Resource efficiency in the transport sector

Dr Karla Cervantes Barron

Climate Compatible Growth

UKaid from the British people

"The views expressed in this material do not necessarily reflect the UK government's official policies."

University Partnership:

University of Oxford

The Open University

University of Cambridge

Centre for Global Equality

Climate Parliament

Imperial College London

Loughborough University

STEER – Centre for Sustainable Transitions: Energy, Environment and Resilience

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Climate Compatible Growth (CCG) is a £38 million **priority-driven** research programme.

- CCG is funded by the UK Foreign and Commonwealth Development Office (FCDO).
- CCG promotes **investment** into **sustainable transport and energy systems** in our partner countries (2020-2025).
- **Long-term objective**: Local experts delivering **low-emission policy and investment** recommendations that support growth.

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resource efficiency collective

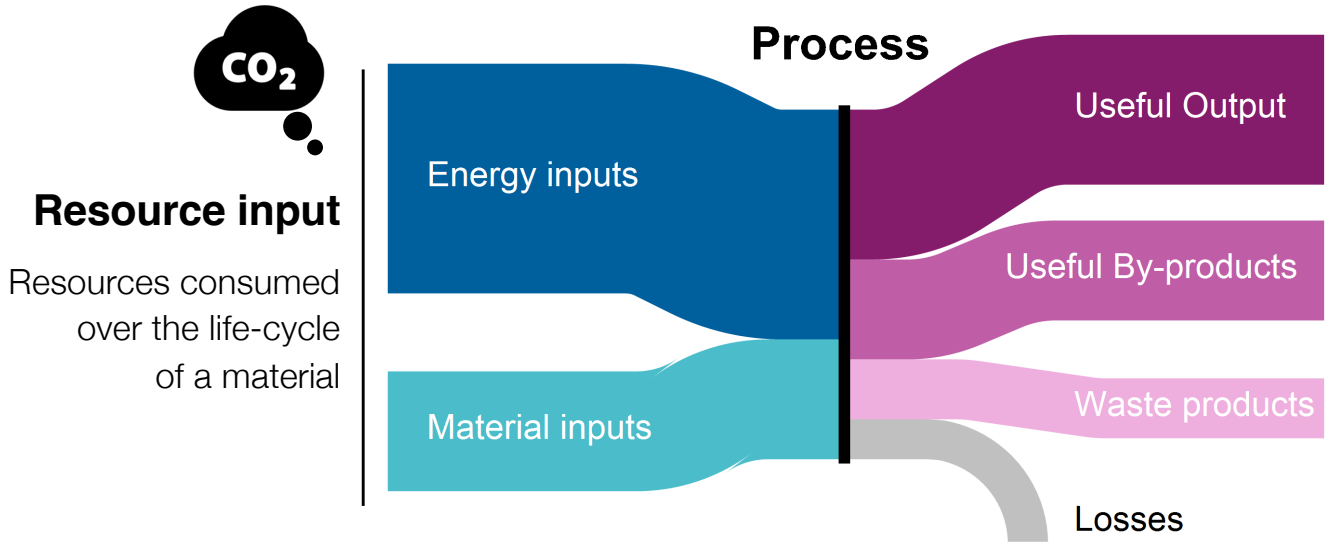
Resource Efficiency Collective is a research initiative at Cambridge University. Together, we seek answers to a challenging question: how can we deliver future energy and material services, while at the same time reducing resource use and environmental impact?

UNIVERSITY OF CAMBRIDGE

www.refficiency.org

Resource efficiency

Can we deliver future energy and material services, while reducing resource use and environmental impact?



Resource input

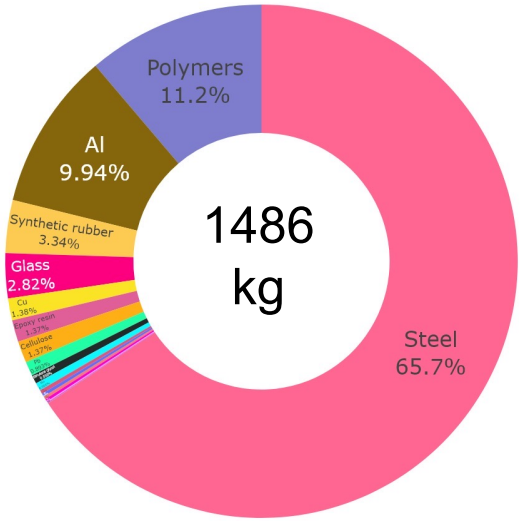
Resources consumed over the life-cycle of a material

Resource efficiency = $\frac{\text{Useful output}}{\text{Resource input}}$

Electrifying vehicles and decarbonizing electricity reduces emissions

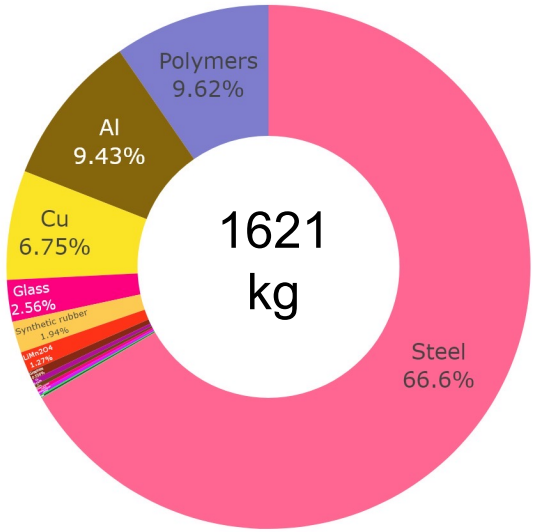
ICE

241 gCO_2e/km



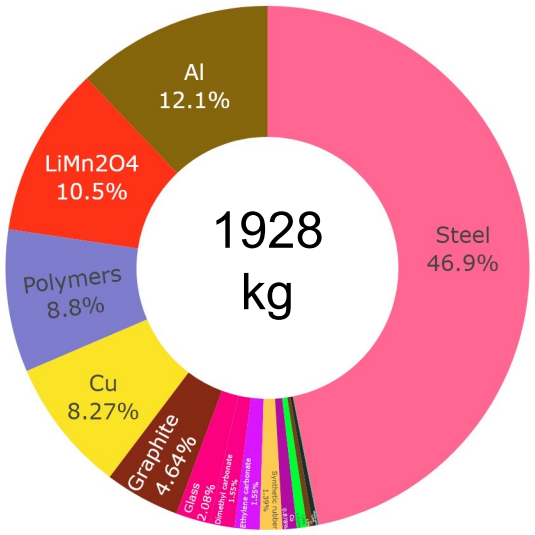
PHEV

152 gCO_2e/km

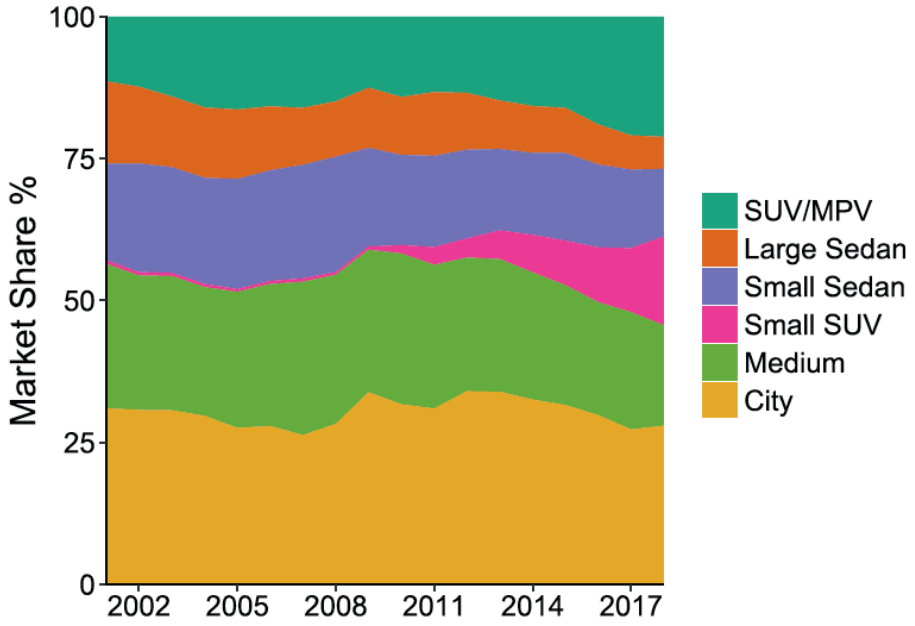


BEV

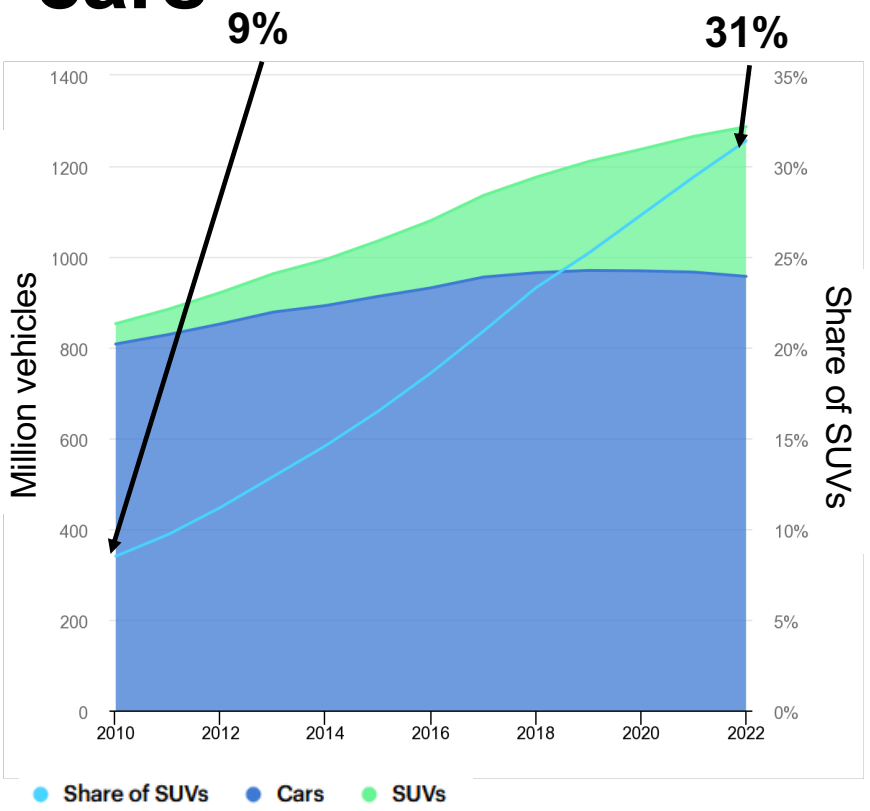
75 gCO_2e/km



But, we are using bigger cars

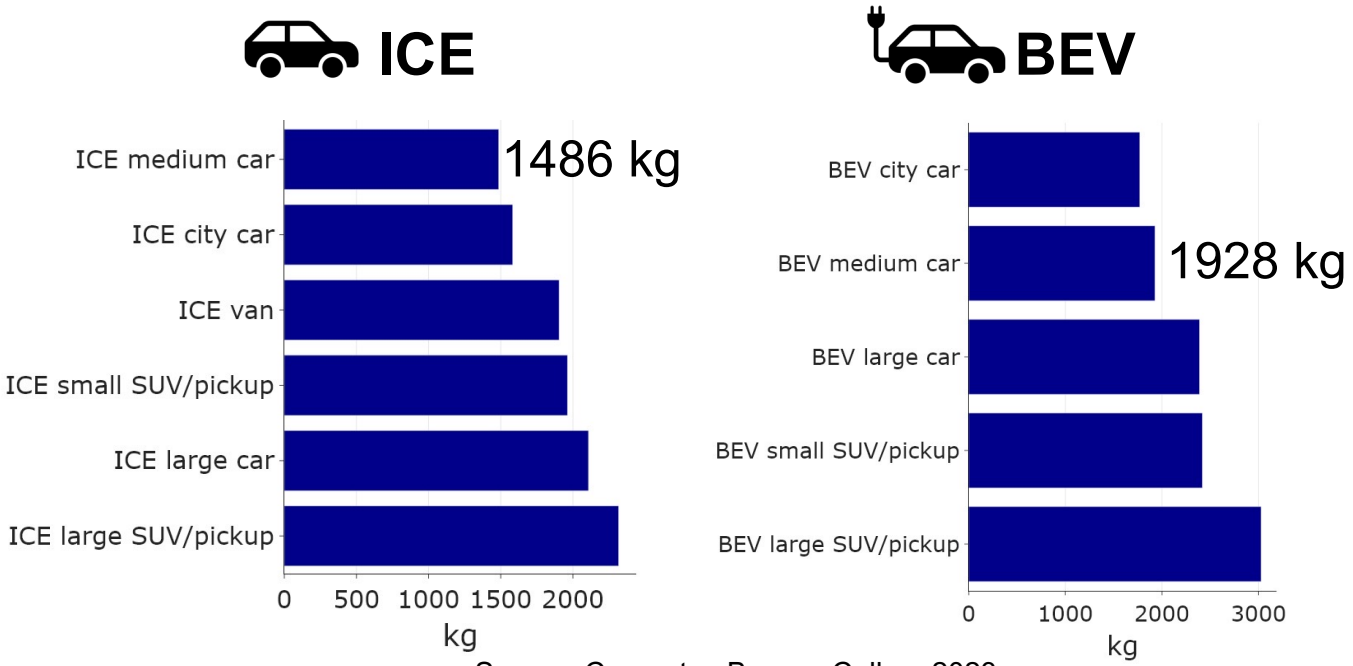


UK vehicle size segment market share 2001-2018.
Source: Craglia & Cullen, 2019
https://www.sciencedirect.com/science/article/abs/pii/S0301421519305786



Passenger car fleet and share of SUVs in total car emissions, 2010-2022.
Source: IEA, 2023

Bigger cars mean more resources, emissions and space - even if they are EVs



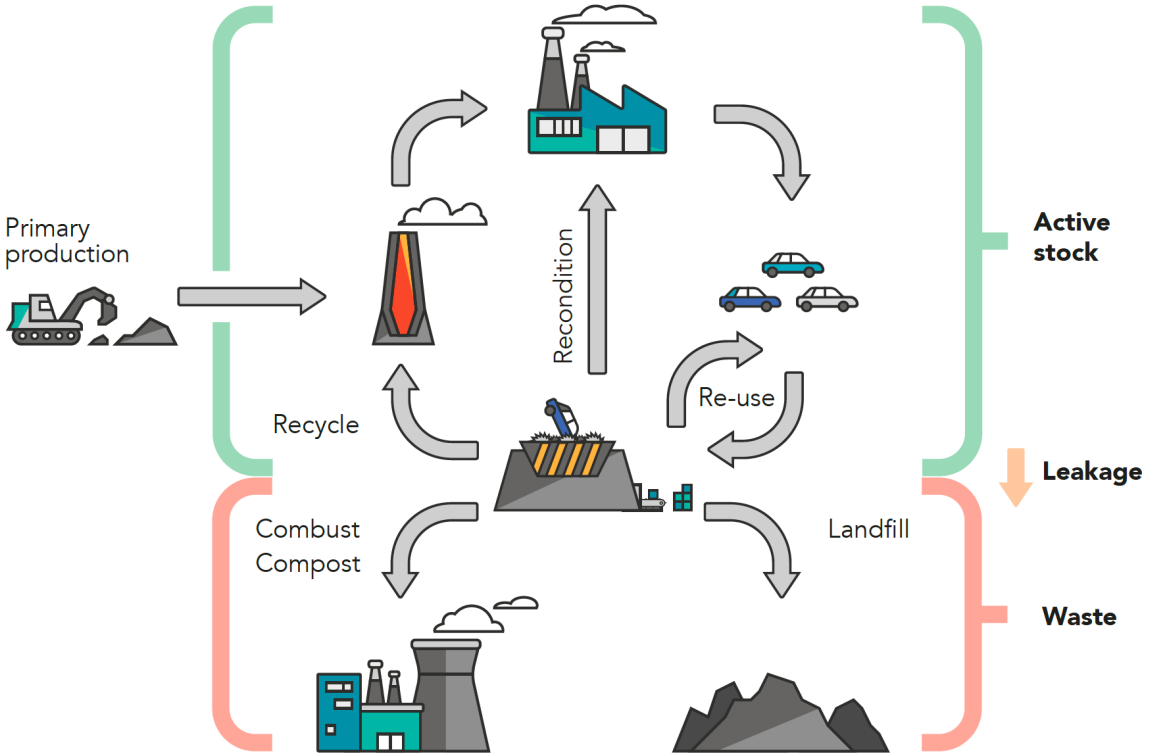
Source: Cervantes Barron, Cullen, 2023

$$330\ million\ eSUVs \quad * \quad 3\ tonne/e\boldsymbol{SUV} = 990\ tonne$$
$$330\ million\ e\ med\ car \quad * 1.9\ tonne/e\boldsymbol{car} = 627\ tonne$$

57% more material

What alternatives are there?

Circular economy principles



Ashby, 2017

What alternatives are there?

Primary production

1. Design innovations
- Reduce raw material use
- Reduce energy use

2. Vehicle attributes
- Reduce car size
- Efficiency standards

3. Use low-carbon materials
- Novel processes for steel, or cement

1.1 Design car parts differently

Sheet metal accounts for **25%** of car frame **manufacturing emissions**.
- **Traditional**: **47%** of **waste** steel
- **DeepForm**: **14% waste** steel

DeepForm

https://deepform.co.uk/

Active stock

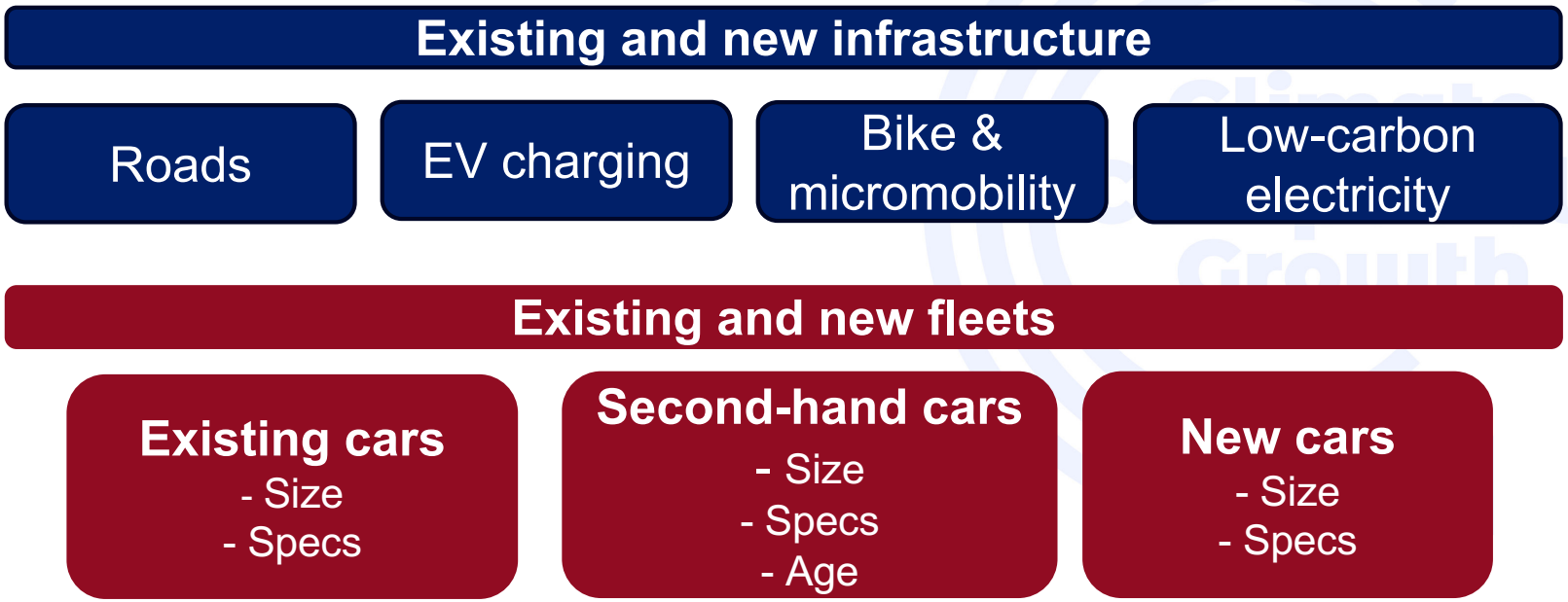
Stock measures/ alternative mobility

Reduce number of cars used
Car infrastructure
- Car sharing
- Low-carbon transport networks

Waste

Waste management
- Use for longer
- Reuse
- Recycle

Different countries need different solutions



What are we working on in CCG?

Tools and data to support decision-making and country engagement.

resource efficiency collective

Material demand projections model

matdp

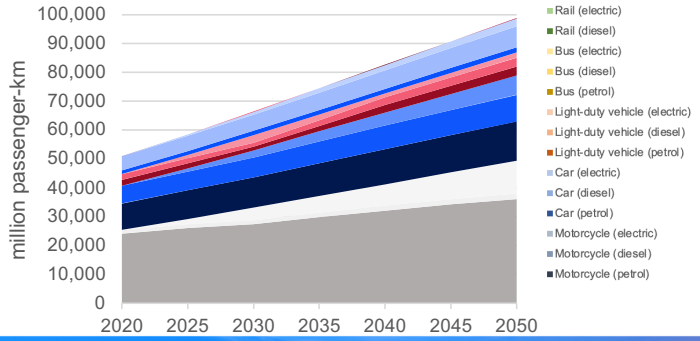
102 bulk and critical materials

- electricity technologies
- transport technologies
- battery technologies
- T&D technologies
- road types

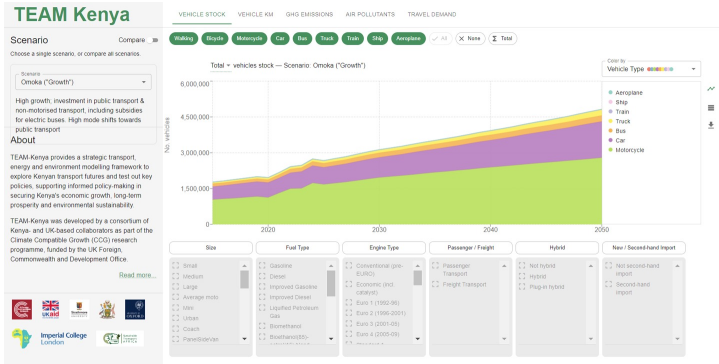
Transport starter data kits

Datasets on transport from **1990 to 2021** for **60 countries**

STEPS



Demand-led transport modelling in Kenya



Access to finance is crucial – Kenyan policymakers can leverage int'l development finance

This requires **strong policy action** on **public transport** and e-mobility adoption

Strong public transport support **increases access to mobility** *for low-income groups*

Thank you!

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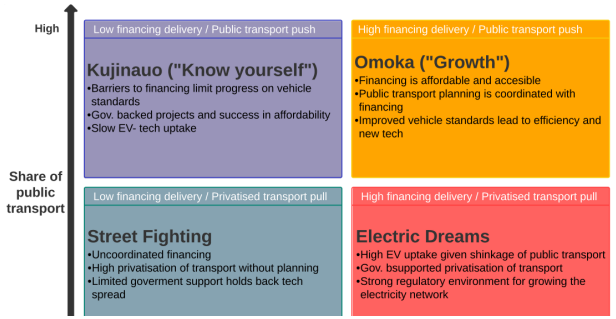
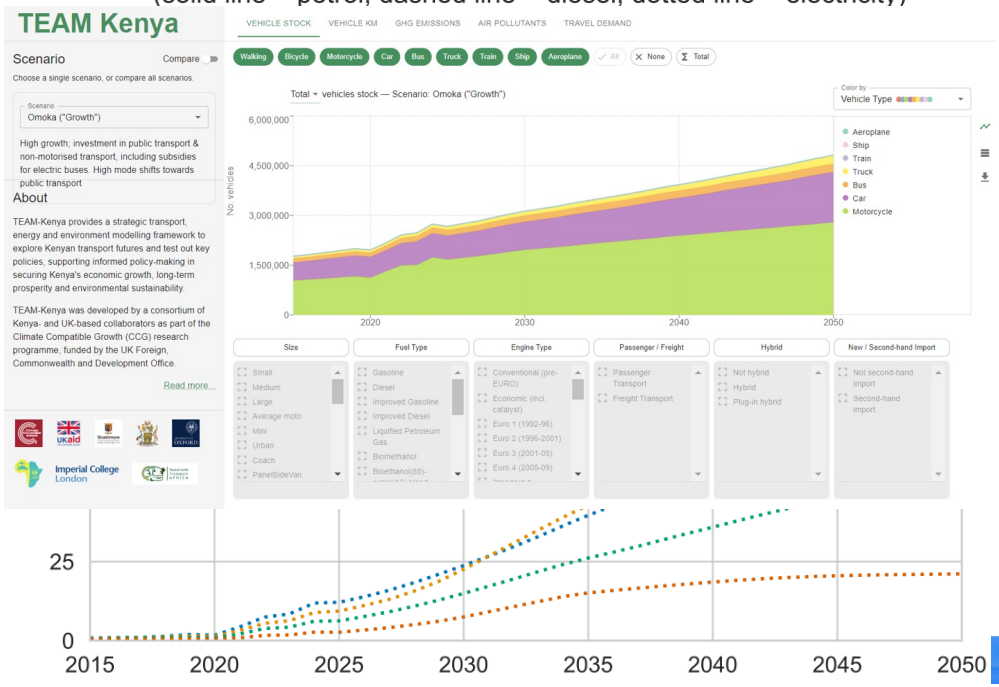
Climate-compatible transport pathways for Kenya



Taxation from fuel sales by scenario and year
(solid line = petrol; dashed line = diesel; dotted line = electricity)



Kenya can **increase transport service provision** *in a climate-compatible manner*

Emissions intensity (CO2/GDP) can **be in-line with an industrial nation** *in 2-3 decades*

This requires **strong policy action** on **public transport** and e-mobility adoption

Dwindling **fuel tax revenues** **are largely compensated** for by electricity taxes *due to increasing service demand*

Strong public transport support **increases access to mobility** *for low-income groups*

Electricity demand ↑***13-41% by 2040*** relative to IEA 'Stated Policies' scenario **(4-5x increase vs. 2022 overall!)**

Access to finance **is crucial – Kenyan policymakers can leverage international development finance;** the **int'l community must make it available!**

Starter data kits -What are they?

Dataset on transport from **1990 to 2021** for **60 developing countries**

Population (total, growth, urban, rural)

GDP (total, growth, sector)

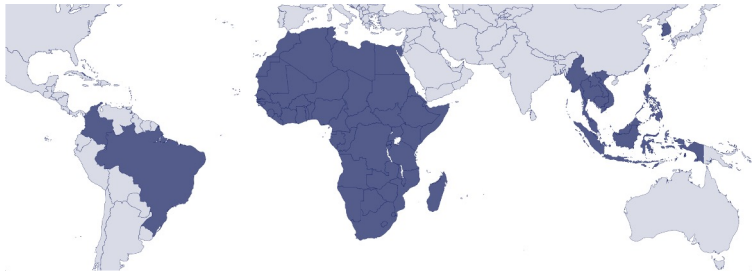
Passenger activity

Freight activity

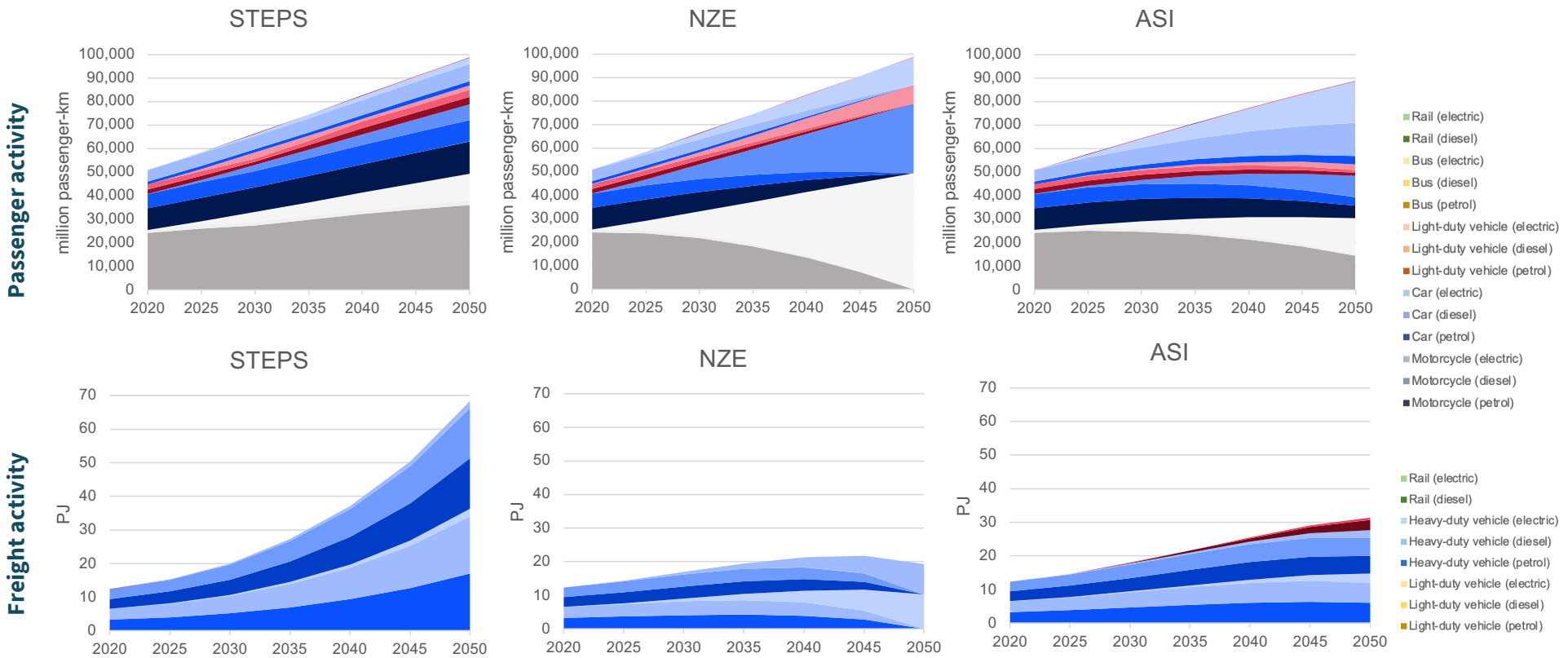
Vehicle fleet no.

Energy intensity

Load factor



How can it be used?



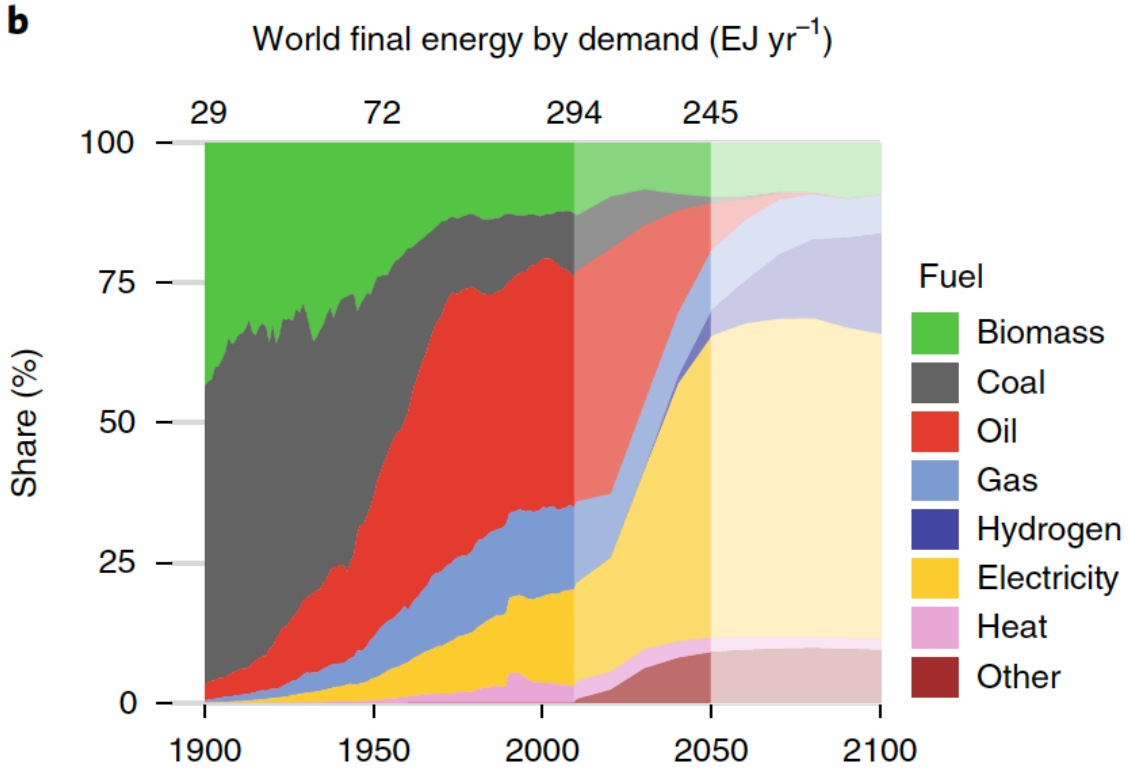
How can it be used?

A set of data and an initial model

Analysis can be quickly updated, adapted, adopted and applied

Clear policy targets and loan applications, fast policy analysis, and slower burn academic processes.

Electrifying vehicles and decarbonizing electricity reduces emissions



Halving the demand for energy makes the transition away from fossil fuels and towards electrification much easier

Source: Grubler et al., 2018. https://www.nature.com/articles/s41560-018-0172-6