In November 1776, Alessandro Volta performed his classic experiment disturbing the sediment of a shallow lake, collecting the gas and demonstrating that this gas was flammable. Ever since, scientists and engineers have worked at understanding this complex anaerobic biological process and harvesting the valuable methane gas produced during anaerobic decomposition. Two lines of exploitation have developed mainly during the last century: the use of anaerobic digestion for stabilization of sewage sludge, and biogas production from animal manure and/or household waste. Lately, the emphasis has been on the hygienic benefit of anaerobic treatment and its effect on pathogens or other infectious elements. The importance of producing a safe effluent suitable for recirculation to agricultural land has become a task just as important as producing the maximum yield of biogas from a given type of waste. Therefore, anaerobic digestion at elevated temperatures has become the main area of interest and has been growing during the last few years.

Anaerobic digestion demands the concerted action of many groups of microbes each performing their special role in the overall degradation process. Both Bacteria and Archaea are involved in the anaerobic process while the importance, if any, of eukaryotic microorganisms outside the rumen environment is still unknown. The basic understanding of the dynamics of the complex microflora was elucidated during the latter part of the last century where the concept of inter-species hydrogen transfer was introduced and tested. The isolation of syntrophic bacteria specialized in oxidation of intermediates such as volatile fatty acids gave strength to the theories. Lately the use of molecular techniques has provided tools for studying the microflora during the biomethanation process in situ. However, until now the main focus has been on probing the dynamic changes of specific groups of microorganisms in anaerobic bioreactors and less emphasis has been devoted to evaluating the specific activities of the different groups of microbes during biomethanation.

Anaerobic digestion of waste has been implemented throughout the world for treatment of wastewater, manure and solid waste and most countries have scientists, engineers and companies engaged in various aspects of this technology. Even though the implementation of anaerobic digestion has moved out of the experimental phase, there is still plenty of room for improvements. The basic understanding of the granulation process, the basis for the immobilization of anaerobic microbes to each other without support material in UASB reactors, is still lacking. Like any other bioprocess, anaerobic digestion needs further control and regulation for optimization.

Besides treatment of waste, anaerobic digestion possesses a major potential for adding value to other biomass converting processes such as gasification, bioethanol or hydrogen from ligno-cellulosic materials. Conversion of ligno-cellulosic biomass will often leave a large fraction of the raw material untouched which will be a burden for the over-all economy of the process and will demand further treatment. Anaerobic digestion will on the other hand be capable of converting the residues from the primary conversion into valuable methane, which will decrease the cost and the environmental burden of the primary production.