Assessing the potential for ethanol-fueled power generation as a flexible dispatchable option for firming intermittent sources in Brazil

Alexandre Koberle[1], Joana Portugal, David Castelo Branco, Alexandre S. Szklo, André FP Lucena, Roberto Schaeffer

Energy Planning Program, Graduate School of Engineering, Universidade Federal do Rio de Janeiro, Centro de Tecnologia, Bloco C, Sala 211 CidadeUniversitária, Ilha do Fundão, 21941-972 Rio de Janeiro, RJ, Brazil

alexkoberle@gmail.com, portugal.pereira@ppe.ufrj.br, davidcbranco@gmail.com, szklo@ppe.ufrj.br, andrelucena@ppe.ufrj.br, roberto@ppe.ufrj.br

--Recibido para revisión 2014, aceptado Feb 28 2015, versión final Feb 28 2015

***Abstract*— The greenhouse gas (GHG) mitigation potential from electric vehicles (EVs) depends on what type of electricity generation capacity is deployed to supply the additional demand created by EVs. In Brazil, in addition to an increase in electricity demand, fleet electrification would mean a reduction in the demand for ethanol for light-duty vehicles (LDVs), which could then be used to power flexible and dispatchable stationary generators. Ethanol generation would provide this service emitting limited GHGs, while, at the same time, improving the reliability of variable renewable generation. Study results show a trend to a more carbon-intensive configuration of the Brazilian electricity matrix, with a large increase in coal power by 2050. This could negate the mitigation effects of LDV fleet electrification. Conversely, the cheapest option for BioCCS in Brazil is the capture of the almost pure stream of CO_2 during the fermentation phase of ethanol production. Under more stringent emissions mitigation scenarios, this option can be a significant contributor to net negative emissions, with model results showing large quantities of ethanol introduced due to the lower carbon capture cost, potentially leading to excess ethanol in the market. In this context, this study aims to assess the techno-economic potential of ethanol stationary power generation as a dispatchable backup for intermittent power sources. Some of the technologies examined include dual-fuel Diesel engines and aeroderivative turbines powered by ethanol, and their fuel consumption is matched to regional ethanol production capacity to estimate the potential for electricity generation.**

***Keywords*—ethanol, power generation, firming capacity, Brazil.**

1 Introduction

The electrification of the vehicle fleet is an important option for decarbonizing the transport sector [1]. However, the greenhouse gas (GHG) mitigation potential from electric vehicles (EVs) depends on what type of electricity generation capacity is deployed to supply the additional demand created by EVs. In Brazil, in addition to an increase in electricity demand, this switch would mean a reduction in the demand for ethanol for light-duty vehicles (LDVs), which could then be used to power flexible and dispatchable stationary generators. Ethanol generation would provide this service emitting limited GHGs, while, at the same time, improving the reliability of variable renewable generation, thereby increasing the mitigation potential of renewable sources. Moreover, the sugar-ethanol sector has recently suffered from shrinking demand that has forced the closure of several plants since 2012, and remaining plants are operating with a considerable idle capacity [2]–[4]. In the short term, the low cost of ethanol has caused many distilleries to close or to shift their production in favor of sugar instead of ethanol.

Although Brazil has one of the cleanest electricity matrices in the world today, study results show a trend to a more carbon-intensive configuration, with a large increase in coal power deployment by 2050 [5], [6]. This could

[1] Corresponding author: alexkoberle@gmail.com - +55-11-94525-5454