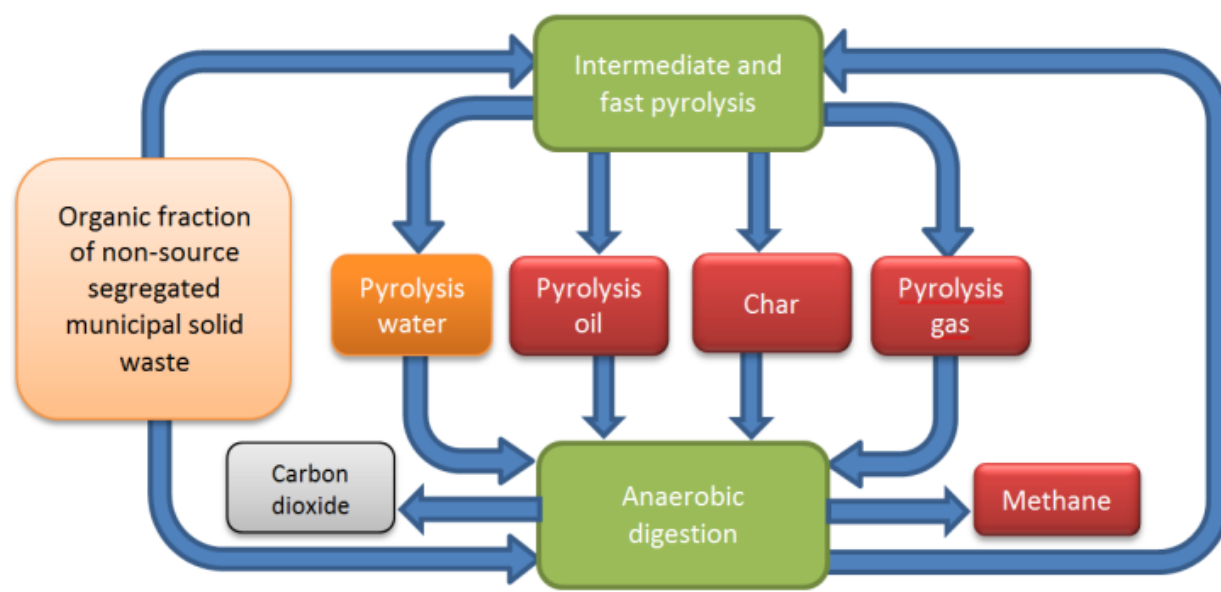




SUPERGEN - Increasing energy yield from the integration of anaerobic digestion and pyrolysis

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Waste and mixed biomass sources are difficult to process into usable fuel products, and the key research challenges therefore lie in developing technologies to provide second generation biofuels from these waste sources. The vision for the research is to develop a synergy between biological (AD) and thermal (intermediate and fast pyrolysis) conversion processes in which the overall net energy yield from waste biomass can be improved, producing energy carriers that are both storable and transportable. These gains can be achieved as the thermal process allows access to lignin-bound components within the biomass which are otherwise unavailable for anaerobic biological conversion. In return, biological system can process the lower carbon chain molecules in pyrolysis oils and in the aqueous fraction to produce a fuel gas, thus improving the value of the liquid fuel fraction. The solid char also has potential for use as an energy carrier as well as other value-added uses.



The vision includes proving that this hybrid approach can provide a sustainable and societally acceptable means of recovering value from the non-source segregated organic fraction of municipal solid waste (MSW). This waste fraction currently poses the greatest challenge to the UK Government in terms of the requirement for diversion of organic materials generated by society, industry and commerce from landfill: whilst it also offers the potential to contribute significantly to renewable energy targets and to the offset of carbon emissions. This project is therefore closely aligned to the aims of the SUPERGEN call 'Challenges in Bioenergy Technologies' and also to several areas within the RCUK research portfolio on energy, bioenergy and living with environmental change.

The overall aim of the project is to improve the overall net energy yield obtained from residual municipal solid waste, through a combination of thermal pyrolysis and anaerobic digestion. The research will develop understanding of each process individually and will stimulate a new understanding of the processing requirements to develop a synergy between the two technologies (intermediate pyrolysis and anaerobic digestion (AD)). A greater understanding will be achieved for the digestion of oil products, which is currently an area of developing AD research. Advances in the analysis of microbial populations will also be achieved through this project. Collaboratory work packages will analyse the energy balances of these two processes individually and as a synergy, which will later be used to advise future research and commercial application of the work. These themes are also reflected in the socio-economics of the project, ensuring potential users of the technology have the opportunity to address their questions regarding the synergy.



Objectives

The SUPERGEN project is aimed at developing a beneficial synergy between anaerobic digestion (AD) and pyrolysis for the processing of non-source segregated organic fraction of municipal solid waste (MSW). The objectives are:

- To determine the optimal processing parameters for intermediate pyrolysis of MSW fractions and their effect on the quantity and composition of the char, oil, water and gaseous products produced.
- To establish baseline energy production potentials of MSW fractions and the different pyrolysis products produced, as either single or co-digested substrates for AD.
- To measure the influences of different pyrolysis products produced under different conditions on anaerobic digestion systems in relation to performance and stability parameters.

- To determine the potential of pyrolysis waters produced from intermediate and fast pyrolysis in AD.
- Quantify the effect of intermediate pyrolysis gases and vapours introduction directly into mesophilic and thermophilic AD systems.
- Anaerobic digestion of intermediate pyrolysis oil using high rate immobilised cell anaerobic digesters for rapid conversion, with an assessment of the specific microbial consortia and the kinetic limitations to the process. The incorporation of char into AD may also be considered, depending on the composition analyses of char relating to the suitability for AD (for example mercury content).
- To evaluate the above combinations of thermal and biochemical conversion for net energy gains or losses compared to energy gains or losses from individual process streams and conventional technology. Flow charts and energy balance modelling of process integration techniques will be used to lead to likely favourable routes and use this information to drive experimental design and data collection.
- Investigate the social, market and regulatory aspects of each individual technology, the potential benefits or drawbacks of integrating the technologies and the options for achieving this. This project will identify the institutional drivers and barriers to this synergy, including perceptions of stakeholder, market and civil society perceptions.

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