

SUPERGEN Bioenergy Challenge

Increasing energy yield by the integration of anaerobic digestion and pyrolysis

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Project Aim

To improve the overall net energy yield from municipal solid waste by combining pyrolysis and anaerobic digestion.

- The majority of MSW is disposed of by either landfilling or incineration, which are very costly (currently £85-£100/t) and unsustainable.
- The EU directive has set a UK target to achieve 20% electricity from renewable sources by 2020
- 70% of MSW is considered to be biodegradable and could potentially be used as a fuel in energy generating systems (biodegradable fractions of mixed wastes are eligible under the ROO using advanced thermal conversion routes)

What is MSW?

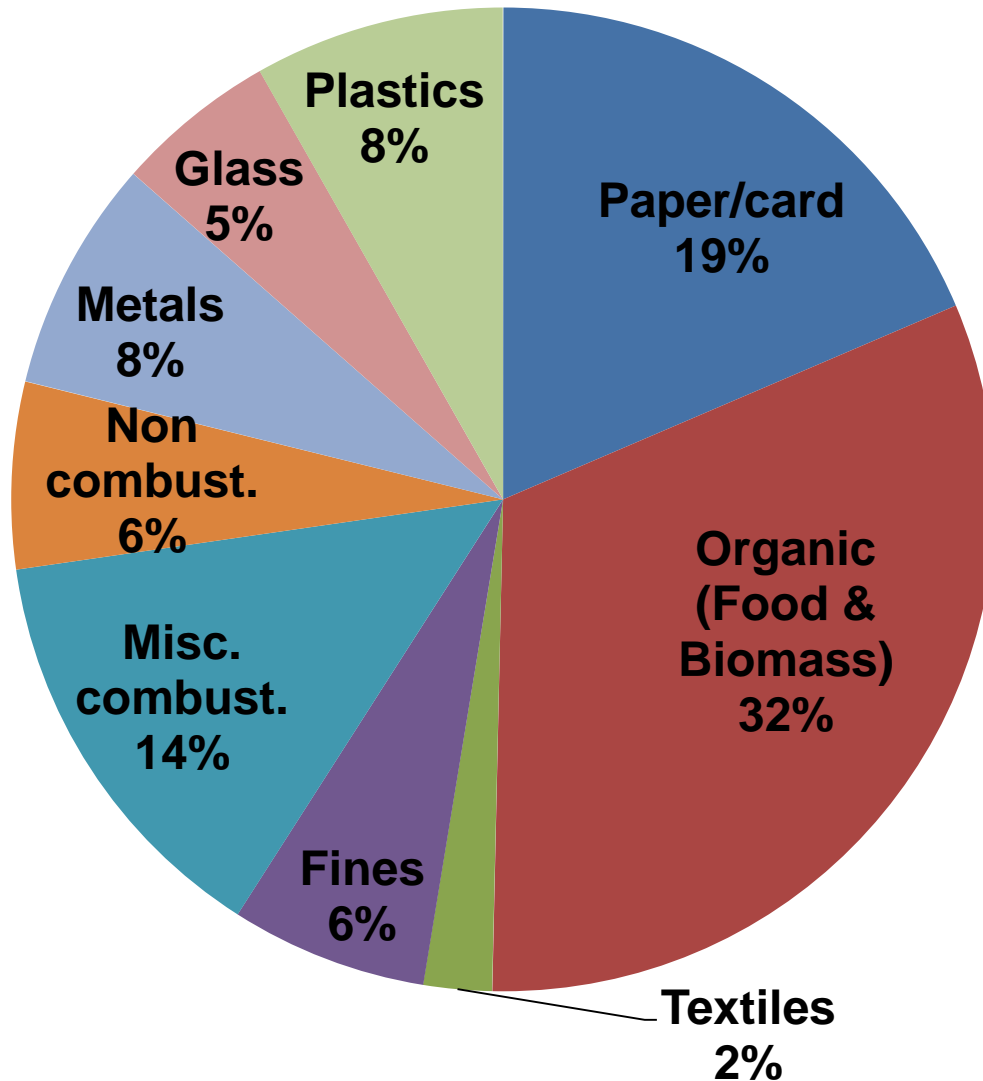
- Municipal Solid Waste (MSW), consists of everyday unwanted household items such as plastics, food, biomass, metals, paper, card, textiles and other miscellaneous materials collected by the local authority.

Why is this Supergen challenge project important?

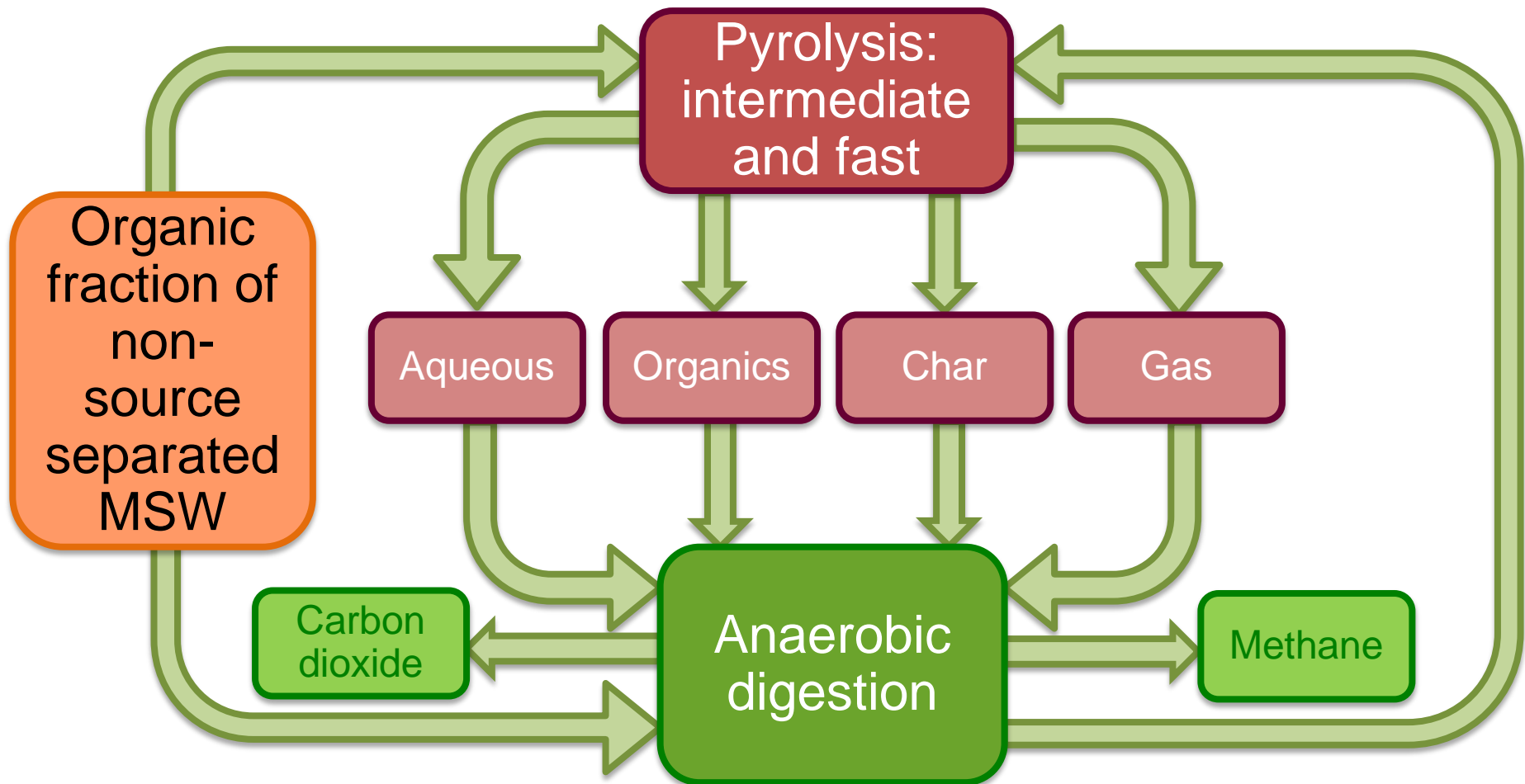
- ~46 million t/y of MSW are currently produced in the UK, which is forecast to rise to 52 million t/y by 2020



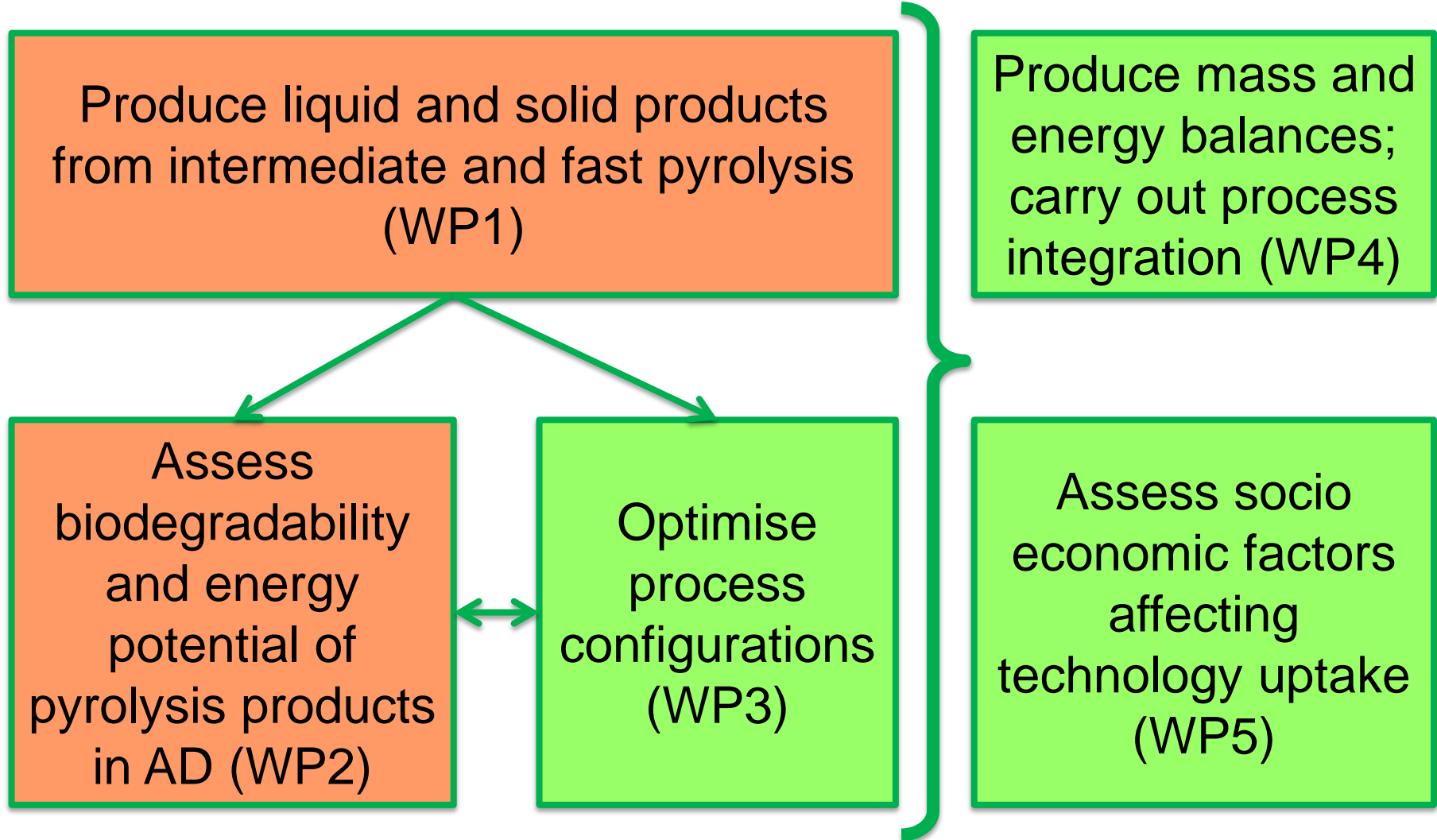
MSW Feedstock Composition Forecast for 2020



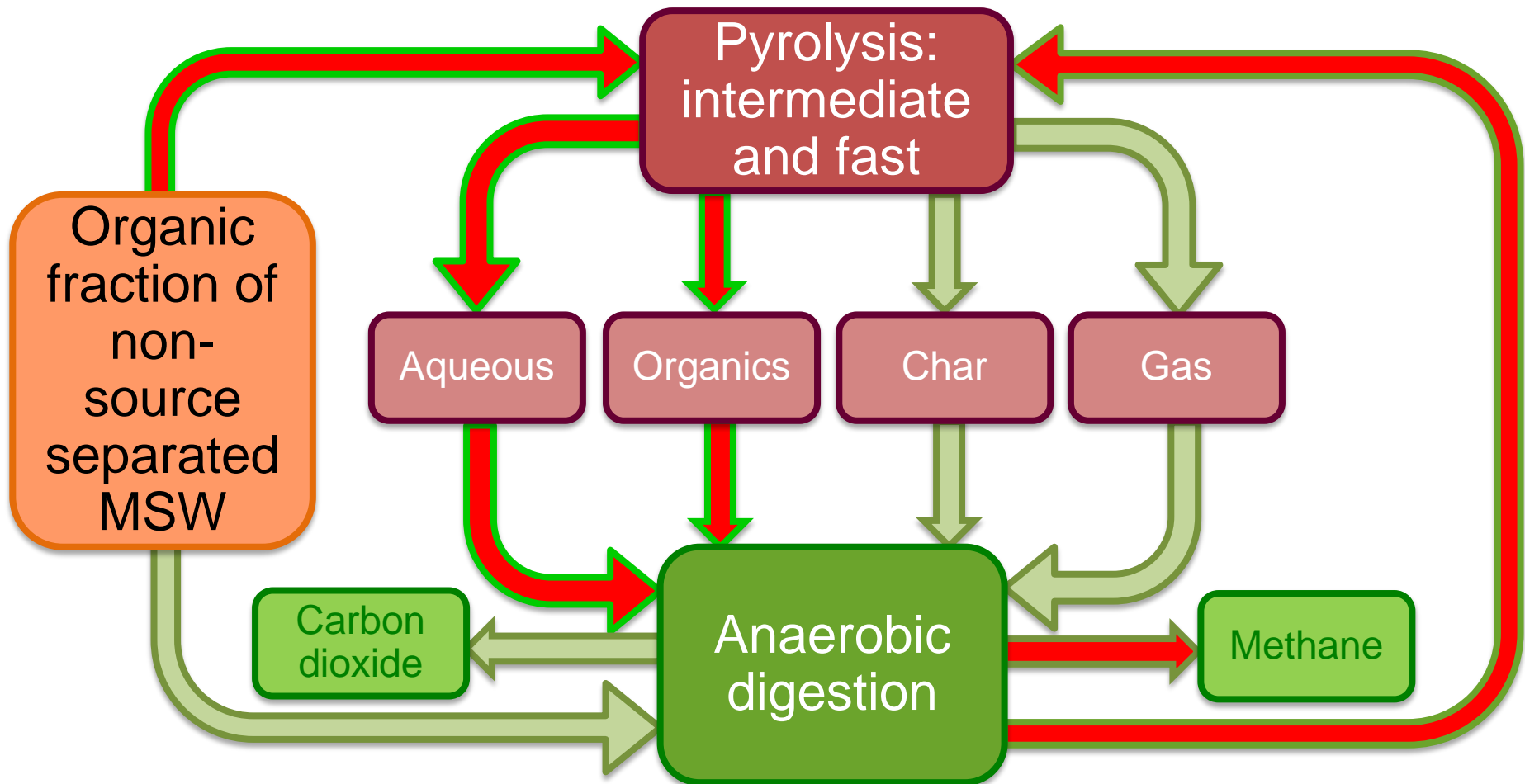
Conceptual process



Project structure



Conceptual process - current work



Pyrolysis

Intermediate pyrolysis is carried out in a Pyroformer. This is a twin screw auger reactor that recirculates the product char to transfer heat from the reactor wall to the biomass in the inner screw.

Intermediate pyrolysis liquids are always clearly phase separated. The darker organic phase sometimes floats and sometimes sinks.

Fast pyrolysis liquids are usually homogenous, but MSW has not yet been tested.



Feed, product and process characteristics

	C %	H %	N %	S %	O %	HHV MJ/kg
Feedstock	29.7	4.21	1.15	1.04	32.07	16.3
Organics	63.5	9.68	3.11	1.08	16.48	35.8
Aqueous	7.3	11.0	1.72	<0.10	66.01	18.3
Char	22.6	2.19	0.61	1.41	9.27	11.0

Feed	Feed	IS	OS	C:B	Liquid	Organics	Gas	Char	Total % = closure
MSW pellets	4.8 kg/h	6 rpm	1 rpm	1.6	41.6 wt%	68.5 wt% #	18.6 wt%	38 wt%	98.2

IS: Inner screw; OS: Outer screw; C:B – Char:biomass ratio
- organics are % of total liquid

Biodegradability & energy potential

Initial work is focussed on measuring the bio-methane potential and the energy yield as methane of:

- the aqueous fraction which is around 80% water and 20% dissolved organics
- The organic fraction which has around 20% water

Initial work is examining additions to an operational digester fed with more conventional substrates.

The effect of char addition will also be studied which may act as a substrate for microorganisms and would be incorporated into the solid digestate for spreading on land.

It is also planned to add gas into a digester to explore the benefits of this approach.

Process integration and optimisation will conclude the project.

Biodegradability & energy potential

Measurement of biomethane potential (Southampton)



*See
posters for
more
details*



Measurement of energy potential in laboratory digesters (Harper Adams) (Southampton)



Socioeconomics

- While new waste management options may offer improved environmental performance, they can also face several non-technical obstacles.
- Actors' expectations can shape both technology and policies facilitating or impeding specific technoscientific pathways.
- Understanding expectations in integrating AD-pyrolysis will enable factors to be probed in bringing a new environmental technology to market, especially with existing powerful incumbents.
- The project will inform thinking on societal governance of new technologies, particularly relating to the support given to socio-technical niche experiments.

Thank you