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High value uses of waste methane from landfill and biogas methane from anaerobic digestion

Two of the greatest challenges facing industry and society are the future sustainable production of chemicals and fuels from non-food resources while at the same time reducing GHG emissions. To date, the focus has been on the use of lignocellulosic biomass feedstocks, which is reliant on an energy intensive pre-treatment step, and thereafter, the addition of costly exogenous hydrolytic enzymes. An exciting alternative is to use waste gases as the feedstock. Gas fermenting microbes can grow on C1 compounds, such as methane (CH<sub>4</sub>) derived from non-food sources. Capturing waste methane released from landfill, anaerobic digestion, fossil fuel extraction and the stranded gas associated with shale gas, then fermentation with methane utilising bacteria to make useful chemicals and fuels will lead to significant benefits to the environment and society.

The concept of sustainable bioprocesses is now very much at the heart of the UK bioeconomy. This project represents a part of a much bigger concept, but the impact of its aim will be considerable if it can be shown that methanotrophic bacteria are able to grow on raw biogas and landfill gas. In this proposal, we will address the scientific and technical challenges necessary to develop the initial steps of a sustainable bioprocess to produce valuable biomass/animal-feed and chemical (PHB) through the microbial fermentation of methane. Methanotrophs oxidize methane at ambient temperatures and pressures and are therefore attractive systems for methane-based bioconversions. Down the road, those strains that are amenable to DNA transfer may be engineered to produce industrially useful chemicals, including derivatised polymers based on the already produced PHB. PHB is the key building block for making biodegradable plastics, which is ideal for fruit and vegetable packaging.

The integrated approach to supply of food, packaging and energy production are key aspects to the success of urban living in a modern society. We also think that there will be opportunities for improved agricultural productivity in rural areas too, by the better use of biological resources that are available. Use of these processes in an integrated way without compromising the environment as a whole.