ELECTRIC MOBILITY INVESTMENT IN DEVELOPING COUNTRIES: EMERGING REGIONAL PATTERNS FROM CROSS-COUNTRY ANALYSES.

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Overview

On paper, many developing countries have made pledges to decarbonise and reduce GHG emissions. Nevertheless, decarbonisation is barely happening in many of them. Among other reasons, transport electrification with electric mobility, which is pivotal in the decarbonisation strategy of many developing countries, is beset by investment challenges on the demand and supply side. On the demand side, the lingering 'where will the money come from' challenge remains critical because the governments are financially constrained. On the supply side, investors remain unsure of which country to make electric mobility investments. This paper contributes to this academic and policy debate from the transport and power sector coupling context. We apply our conceptual framework to analyse some developing countries with wholesale power markets and wholesale and retail power markets. Then, we conduct cross-country analyses of fifteen countries to assess the possibility of emerging patterns in electric mobility investment solutions in the countries. We argue that regional or continental patterns may be emerging among some countries. We found that Latin American countries (Chile, Colombia, Argentina) appear to follow a pattern of investment in public transport electrification with electric buses, although the countries are at different stages of development. Romania, Poland, and Türkiye appear to follow an investment pattern in private electric vehicles. We found a pattern with low-cost two and three-wheelers in Central American countries (Nicaragua, Guatemala, and El Salvador). We recommend policies on electric mobility investment issues in developing countries.

Methods

We build upon insights from the conceptual framework developed in Arowolo and Perez (2023) and Arowolo and Perez (2024a) on the industrial organisation models to explain the contemporary state of electric utilities with the increasing impact of electric mobility in the context of decarbonisation and digitalisation**.** The models are (i.) full vertical integration plus peer-to-peer innovation with electric mobility (Model 1+); (ii.) wholesale market plus peer-to-peer innovation with electric mobility (Model 2+); (iii.) wholesale and retail market plus peer-to-peer innovation with electric mobility (Model 3+); (iv.) single buyer plus peer-to-peer innovation with electric mobility (Model 4+). We hypothesise the relationship between our proposed electric utilities industrial organisation models and how each model could be impacted by decarbonisation and digitalisation (Arowolo and Perez, 2024b). Then, we use the framework to identify and classify developing countries based on literature (Foster and Rana, 2020; de Halleux, 2020). We conduct case study analyses of the interaction of electric utilities and electric mobility in five developing countries (Ecuador, Peru, Nicaragua, Guatemala and El Salvador). Case studies are a good fit for analysing issues that cannot be easily studied through quantitative analysis. Case studies are also suitable when disaggregated data is unavailable for analysis (Nepal et al., 2018). Then, we conduct cross-country analyses of fifteen countries in this paper (including ten from our previous works).

Results

We find existing government policy support for the electric mobility market in Peru, Ecuador, Nicaragua, Guatemala, and El Salvador. The markets could also attract electric mobility investments, albeit low-cost investment solutions such as electric motorcycles, electric tuk-tuks, and refurbished or second-hand electric vehicles. These could provide some promising decarbonisation potentials, but the potential for digitalisation is still in its infancy in these countries. We find the following emerging pattern of electric mobility investments from our cross-country analyses of fifteen countries. Three Latin American countries - Chile, Colombia, and Argentina, appear to follow a pattern of attracting investment in public transport electrification with electric buses. The private electric vehicle market is developing in Eastern European countries - Poland, Romania, and Türkiye. In Central America, El Salvador, Guatemala, and Nicaragua are developing electric two and three wheelers. We could not substantiate any emerging pattern in the Asian and some Latin American countries analysed.

Conclusions

Many developing countries that made pledges to decarbonise and reduce GHG emissions are barely scratching the surface of their set goals. Transport electrification with electric mobility, which remains crucial in the decarbonisation strategy of many developing countries, is beset by investment challenges on the demand and supply

side. On the demand side, the governments are financially constrained to implement the solutions. On the supply side, investors remain unsure of which country to make electric mobility invest in. This paper contributes to this debate from the power and transport sector coupling context, focusing on developing countries with wholesale power markets and wholesale and retail power markets. We attempt to answer the central research question of identifying if there is a regional or continental pattern to electric mobility investment technology solutions in developing countries. We contribute to the extant literature in three significant ways. First, we argue that the threshold size effect of small power systems could also be influential in small transport systems (Jamasb, 2006; Besant-Jones, 2006). Second, with a cross-country analysis of fifteen countries with wholesale power markets and wholesale and retail power markets, we establish a notable investment pattern in some regions or continents. Third, we provide in-depth insights on electric mobility investment in developing countries in the power and transport sector coupling context. We offer the following policy recommendations for policymakers and potential investors interested in electric mobility investment issues in developing countries:

- Policymakers (demand-side)

Developing countries with wholesale and wholesale and retail power markets but small power and transport sectors may struggle to attract electric mobility investment without tailor-made policy interventions. Our analysis shows that Central American countries (Nicaragua, Guatemala, and El Salvador) have small power systems, buttressing the threshold size constraint in the literature. This effect means that competition will not produce the expected outcomes in fostering competition because of high transaction costs. This situation also influences the transport system and requires specific policy responses to attract investments. Therefore, policymakers could focus on carefully designed and context-specific solutions to spur electric mobility investments and market development in these countries.

A robust regulatory framework is required to implement public policy support schemes: In addition to the well-known government policy support schemes that are present in countries with wholesale power markets and wholesale and retail power markets, robust regulatory frameworks are crucial to implement (on paper) policy schemes, and to facilitate an enabling investment climate for potential investors.

- Potential investors (supply-side)

Emerging pattern of low-cost electric mobility solutions in countries with small power and transport sectors: These countries with wholesale power markets in Central America, such as Guatemala, El-Salvador, and Nicaragua, seem to be growing in the two- and three-electric wheelers and second-hand private electric vehicle markets.

Emerging pattern of private electric vehicles in Eastern Europe: Romania, Poland and Türkiye may follow the pattern with private electric vehicles and the deployment of charging infrastructure as observed in developed countries in Western Europe.

Emerging pattern of public electric bus electrification in Latin American countries with wholesale and retail power markets: There seems to be some emerging trend towards public electric buses in some Latin American countries (Chile, Colombia, and Argentina), although they are at different stages in their market development.

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