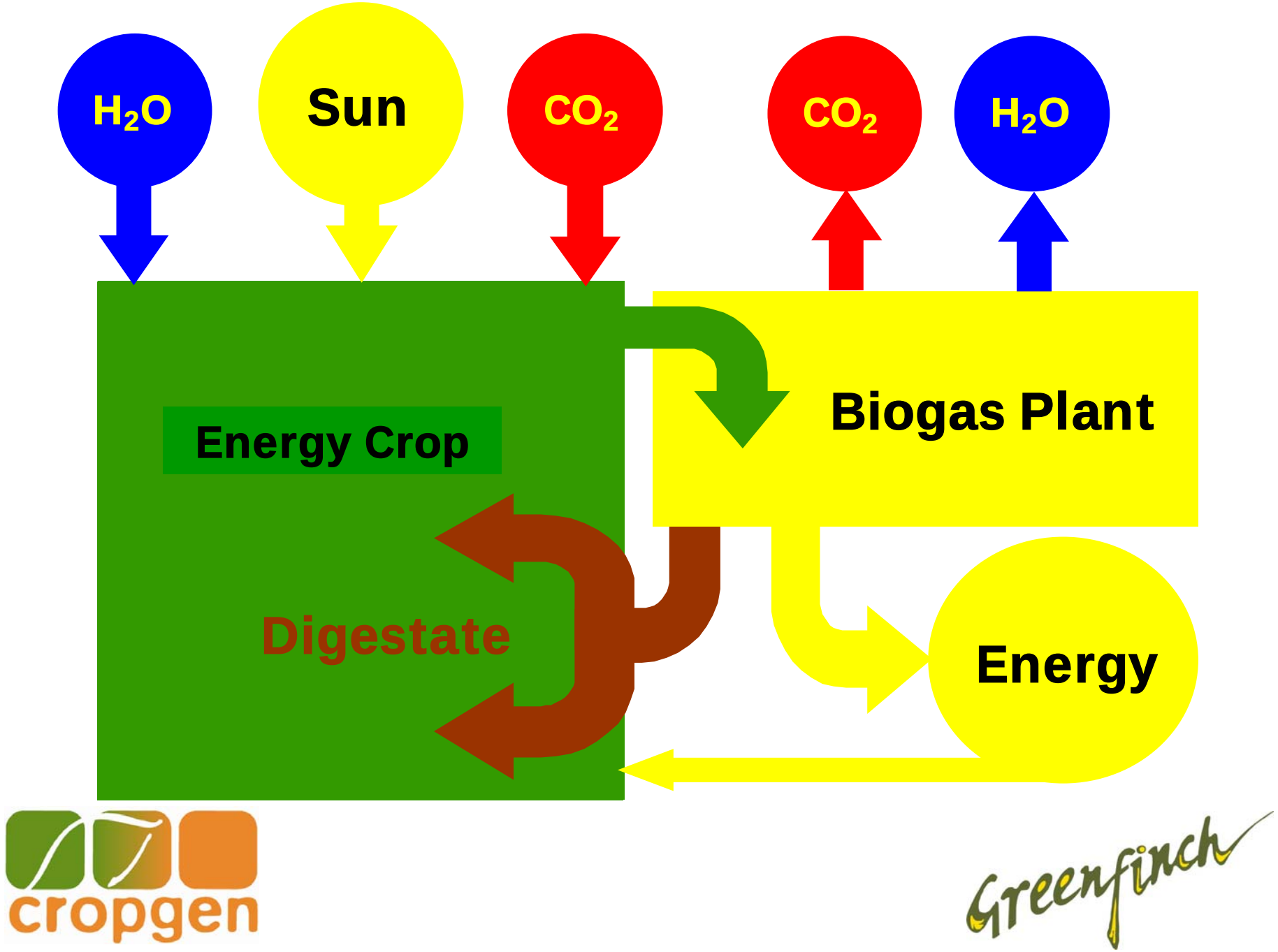
Presentation

- Greenfinch Ltd
- Cropgen
- Farm AD plants in UK
- Anaerobic digestion of energy crops
- Commercial case studies
- Conclusion

- **Based in the west of England.**
- **Specialise in anaerobic digestion.**
- **8 years of R&D into the AD of food waste.**
- **Constructed 7 on-farm AD plants in Scotland.**
- **Constructed the UK’s first biowaste digester.**


Scotland
7 on-farm
biogas plants
England
Wales
Ludlow
Biowaste
Digester

- A pan-European consortium investigating the production of biogas from farm crops.
- 8 universities from Finland, The Netherlands, Austria, Italy, Spain & UK.
- 3 small companies from Finland & UK.
- 3-year project ending in February 2007.
- Researching different crops in different climates.
- Net energy balance is a key area of investigation.
- Commercial solutions are an important output.


H_2O
Sun
CO_2
CO_2
H_2O
Energy Crop
Biogas Plant
Digestate
Energy
cropgen
Greenfinch

Ryegrass Trial Plots

Ryegrass Digester (20m^3)

On-Farm AD Plants in UK

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.
- The potential for co-digestion of manure with energy crops is emerging.

Pig Farm Digester (1970s)

Cattle Farm Digester (1980s)

Central Digester in UK (2002)

Pig Farm + Food Waste (2006)

7 on-farm biogas plants designed & built by Greenfinch in Southwest Scotland in 2004 for the Scottish Executive to research the pollution of bathing waters by faecal matter from agriculture.

Ludlow Biowaste Digester (2006)

Anaerobic Digestion of Energy Crops

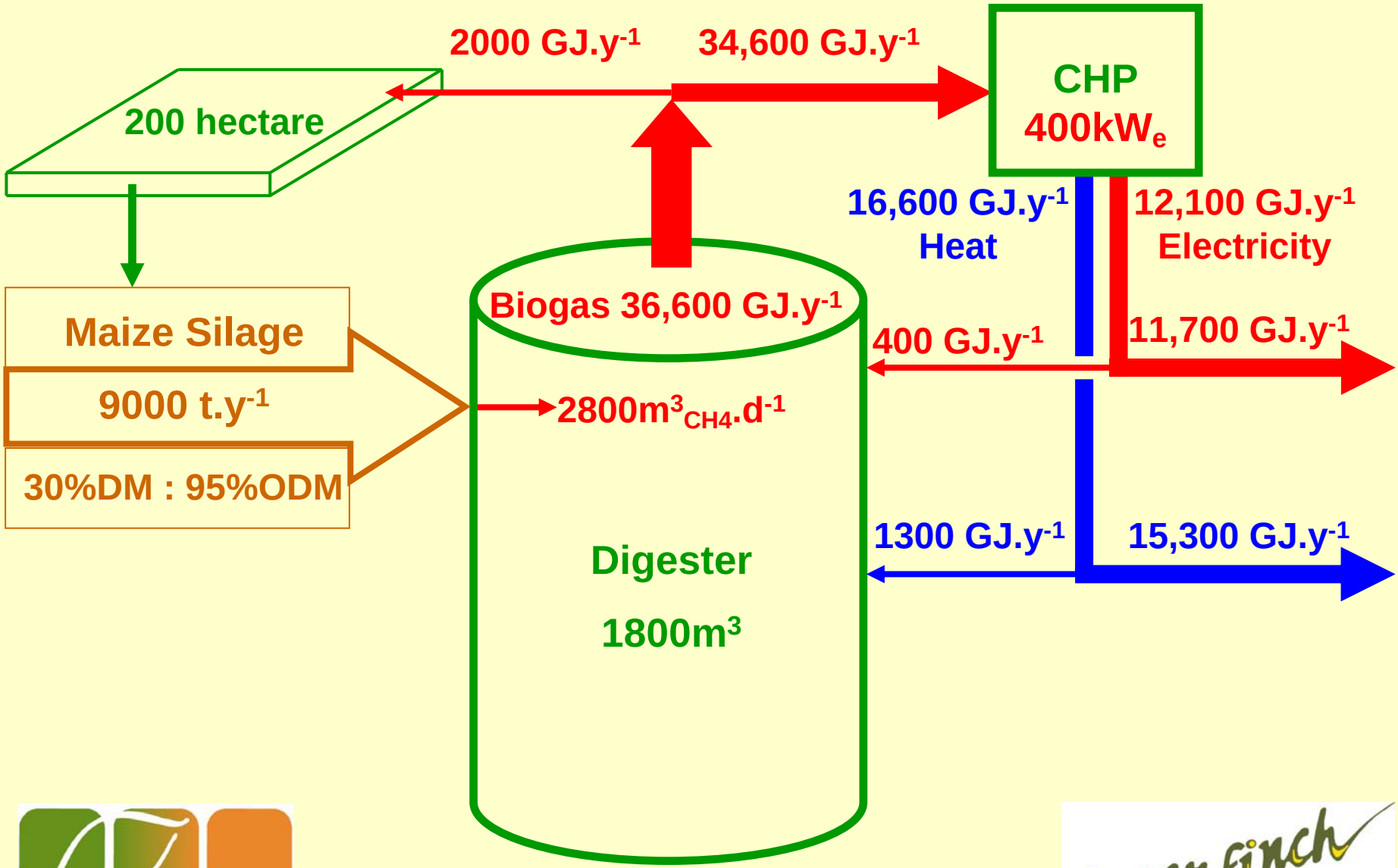
cropgen

Greenfinch

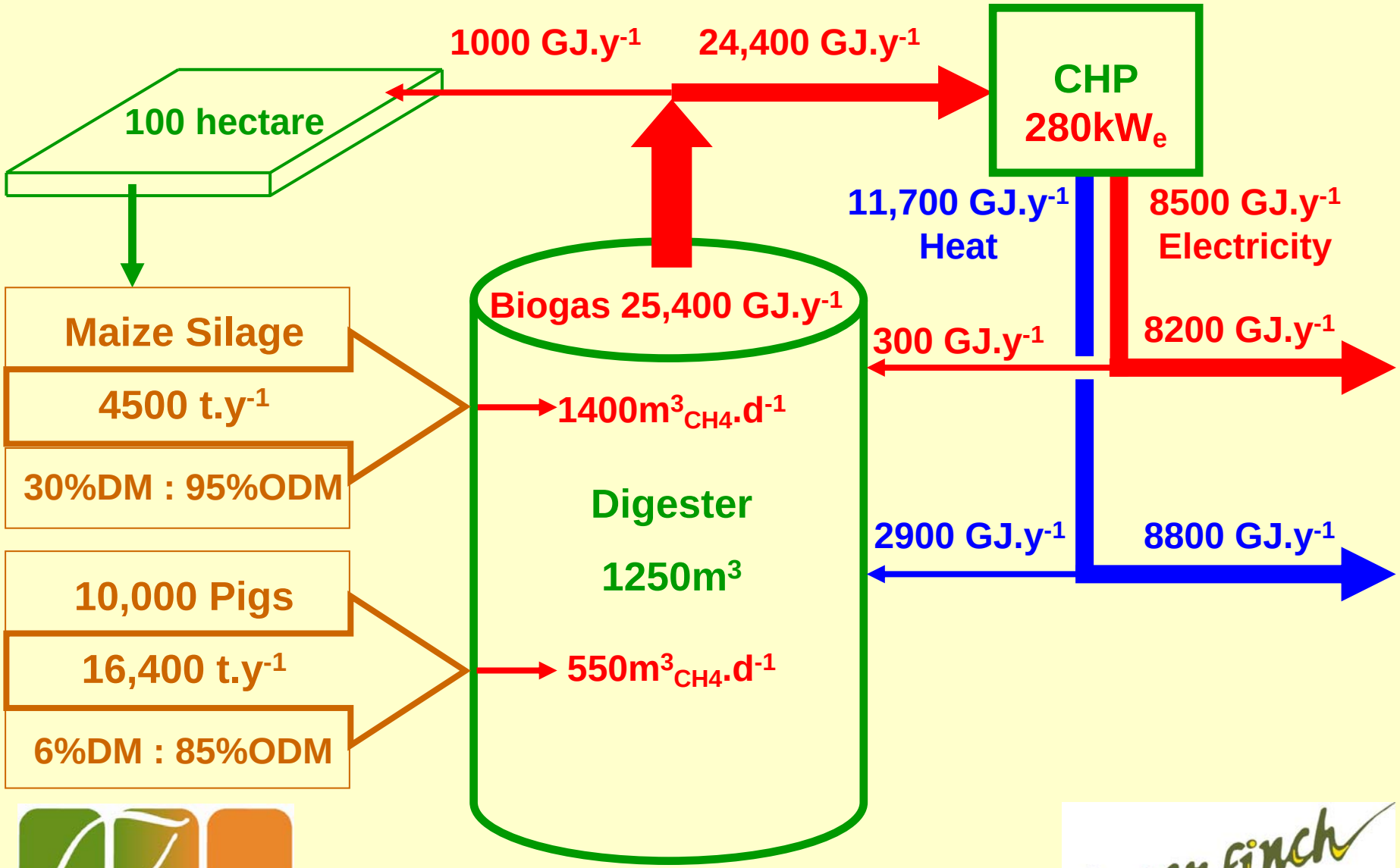
Energy Crop Parameters

Crop Variety		Maize	Ryegrass
Crop Yield	$t_{WET}.ha^{-1}.y^{-1}$	45	56
Dry Matter	%DM	30	20
Organic Dry Matter	%ODM	95	88
ODM Yield	$t_{ODM}.ha^{-1}.y^{-1}$	12.8	9.8
Methane Yield	$m^3_{CH4}.t^{-1}_{ODM}$	400	340
Gross Energy Yield	$GJ.ha^{-1}.y^{-1}$	182	120
Energy for Crop Production	$GJ.ha^{-1}.y^{-1}$	10	24
Net Energy Output	$GJ.ha^{-1}.y^{-1}$	172	96
Crop Production Cost	$€.ha^{-1}.y^{-1}$	€1,100	€1,300

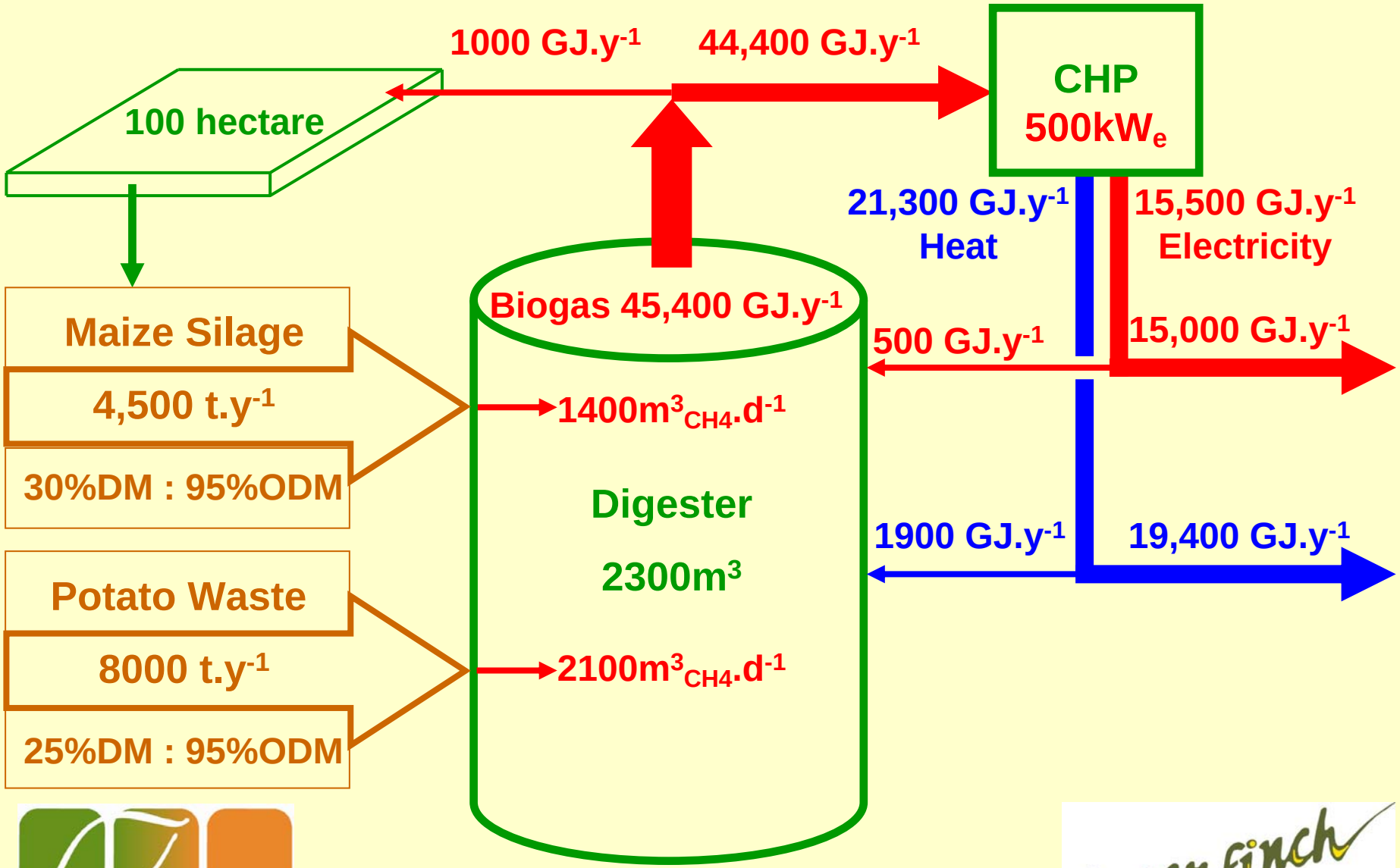
Energy Balance: Maize Silage



Energy Balance: Maize + Pig Manure



Energy Balance: Maize + Potato Waste



UK Commercial Background

- Farmers are looking for diversification.
- Value of renewable electricity is uncertain.
- Value of renewable electricity exported from site – approx. 14 €cent per kW.h.
- Value of renewable electricity used on site – approx. 18 €cent per kWh.
- Surplus heat is difficult to sell.
- Biofertiliser has value but is difficult to sell.
- There are opportunities for gate fees for the AD of food waste, in particular animal by-products.

Commercial Analysis

		Maize	Maize + Pigs	Maize +Potato
Sale of Electricity	€.y^{-1}	440,000	305,000	560,000
Sale of Heat	€.y^{-1}	25,000	25,000	25,000
TOTAL INCOME	€.y^{-1}	465,000	330,000	585,000
Cost of Energy Crop	€.y^{-1}	220,000	110,000	110,000
Cost of Labour	€.y^{-1}	20,000	20,000	20,000
Cost of Maintenance	€.y^{-1}	85,000	60,000	110,000
TOTAL COSTS	€.y^{-1}	325,000	190,000	240,000
INCOME LESS COSTS	€.y^{-1}	140,000	140,000	345,000
CAPITAL COST	€	1,200,000	1,000,000	1,350,000
PAY-BACK	yrs	8.6	7.1	3.9

Conclusions

- Co-digestion of energy crops with food waste and animal manure is becoming economic in the UK.
- AD of energy crops alone is not yet economic unless there is no cost of production, for example if the crop is a waste.
- The economics are improved if the electricity is used on site, for example for refrigeration.
- The economics are improved if food waste includes a gate fee.
- We expect the first UK energy crop AD plant to be built in 2007.

cropgen

www.cropgen.soton.ac.uk

Greenfinch

www.greenfinch.co.uk