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A short-cut model for predicting biomethane availability after biogas Upgrading

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ABSTRACT

Biomethane increasingly grows in importance in the bioenergy sector, as it is a renewable energy source that promotes waste recovery and GHG (greenhouse gases) reduction. In Brazil, the legal framework for biogas and biomethane is being developed, especially in the State of S~ao Paulo. However, many of the final uses to biomethane require an upgrading and cleaning process, to remove contaminants such as H2S and CO2. Facing the great number of technological options to promote biogas upgrading and cleaning so far, policymakers and energy planners might lack the tools to accurately and readily estimate biomethane potentials to comply with a given biomethane quality standard. Our main objective thus is to propose a short-cut, mass balance-based model to predict biomethane availability after promoting a biogas cleaning and upgrading process, regardless of the source of organic feedstock. The model development results in the ratio of biogas to biomethane production and other relevant parameters regarding biomethane use, such as its LHV. The correlation with data from the literature shows that the model has a satisfactory prediction, even when using upgrading technologies that have high methane losses. The model was applied to a case study of upgrading biogas from vinasse from ethanol production in the state of São Paulo; it aided in choosing the upgrading technology for biogas focusing on biomethane injection in the natural gas pipeline and in replacing diesel oil in trucks and heavy-duty machinery in the ethanol plant. Using the proposed model, it was estimated that 1.975x109 Nm3/y of biomethane could be produced, supplying 16.6% of the NG consumption in the State of S~ao Paulo and making it possible to displace the entire diesel oil consumption in ethanol mills. The use of biomethane in the ethanol plants of São Paulo would avoid 3.965x106 tCO2eq of GHG emissions, which represents 5.48% of the GHG emissions of the state in 2016.