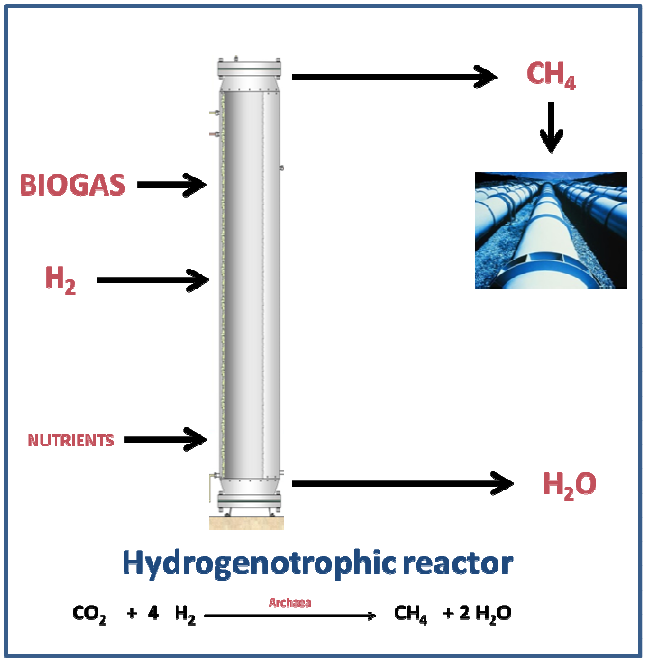
BIOGAS UPGRADING BY BIOLOGICAL CONVERSION OF CO_2 AND H_2 TO CH_4

Principal Investigators: Fernando Fdz-Polando & Israel Díaz

Biogas has become one of the main sources of renewable energy in the EU with a production of 12 Mt of equivalent oil in 2012, showing an annual increase higher than 12% during the last 15 years. Currently, the main use of biogas is the combined production of heat and power in CHP plants; however, there are some factors that are leading to change this scenario. The low efficiency of the combustion due to the presence of carbon dioxide (25-50%), the reduction of feed-in tariffs in electricity from biogas and the political instabilities in natural gas supply in Europe are behind the huge expansion of biogas upgrading plants in the continent. Upgraded biogas can be used as vehicle fuel, injected in the natural gas grid or liquefied like natural gas.

When upgrading biogas, only physical/chemical technologies (i.e.: absorption, adsorption and membranes) are employed at commercial scale despites the high operating costs and disposal problems of these alternatives.



This project aims to develop a biological alternative that transforms CO_2 to CH_4, thus creating added value from CO_2, while minimizing disposal problems. The process occurs in a bioreactor containing an adapted archaeal community to which biogas and H_2 are added so that H_2 and CO_2 are transformed to CH_4 by the action hydrogenotrophic archaeas (Fig. 1).

H_2 utilization seems an attractive possibility since it is being proposed as a source of energy accumulation from renewable energies to equilibrate energy demand picks from consumers and excessive electricity generation during low-demand periods. However, actual technology cannot afford properly direct storage & use of H_2 while employment and transport- grids of CH_4 are well implemented in Europe.

The project presents several challenges to overcome and those will be the specific objectives of the research:

- Low H_2 solubility in water. H_2 is even more hydrophobic than CH_4 what requires special bioreactor design and operation that allows a high transfer rate of H_2 from the gas phase to the liquid phase so that methanogenic archaeas employ it.
- Develop a methanogenic community in the bioreactor. Only lab-scale bioreactors have worked under the sole source of H_2 and CO_2 as substrates so a specific methanogenic community must be developed from inoculum in our pilot-scale bioreactor.
- Upgraded biogas must meet the requirements for grid injection.