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E-Mobility versus synthetic fuels in economically developing nations' road transport

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Who are we?

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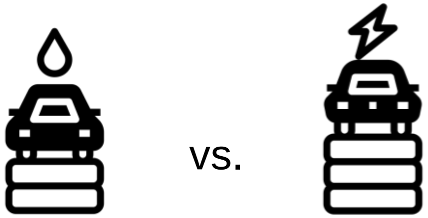
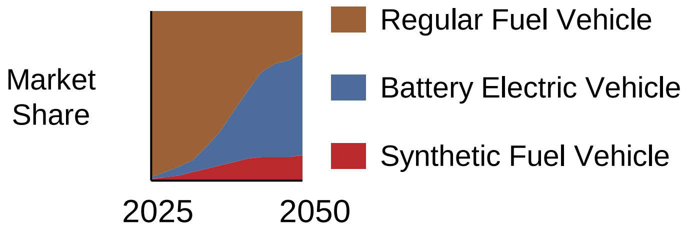
CSFM
Center for Sustainable Future Mobility

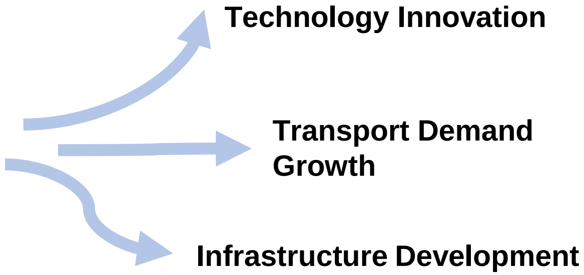
ETH Mobility Initiative



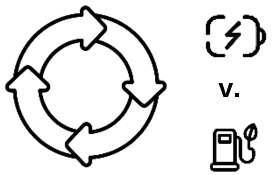
Which technology(s)?



How quickly?



Under which policy narratives and development scenarios?



What does this mean for lifecycle environmental impacts?

Case & Scope

- Africa (continent at large, select focus countries)

nature energy

Perspective | Published: 24 October 2022

Africa needs context-relevant evidence to shape its clean energy future

Science

EXPERT VOICES

Mapping Africa's EV revolution

ROSE M. MUTISO Authors Info & Affiliations

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- Passenger road transport
  - Segment: 2-wheelers, 4-wheelers, mini-bus
  - Technology: ICEs (gasoline, diesel, synthetic fuel), BEVs
  - Sale Status: New and used
  - Timeframe: through 2040/2045

Research Questions & Methodology

Research Questions

- How quickly can Africa transition to low-carbon personal road transport and what are the key barriers?
- What role can battery electric vehicles or synthetic fuels play in decarbonizing passenger road transport in developing countries?
- How do new and used vehicle import dynamics affect the transition?

Methods

- [Step 1] Vehicle total cost of ownership (TCO) analysis using Monte Carlo simulations
- [Step 2] System-dynamics numerical model focusing on 2nd-hand vehicle import flows and global vehicle cost and policy dynamics
- Qualitative interviews, case studies, field work

Step 1 | Total cost of ownership and lifecycle emissions analysis

Societal Perspective

- Eliminate distortions, i.e. no policy (taxes, fees subsidies, etc.)

Early Results

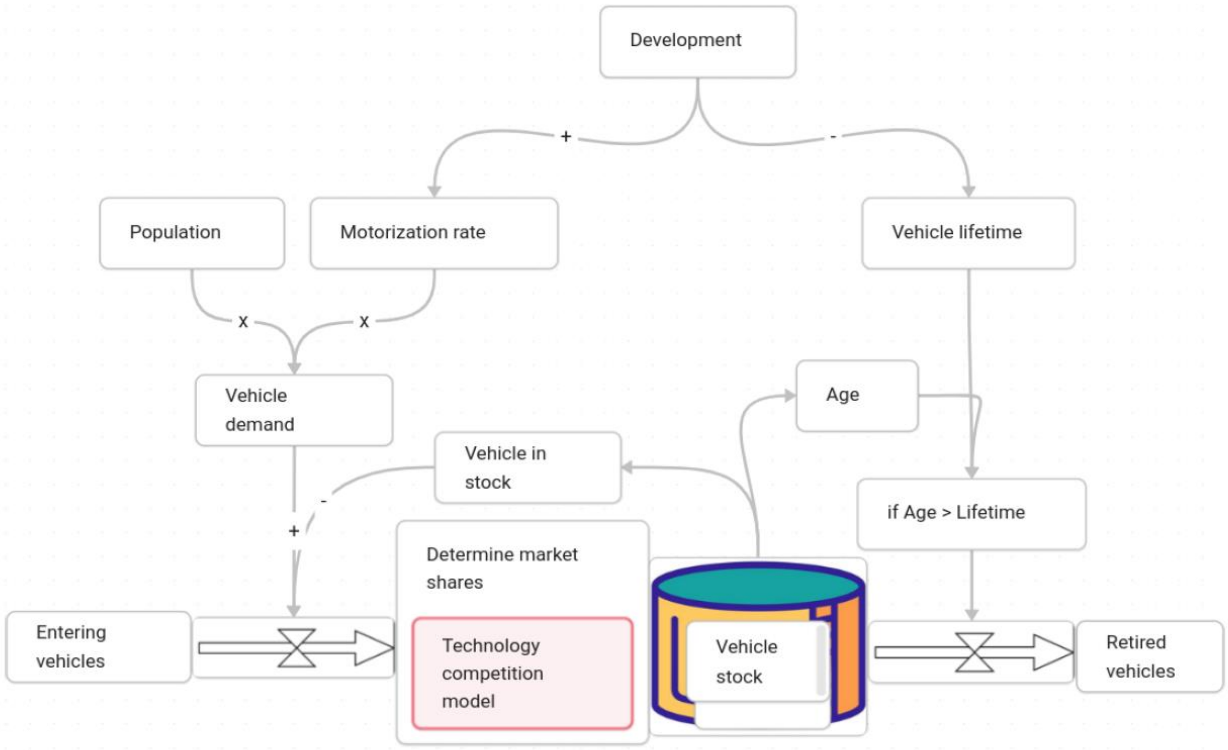
- There are substantial economic and health benefits (welfare gains) to transitioning to EVs in Africa
- Certain applications fare better/worse than others (i.e. 2-wheeler transition to BEVs is clear, less so for small cars)
- Financing is a hugely important factor for BEV competitiveness
- Charging cost (LCOC) is rather inconsequential
- Synthetic fuels do not make sense from a cost perspective after 2030 (except under high private financing conditions) and do not at all make sense from an emissions perspective

Step 2 | System dynamics numerical model
Overview of Focus Points

- Develop a **system dynamics stock-flow model** that projects technology shares of the vehicle fleet under different modelled scenarios in specific African countries

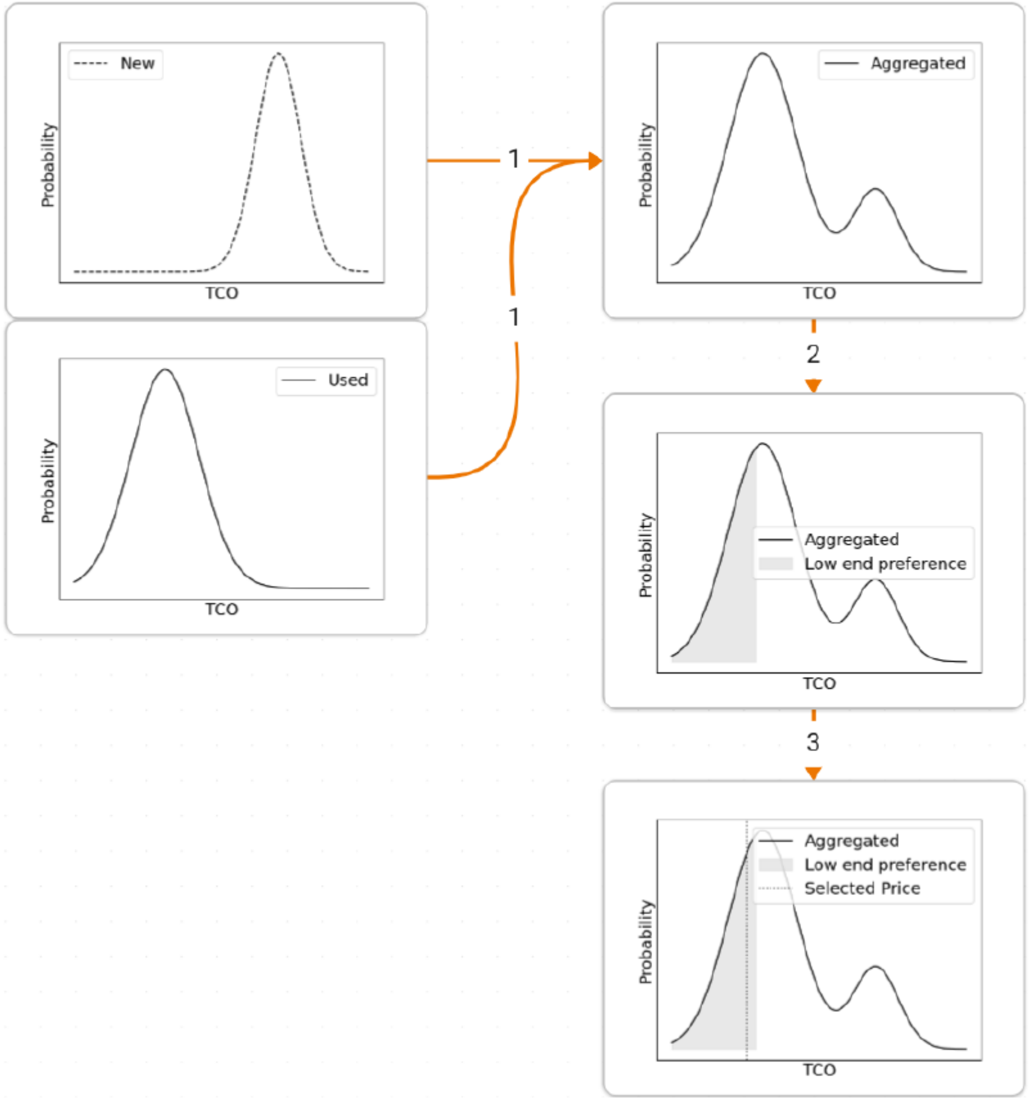
- Develop and evaluate well-defined **transition scenarios** for the African context (x4)

- Assess **impact of policy intervention,** both “local” and “global”, on EV adoption in Africa



Step 2 | System dynamics numerical model
Key Model Features

- Technology competition modelling:
  New vs. Used – ICE vs. BEV
  - Monte Carlo simulations where consumer "sees" price according to its probability of occurrence for each technology
  - Exogenously define shares of new vs. used vehicles (can we endogenize this? -> i.e. tie to development)
- Vehicle stock development
  - Inflow (demand) based on country-specific development (GDP growth) –> motorization rate
  - Outflow function of vehicle age distribution (scrappage curves)
- Elasticities:
  - Option to hold on to a vehicle ("eternal" repairs)
  - Segment switching



Step 2 | System dynamics numerical model

High-level Transition Scenarios & Policy Intervention

Focal points for transition scenarios

- Economic development (WACC, GDP/cap, lifetime, motorization rate)
- Vehicle import dynamics (new & used) “the dumping”
- Global technological development (cost, deployment)
- Oil price scenarios (IEA Scenario Projections)

Focal points for policy intervention

- “Local”
  - Subsidies, derisking
  - Bans, vehicle import age restrictions, forced retirement
- “Global”
  - EU ban on EV (battery) exports

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Thank you!

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