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THE ENVIRONMENTAL ANALYSIS OF ROAD TRANSPORT: SUGARCANE ETHANOL GASOLINE BLEND FLEX-FUEL VS. BATTERY ELECTRIC VEHICLES IN ECUADOR

PROBLEM STATEMENT

The road transportation sector in Ecuador is characterized by its use of fossil fuels as the main source of energy. According to INEC, the transportation sector emitted 18.5 million tons of GHG, which correspond to 42% of the emissions from all sectors in 2016.

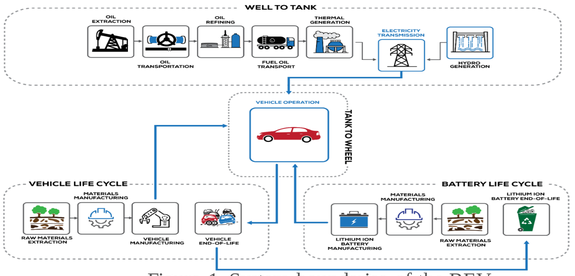

Figure 1. System boundaries of the BEV

OBJECTIVE

Compare the environmental performance of two different vehicle powertrains (BEV and ICEFFV) and their respective energy carrier (electricity and different ethanol-gasoline blends) through a life cycle assessment in Ecuador (Figure 1 and Figure 2).

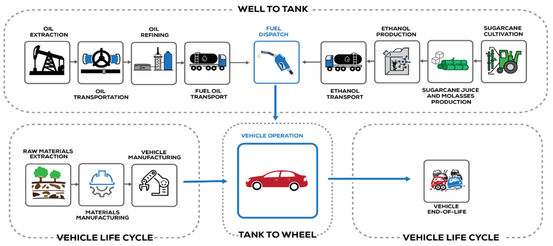

Figure 2. System boundaries of the ICEFFV

PROPOSAL

The two vehicles were selected for comparison based on their similar mass and power ratio. The flex-fuel vehicle has a mass of 1561 kg and an engine power of 132 kW; the battery electric vehicle has a mass of 1544 kg and an engine power of 112 kW. Current, future and single resources scenarios were modeled for both powertrains (Table 1).

Functional unit: 1 km
Minimum energy consumption
Lifetime: 150,000 km

Single resources scenarios

Same escenarios for E15 and E85

S1: Current trends are considered;
S2: Increased hydroelectricity capacity;
S3: uses the maximum technical and economic potential of hydroelectricity

Scenarios	Vector/carrier description	Ethanol-Gasoline blend	Electricity mix	Renewable - fossil share of electricity mix
BEV mix 2018	Electricity	n.a.	2018	83% - 17%
BEV S1-2030	Electricity	n.a.	S1-2030	65% - 35%
BEV S2-2030	Electricity	n.a.	S2-2030	75% - 25%
BEV S3-2030	Electricity	n.a.	S3-2030	76% - 24%
BEV 100% Hydro	Electricity	n.a.	100% hydropower	100% - 0%
BEV 100% FO-ICE	Electricity	n.a.	100% FO-ICE	0% - 100%
BEV 100% NG-CC	Electricity	n.a.	100% NG-CC	0% - 100%
E5 (avg) EC CO_2 (71 t/ha)	Ethanol-gasoline blend.	5% ethanol-95% gasoline	2018 average	83% - 17%
E5 (mgl) EC CO_2	Ethanol-gasoline blend	5% ethanol-95% gasoline	2018 marginal	83% - 17%
E5 (no disp.) EC CO_2	Ethanol-gasoline blend	5% ethanol-95% gasoline	No displacement	n.a.
E5 (avg) EC CO_2	Ethanol-gasoline blend	5% ethanol-95% gasoline	2018 average	83% - 17%

Table 1. Proposed scenarios for the two analyzed powertrains with their respective energy carrier

RESULTS

Figure 3. Environmental impact results for the analyzed vehicles based on current scenarios

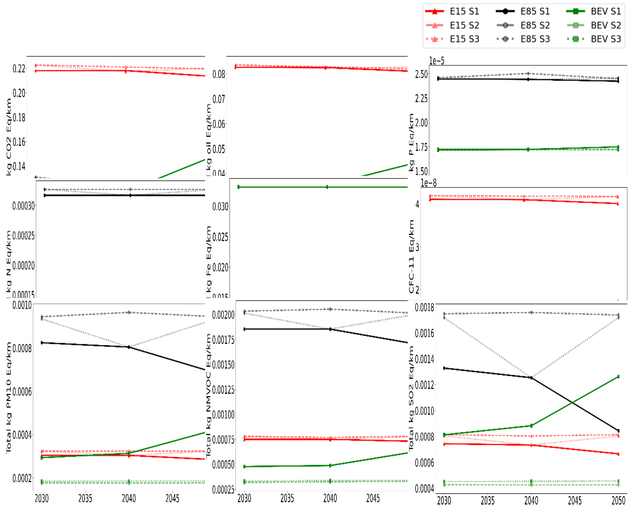

Figure 4. Environmental impact results for the analyzed vehicles based on future scenarios

CONCLUSIONS

- Vehicles with high efficiency using ethanol-gasoline blends (E85) have lower environmental impacts when GWP and FDP are evaluated.
- Ecuador must promote policies and technical instruments to avoid charging electric vehicles with marginal fossil electricity.
- In the future, it is important to maintain the generation of electricity with renewable sources for a better environmental performance of electric vehicles.