Kenya Transport-Energy Futures: building transport pathways to support climate-compatible

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Introduction

The Kenya Transport-Energy Futures (KTEF) project aims to develop decision support tools to assist policymakers at county, national and international scales in testing out credible futures of the transport-energy system given different policy and scenario pathways. KTEF is part of the UK FCDO-funded Climate Compatible Growth (CCG) research programme.

The future of the transport system, and that of the wider energy system in which it is enveloped, will determine Kenya's ability to meet its targets in economic development (Government of Kenya, 2008) and climate mitigation (Government of Kenya, 2021). These transport-energy futures are outcomes of a complex web of systems; they are driven by policy in the transport-energy sector and across the wider economy, and wider changes in society that cannot directly be controlled (including socio-economic changes, such as changes in a population's age distribution, and broader shifts in travel demand, such as a population's propensity for leisure travel).

In developing decision support tools, a strategic transport-energy systems model, the Transport Energy Air pollution Model (TEAM) (Brand et al., 2019b), has been adapted to the Kenyan case.

Re-introducing TEAM: Transport Energy Air pollution Model

TEAM is a strategic transport, energy, emissions and environmental impacts systems model, covering a range of transport-energy-environment issues from socio-economic and policy influences on energy demand reduction through to lifecycle carbon and local air pollutant emissions and external costs. It is built around exogenous and quantified scenarios, covering passenger and freight transport across all modes of transport (road, rail, shipping, air). It provides annual projections up to 2100, is technology rich with endogenous modelling of more than 1,200 vehicle technologies, and covers a wide range of output indicators, including travel demand, vehicle ownership and use, energy demand, life cycle emissions of 26 pollutants, environmental impacts, government tax revenues, and external costs. For more information on TEAM, see (Anable et al., 2012; Brand et al., 2017, 2019a, 2020).

TEAM quantifies the likely impact of policy pathways – given a background context – on transport system energy demand, GHG emissions and air pollutants. TEAM requires various inputs that come from the development of narrative scenarios (a.k.a. 'storylines'). The inputs from these storylines cover the following three types of variables:

- *Context* variables, broadly defined as those that are beyond direct government control, such as fuel prices before tax, demographics and GDP per capita;
- *Policy* variables, broadly defined as those that are within direct government control, such as taxation (e.g. on fuel and vehicle purchase), vehicle purchasing (dis)incentives or scrappage rebates (e.g. tax exemption for EV purchase), and regulations (e.g. air pollution);
- *Demand* variables, broadly defined as changes to travel demand that may result from a combination of policy and context changes, such as reductions in commuter trip passenger-km amongst the working-age population due to growth in teleworking.

This is the first time the TEAM framework is being used in a country with i) limited data on travel demand and vehicle stocks and ii) a sizeable second-hand imports market.

TEAM-Kenya: a transport-energy system model for the Kenyan context

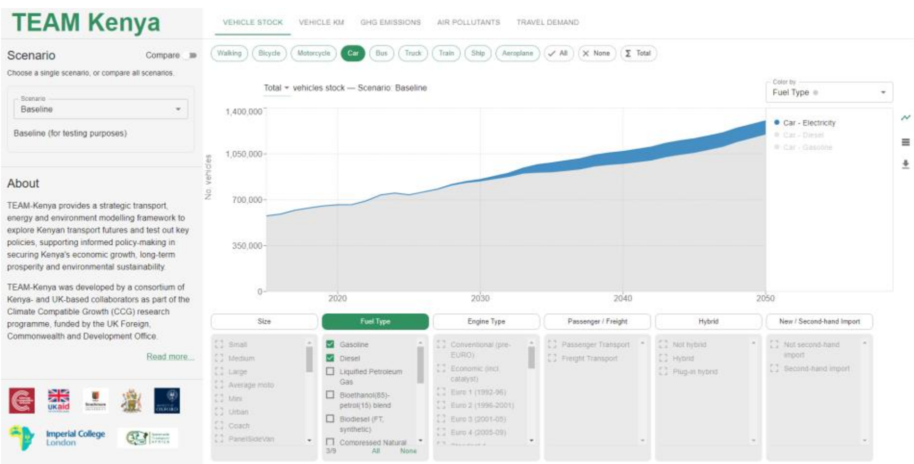
The major updates carried out as part of this adaptation, which were made in January-March 2023, are detailed in Table 1.

Table 18. Major updates as part of the adaptation of TEAM-Kenya (from TEAM-UK)

Change title	**Details**
Second-hand import technologies	The majority (~85%) of cars and minivans bought in Kenya are second-hand imports (SHI), mostly from the Japanese and UK markets. Therefore, TEAM-Kenya models separate markets for SHI and new technologies; in the present version, SHI technologies have been made for all car and minivan types, and they are offset by a fixed number of years. Presently, as Kenyan law stipulates that no vehicle over 8 years old is allowed to be imported into the country, SHI vehicles in TEAM-Kenya are 8 year-delayed versions of their new counterparts.
Changes to vehicle stock data (baseline year)	Data for the Kenyan vehicle fleet for the base year (2015) were generated from a report from GIZ and the University of Nairobi (Ogot et al., 2018). Data were processed from the format as provided in the report into the format as required by TEAM-Kenya according to a set of assumptions as described in (Giki & Dixon, 2023).
Changes to travel demand (baseline year)	Concurrent CCG work is currently (at the time of writing in May 2023) collecting travel survey data from approx. 1000 participants in Kenya. However, these data are not yet available. As a working version, travel demand data (trips and distance by modes and purpose) were input based on data from a 2013 World Bank study as published in (Salon & Gulyani, 2019). As data in the latter only covers commuting travel, a set of assumptions based on the literature were made to translate travel demand for commuting trips into other trip types (Dixon et al., 2023).
Changes to background demographic data and projections to 2050	The population, GDP, number of households and urban/rural split, the share of households with more than 1 person, and the share of the population of driving age, for the base year (2015) were taken from a set of online sources. Projections were made, either from online sources or by using assumptions based on proxies. For a list of data sources and assumptions, see (Dixon et al., 2023).

A graphical user interface (GUI) was developed for TEAM-Kenya to allow effective communication of model results (Figure 1). TEAM-Kenya modelling results are still in development and are due for release in July 2023. However, the next section covers the development of scenarios used for modelling.

Figure 105. Web-based graphical user interface for communication of results (Ziarkowski & Dixon, 2023)

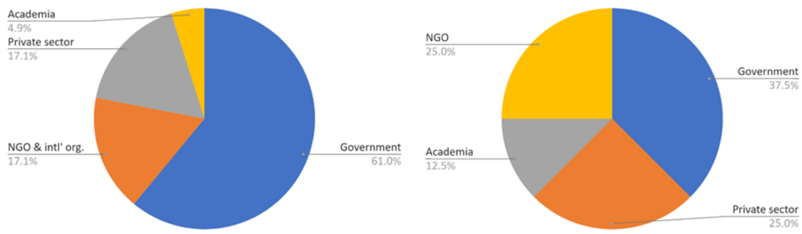


Scenario development

Whilst both Global North and Global South transport transformations appear to be similar in aspiring to cleaner, just and modern transport, the futures in which both transformations are occurring and their plausible outcomes are strikingly particular to the place where they are planned and executed. Taking this difference as a basis, this study was designed to identify narratives from the point of view of the experts and decision-makers based in and currently key to the planning and implementation of transport and energy in Kenya. Modellable scenarios, pertaining to the three points above (context; policy; demand), were developed for the TEAM-Kenya model through (i) interviews with local experts and (ii) a scenario development workshop.

41 key experts were first identified and then interviewed to provide insights from the current state of transport in the country and the key areas of transformation in the sector but also in wider social and economic dynamics. The key experts covered the central actors engaged both in the planning, regulation, implementation, service provision, manufacturing, and financing of transport. As such it covered civil servants in the Kenyan national and local government of Nairobi, manufacturers, start-ups and transport service providers, NGOs and financing institutions (Figure 2). The interviews, each lasting approx. 1 hour, were formulated around a set of semi-structured questions around the current state of Kenya and visions of Kenya in the future. The questions are available in the appendix.

Figure 106. Breakdown of experts and decision-makers engaged for scenario development for interviews (left) and workshop attendees (right)

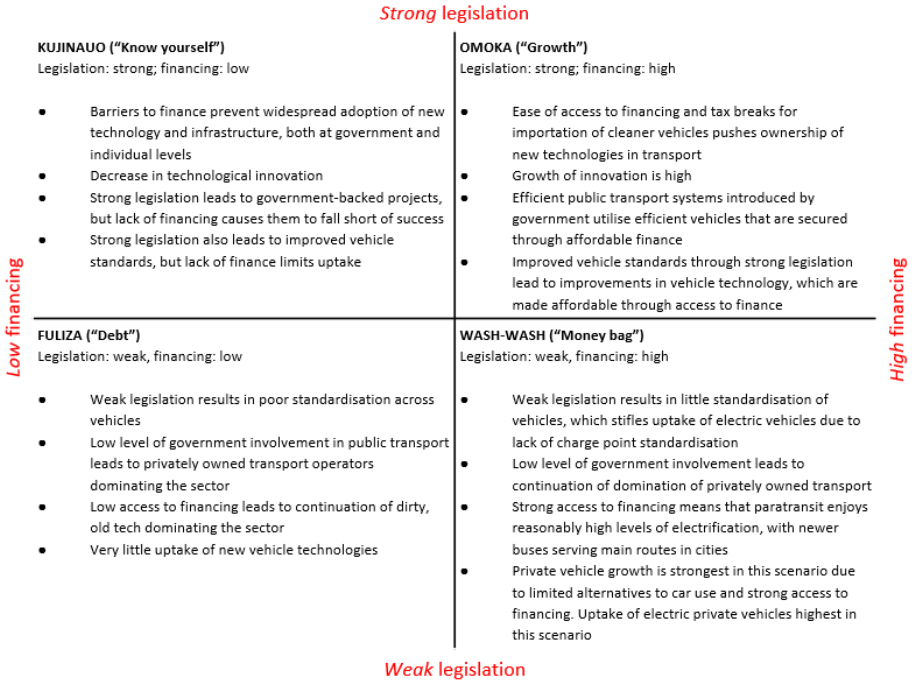


The full-day workshop was attended by 32 stakeholders on 28 March 2023 in Nairobi. The workshop was planned and executed following methodologies for scenario-making that place the identification of narratives from the central actors –or users– as the core-basis of scenario building (Ramírez & Wilkinson, 2016). In this sense, the purpose of the workshop was not to extract knowledge from participants, nor to give them instructions of a preconceived outcome. Rather, it consisted of a collaborative process of unstructured exercises to prompt both their expertise and imagination for understanding their present setting and plausible future events to occur in their environment.

The workshop was structured around three main sessions.

1. The first session consisted on the identification of the factors that influenced decision-making (e.g. fiscal policy), as well as wider actors in the sector (e.g. ministry of transport) influenced or impacted by such factors.
2. In the second session, the participants were asked to identify plausible outcomes of those factors, and choose the two most definitive for the sector to work over a four-quadrant chart. This builds the core of the scenario-making exercise, and sets how particular factors interact and impact outcomes. The result gave a chart of four scenarios to which participants had to discuss within their groups to find fitting names to what was plausible to occur in each pane. An example chart is shown inFigure 3, which used the axes of 'strength of legislation' and 'availability of finance' to produce four separate scenarios. The scenarios' names are references to Kenyan popular culture.
3. Finally, in the third and last sessions, participants were asked to provide the storyline of how the most likely or most interesting scenario to them would have to unfold. The starting point was chosen depending of the first crucial step taken towards that scenario, or the event setting the scenario in motion. Such point could be located in the past, as well as starting in the present. Equally, the previous outcome identified of the scenario in the quadrant could be considered the end of the story as well as the middle point of it. Thus, the participants within their teams had to decide how to arrange the narrative to fit a causal chain of events and their progression across time.

Figure 107. Example quadrant of four scenarios: Omoka, Wash-Wash, Fuliza and Kujinauo



Conclusion

The KTEF project represents, to the authors' knowledge, a vanguard effort to develop decision support tools in a data-poor context to assist policymakers in trialling policies to support low-carbon economic growth. Whilst the project is still underway – at the time of writing, data is still being collected and efforts are ongoing to translate the scenarios developed from the workshop into modellable scenarios in TEAM-Kenya – there have been many lessons learnt from the project, in terms of the availability of data and the cumbersome nature of translating transport models from one context to another.

In comparison to many other sub-Saharan African economies, availability of data on the transport system in Kenya is relatively good: there are datasets on travel behaviour and vehicle fleet datasets (albeit some of these are at least partially from modelled results, such as (Ogot et al., 2018)). That being said, developing a model with sufficient detail for the TEAM framework in Kenya was challenging and required significant resources in data collection and model development.

Ultimately, transport systems across the world are highly diverse and, as such, pathways for their evolution in meeting climate mitigation and economic development goals must be context-specific. Renewed effort is required in developing modular, open-source tools that can be easily adapted according to different transport contexts and levels of data availability; in order to do that, in-country stakeholders must be engaged from the start. Investment in the development of these tools is necessary, but will act to promote climate finance being assigned to the right projects in securing climate-compatible transport pathways for the world.

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