LIFE CYCLE GREENHOUSE EMISSIONS OF COMPRESSED NATURAL GAS-HYDROGEN MIXTURES FOR TRANSPORTATION IN ARGENTINA

Pablo Martínez (1), Laura Dawidowski (2), Darío Gómez (2), Daniel Pasquevich (1)

(1) Instituto de Energía y Desarrollo Sustentable, CNEA. CONICET, Av. Del Libertador 8250, Ciudad Autónoma de Buenos Aires, C1429BNP, Argentina. pmartinez@cnea.gov.ar, pasquev@cab.cne.gov.ar

(2) Centro Atómico Constituyentes. CNEA., Av. Gral Paz 1499, San Martín, Pcia. de Buenos Aires, 1650, Argentina. dgomez@cnea.gov.ar, dawidows@cnea.gov.ar

Keywords: CNG-H2, fuel, life cycle, SMR, electrolysis

The main objective of this work is to develop a model for assess the life cycle greenhouse emissions of compressed natural gas-hydrogen (CNG-H2) mixtures used for transportation in Argentina. In order to assess the overall fuel life cycle, this works conducts a well to wheel analysis for different hydrogen generation and distribution options. The combustion stage in road vehicles is modeled using the COPERT IV model. Hydrogen generation options include classical steam methane reforming (SMR) and electrolysis in central plants and distributed facilities at the refueling stations. Centralized hydrogen generation by electrolysis using electricity generated in solar photovoltaic plants, wind farms and nuclear plants are also considered. Hydrogen distribution options include gas pipeline and refrigerated truck transportation for liquefied hydrogen.

The life cycle assessment is carried out quantifying fuel and electricity consumption and greenhouse gas emissions in each stage of the fuel life cycle. Greenhouse emissions of the national electricity generation system are considered. Life cycle stages consider two types of feedstock: natural gas and hydrogen. For natural gas, life cycle stages include: extraction, pipeline transport and intermediate compression. For hydrogen, life cycle stages depend on the generation step. Due to lack of experimental data, the greenhouse emissions for CNG-H2 mixture combustion in road vehicles are modeled as a fraction of emissions of pure CNG road vehicles. The emissions inventory is made using literature available emission factors for CO2, CH4 and N2O of each life cycle stage considered. A distance of 1 Km city transport had been chosen as the functional unit for the study. As a result the life cycle greenhouse emissions are expressed in g CO2 eq. /Km for each fuel pathway considered. As a general trend the life cycle greenhouse emissions for vehicles using CNG-H2 (90-10) mixture are higher than those for pure CNG vehicles.