FM Journals
Frontiers Journal of Renewable energy

Comparison of different system layouts to generate a substitute of natural gas from biomass and electrolytic hydrogen

Giuseppe Spazzafumo, University of Cassino and Southern Lazio, Italy

Abstract

Energy storage from renewable sources is maybe the main issues for the energy sector. Hydrogen seems to be the more compact, flexible and clean solution. However a complete replacement of fossil fuels with hydrogen will probably require some decades. Therefore a bridge solution which concentrates investments on renewable hydrogen production is desirable.

A first solution could be the direct injection of hydrogen into the existing natural gas pipeline. A further way to increase the need for renewable hydrogen bypassing the problem of its distribution is the production of a substitute of natural gas.

If the power excess is due to lack of demand, biomass could be gasified with electrolytic hydrogen to generate directly a gas rich in methane. After water condensation such a gas could be fed to a methanation process to convert almost completely carbon in methane. Hydrogasification and methanation are exothermic processes: the heat recoverable could be used for thermal application or to supply extra power to the electrolyser.

If the power excess is due to problems of grid stability, biomass could be gasified with electrolytic oxygen and the syngas could be fed, together with other electrolytic oxygen, to a power unit. The power units considered are steam and gas turbines, internal combustion engines and high temperature fuel cells. The exhaust gas is composed almost exclusively by CO_2 and H_2O. After water condensation, CO_2 could be fed together electrolytic hydrogen to a methanation process to obtain the substitute of natural gas. Heat from exhaust gas cooling and from methanation process could be recovered to generate power suitable for imput into the grid.

In all cases the input is low value energy (biomass and electric power which cannot be absorbed by the grid) and the output is high value energy (substitute of natural gas and eventually stable electric power).

Biography

Graduated (Mechanical Engineering, 1984), University of Pisa. PhD (Energetics, 1988), University of Pisa. Associate Professor at University of Cassino and Southern Lazio (Italy) in the field of Systems for energy and environment. Author of more than 80 scientific papers. Co-author with Prof. Bent Sørensen of "Hydrogen and Fuel Cells - Emerging Technologies and Applications" (Third Edition). Owner of 4 Italian patents. Invited speaker at several international conferences and round tables related to the hydrogen energy sector. Guest editor of some Special Issues of the International Journal of Hydrogen Energy. Member of Scientific Committees of several Italian and international conferences and chairman of technical sessions. Coordinator of HYPOTHESIS (HYdrogen POwer THeoretical and Engineering Solution International Symposium) series and chairman of its Scientific Committee. Member of the Board of Directors of the International Association for Hydrogen Energy since 1999. President of IAHE Hydrogen Energy Systems Division. IAHE Rudolph A. Erren Award.