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The Impacts of Ethanol/Gasoline Equivalence Ratio on the Sustainability of Brazilian Sugarcane Ethanol

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In the Brazilian context, the flex fuel vehicles that can operate with gasoline (with 18 to 25% ethanol blend), hydrous ethanol or any mixture of these two basic Otto cycle engine fuels represented 62% of the light duty fleet in January 2014. All filling stations offer both fuels all over the country and the choice of drivers is normally based on the relative prices of the fuels: the equivalence ratio is assumed as 0.70 L of gasoline (E25) to 1 L of ethanol, based on their energy contents.

The flex fuel engines in Brazil are basically gasoline models modified to accept ethanol as fuel, but taking little advantage of the better characteristics of the latter compared with the former (higher Octane Number and latent heat of evaporation, faster and cooler burning and generating more mols of combustion gases per mol of burned fuel). The small size of the ethanol (neat or flex) car fleet worldwide is probably the most important condition still limiting the advances with this fuel. Brazil and USA are the countries that should take the lead in this development due to the importance of ethanol in the Brazilian economy and the blend wall problem in USA.

However, besides the impact of the ethanol/gasoline equivalence ratio on the competitiveness of the biofuel, there are several other aspects equally important for the sustainability of ethanol that are normally overlooked, especially the land demand for feedstock production. Associated with less land use for feedstock production there will be less greenhouse gas emissions (soil emissions of N₂O and methane, less fossil fuels use in fertilizer production and application, in soil preparation and management in general, and less land use change derived emissions), less impacts on water availability and quality, biodiversity and social impacts related to land tenure and food security.

This work is aimed at evaluating some the above impacts with improvements in the ethanol/gasoline equivalence ratio, without going deep in the technologies needed, but focusing on the main sustainability aspects based on the Brazilian sugarcane ethanol production model. The objective is to call the attention of policy makers and researchers to the important contribution that improvements in the ethanol/gasoline equivalence ratio will bring to the sustainability of our main biofuel.