Energetical and environmental balance of biogas as biofuel for mobile application

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Abstract

The fossil fuel resources are decreasing and many researches are looking for alternative fuels to comply with transportation need while reducing the environmental impact of this sector. Inside the transport activity sector, off road vehicles and machines used for agriculture needs a small, but vital energy amount of around 2 Mtoe in France. The anaerobic digestion of rural wastes could roughly cover the machine needs. This paper aims to study environmental and energetic interest of this short power supply path. An ideal biogas production system is built up from average characteristic of current rural biogas plants in France. Pollutant emission, energy demand and production are assessed for various scenario for producing methane for dual fuel engine. Life Cycle Assessment (LCA) is used to look for the environmental impact of the dual fuelled agricultural machines, compared to the diesel ones. The energy balance is always in favour of biogas fuel, whereas LCA energy indicators indicates a benefit for the biogas path. The gap is related to the way to handle with the biomass energy input, that is not taken into account in conventional biofuel LCA. Then, a carbon balance is presented to discuss the impact of biogas fuel on the climate change. Dual fuelled engine were found interesting for their small climate change impact. But we also show how the biogenic carbon assumption and the allocation choice for the avoided methane emissions of digestion path are crucial to quantify CO2 saving. Other environmental issues of biogas fuel were examined. Results indicates that high management and green electricity are the keypoint for a sustainable biogas fuel, specially in regards with the impact on respiratory diseases from inorganic species. At the end, biofuel environmental damages are reduced if energy needs during production are covered by themselves production. This implies that agricultural equipments used in biofuel path should use biofuels with higher substitution rate.