Long term diffusion dynamics of alternative fuel vehicles in Brazil

Abstract

Alternative fuel vehicles (AFV) are a promising alternative to reduce greenhouse gas emissions in the transportation sector and ultimately, to contribute to a more sustainable society. Within the current commitments of the Brazilian Government to international agreements, in terms of emissions reductions by 2030, some new policies have been implemented, in order to incentivize the diffusion of AFV in the country. Yet, how will these policies contribute to the goal of increasing its fleet in the long-term, how long will it take and what are the differences (if any) among the policies, in terms of their effectiveness, are questions that remain unanswered. In this sense, the main aim of this paper is to investigate the impact of public policies in the long-term diffusion dynamics of AFV in Brazil. In order to do so, a system dynamics model is developed, based on the Generalized Bass Diffusion model, the Cobb-Douglas function and the learning curve theory. The model is used to test four different policies and some uncertainties related to: (i) the exemption of the import duty; (ii) the reduction of the motor vehicle property tax; (iii) the exemption of the tax on manufacturing goods; and (iv) a banning regulation for internal combustion engine vehicles in the long-term. The results highlight the importance of the current incentive policies but at the same time call for reinforcing efforts in order to increase the AFV fleet to significant values by 2030. Conversely, the banning regulation obtains a higher diffusion rate, but only achieves significant values by 2060. The paper concludes by showing the main contributions and policy implications of the effectiveness of the four policies studied as well as some suggestions for future work.

Key-words: Hybrid vehicles, electric vehicles, system dynamics, technology diffusion, Bass diffusion model, future-oriented technology analysis.

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1 List of Abbreviations: Alternative Fuel Vehicle (AFV); Bass Diffusion Model (BM); Brazilian National Association of Motor Vehicle Manufacturers (ANFAVEA); Brazilian Institute of Geography and Statistics (IBGE); Conventional Cars (CC); Electric Vehicles (EVs); Exploratory Modeling Analysis (EMA); Future-oriented Technology Analysis (FTA); Generalized Bass Diffusion Model (GBM); Hydrogen Fuel Cell Vehicle (HFCV); Import Duty (ID); Motor Vehicle Property Tax (MVPT); Sustainable Development Goals (SDG); System Dynamics (SD); Tax on Manufacturing Goods (TMG).
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