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Understanding The Future Metabolism of Ecuador's Energy System Using MuSIASEM

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The rapid and unavoidable change of the countries' energy systems composition is a matter of global interest in various science fields and the public policymakers. Several institutions dedicated to conducting behavior analysis in the systems of energy forecast different future scenarios regarding the composition of the final energy consumption on a global scale in the short term. These differences in the results are due to the criteria that organizations and governments take into consideration to forecast the scenarios. The lack of an established methodology to conduct these types of assessments creates several forecasts and different understandings of the energy system. In Ecuador, the energy system has not been completely evaluated and the results of the energy forecast of some undertaken studies differ from each other in their final scenario making it difficult to know the health of the system and anticipate the preparation of public policies. Therefore, this work aims to develop a methodology based on MuSIASEM grammar to build future energy scenarios based on the understanding of the scarcity of primary energy sources and the dynamics of the end-use energy in the different compartments of socioeconomic systems, applied in the Ecuador system by 2035

The construction of the Ecuadorian energy system scenario is based on the structuration of the MuSIASEM grammar, in which the energy system elements and their relationship with the socioeconomic sectors are shown at different levels and scales.
Energy systems join functional (example: electricity production) and structural (example: thermal/hydraulic energy) subcategories within a metabolic route, so these make it possible to join two non-equivalent points of view of the metabolic pattern of a given society. For the generation of the accounting of flows (example: electricity/fuels) and funds (example: power capacity/ human activity). Moreover, within the energy grammar, it is necessary to take in mind the concepts of primary energy sources (PES), energy carriers (EC), energy systems (ES), and energy end uses (EU)

The 2035 energy demand for Ecuador indicates that it will exist an increase in the fuel and electricity metabolic rate. The increase will be from 2,6 to 4 MJ/h of fuel, and from 0 to 0,5 MJ/h of electricity for the Agriculture sector, from 7,4 and 11,3 MJ/h to 15 and 30 MJ/h of electricity and fuel respectively for the Building and Manufacturing sector, from 0 to 2 MJ/h of electricity

and from 309 to 300 MJ/h of fuel for the Transport sector, from 4,5 to 5 MJ/h of electricity and from 4 to 6 MJ/h of fuel for the Service and Government sector, from 0,2 to 0,3 MJ/h in electricity and from 0,3 to 0,5 MJ/h of fuels for the Households sector. Finally, the sector that concentrates the greater consumption by work hour will be the Energy sector, in which case the energetic intensity increases from 114,7 to 115 MJ/h of electricity and from 750,4 to 810 MJ/h of fuel. The electricity generation system shows a gross energy increase of 28.083 GWH produced in 2017 to 45.463 GWH by 2035.

The scenario considers the production mix extension to hydro-power and renewable energies while the thermal generation is reduced from 26% to 17% from the total generation of electricity. This allows maintaining the CO2 emissions at the year base levels of 6.477 KTon CO2.

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