FINAL REPORT

Project Reference: HVT/007

Applied Research Programme in High Volume Transport

Theme 3 – Low Carbon Transport

Part 1 - State of Knowledge study to formulate the Applied Research Programme and implementation strategies

Submitted by the Partnership on Sustainable, Low Carbon Transport (SLoCaT)

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List of Abbreviations

1.5DS	1.5 degrees Celsius scenario
2DS	2 degrees Celsius scenario
AGETU	Urban Transport Agency, Abidjan
BAU	Business as Usual
BRT	Bus Rapid Transit
BUR	Biennial Update Report
CDM	Clean Development Mechanism
CETUD	Executive Council of Urban Transport in Dakar
CFI	Climate finance instrument
CNG	Compressed Natural Gas
COP21	21st Conference of the Parties
COP24	24th Conference of the Partiers
CTF	Clean Technology Fund
DFID	Department for International Development of the United Kingdom
EST Forum	Intergovernmental Regional Environmentally Sustainable Transport Forum
EV	Electric Vehicle
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse gas
GNI	Gross-national income
Gt	Gigatonnes
HIC	High-income country
HVT	High volume transport
ICT	Information and communication technologies
INDC	Intended Nationally Determined Contributions
INR	Indian rupees
IPCC	United Nations Intergovernmental Panel on Climate Change
ITDP	Institute for Transport Development Policy (
ITS	Intelligent transportation system
LC-HVT	Low-carbon, high-volume transport
LCS	Low carbon scenario
LIC	Low-income country
LMIC	Low- and middle-income country
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MDB	Multilateral Development Bank
MIC	Middle-income country
MRV	Monitoring, reporting and verification
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NC	National Communication
NDC	Nationally Determined Contribution
NMT	Non-motorised transport
NO_x	Nitrous oxides
NUMP	Nationally Urban Mobility Programme

ODA	Official Development Assistance
PAYD	Pay-As-You-Drive
PM	Particulate matter
PPP	Public-private partnership
PT	Public Transport
QW	Quick win
SDGs	Sustainable Development Goals
SEA	Strategic environmental assessment
SLCPs	Short-lived climate pollutants
SLoCaT	Partnership on Sustainable Low Carbon Transport
SoK	State of Knowledge
SUMP	Sustainable Urban Mobility Plan
SUTRI	Sustainable Urban Transport Program Indonesia
TEEMP	Transport Emissions Evaluation Models for Projects
TOD	Transit-oriented development
TRP	Taxi Recapitalisation Programme
UGX	Uganda shillings
UN	United Nations
UNCRD	United Nations Centre for Regional Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollars
ZAR	South African rand

EXECUTIVE SUMMARY

The research documented in this Report explores the current state of knowledge of, interest in, and capacity to implement low carbon, high volume transport (LC-HVT) among study participants in a cohort of countries in Africa and South Asia. This project report thus uses primary research to provide a review of the challenges and barriers, interest and knowledge gaps within the cohort relating to the implementation of particular low carbon transport measures, supported by a literature review and relevant case studies. A further outcome of the project is to provide recommendations to the Department for International Development of the United Kingdom (DFID) on future research directions for Part 2 of the Applied Research Programme into High Volume Transport.

There are many studies that demonstrate the similarity of transport issues across low income countries with a similar climate (1). DIFD includes 32 priority countries in Africa and Asia, and has China, India and South Africa as development partners. The chosen cohort of nine countries includes two of these development partners and lessons that can be learnt from them, where applicable, are highlighted in this report.

This report has six chapters. In **Chapter 1**, the project and the country selection process are introduced. The project explores the following principal research questions:

- RQ1: What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?
- RQ2: Is it necessary and/or desirable to promote LC-HVT over the coming years? Why is it important (or not) to promote this?
- RQ3: What are the principle barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?
- RQ4: What knowledge is needed to remove these barriers (e.g. developing capacity, and sharing knowledge/good practice/tools)?

Analysis and findings presented in this Final Report are drawn from the following three primary sources and activities:

- Expert Interviews
- Stakeholder Survey
- Capacity-Building Workshop

Primary data is reported as a single source – in other words, unless relevant, the report does not distinguish between data collected by survey, expert interview, or face-to-face. These interviewees are referred to as stakeholders, experts, or (study) respondents interchangeably. The intention is not to differentiate between Africa and South Asia, but to focus on commonalities between the low- and middle-income country cohort, and relevance to low-income countries other than those selected; thus, data is reported by country or region only where exceptions are noted or particular points of interest are evident.

In addition to conducting peer-reviewed and grey-literature reviews, four data matrices were developed with the aim to: A) review implementation of ‘quick-win’ low carbon transport measures in selected

countries; B) create an overview of envisioned or planned low carbon transport activities in the selected countries; C) identify what has been implemented so far; D) examine the potential preference for new activities that allow to have 'quick wins' in the selected countries. In other words, it allowed review of LC-HVT on a global scale, to examine the current situation of LC-HVT in the selected countries and potential future strategies.

The case for low carbon transport in mitigating climate impact globally is made in **Chapter 2.** Although broadly, low carbon transport is currently a low priority within the countries selected for this research project, there is a clear case for driving this agenda as a substantial sustainable development benefit.

Transport, access, and mobility are key to sustainable development. Transport interventions are mostly driven by development concerns, such as the need to reduce congestion, improve mobility/accessibility for a growing urban population, rural connectivity, and logistics to support an expanding industrial and economic activity. Thus, low carbon transport in LICs is usually seen as a desirable co-benefit but not as a driver of transport interventions. This chapter places the project research within a global consensus regarding definitions or descriptions of low carbon transport, and how low carbon transport measures could be implemented.

Chapter 3 presents an overview of the ambitions and mitigation potential of low carbon transport and the transport emissions within the selected countries. It summarises the targets and mitigation measures reported in these countries' Nationally Determined Contributions (NDCs) and other submissions in terms of United Nations Framework Convention on Climate Change mechanisms. Low carbon transport-specific profiles and factsheets of the selected countries are included in the appendix. This chapter also includes an overview of existing greenhouse gas emission calculation and decision-support tools, particularly those able to assist national, regional and local government agencies in developing and implementing low carbon transport policies in low-income countries.

While the concept of environmental sustainability in transport development (e.g. congestion, air pollution, road safety, social equity) initiated international attention dated back to the Rio+ 20 Summit in 1992, climate change mitigation and adaptation are relatively new and emerging concepts and criteria for transport development. With the 2015 Paris Agreement, new mechanisms (NDCs, National Communications, Biennial Update Reports) provide opportunities to establish a link between transport policy and climate policy in low income countries, thereby creating a foundation to scale up implementation of low carbon transport. These policy realms are usually covered by different ministries (e.g. transport vs environment/energy). This chapter shows that the climate change reports submitted to date by the nine project countries include the transport sector, indicating both an emerging link between transport and climate change and a scope for strengthening it.

The fact that most of the nine countries include a list of mitigation actions for the transport sector (even though climate change is not a primary policy driver) shows that there are options for climate change mitigation in the transport sector, which can serve as useful examples even for LICs with low per capita emissions and other key development priorities. However, the current targets and activities on transport by the selected project countries are still incompatible with the 1.5-degree Celsius target of the Paris Agreement. While various countries lack a specific target for transport emission mitigation, most of the countries with existing 2030 emission targets have to increase their level of ambition.

Chapter 4 presents examples of low carbon transport 'quick wins' that have particular support or priority within the selected countries and assess their mitigation potential and implementation progress.

These ‘quick wins’ were pre-selected based on a literature review (of which an overview is presented here) and peer consultation, and their potential tested with study respondents. ‘Quick wins ‘include policy/legislation and application of specific technologies.

The chapter shows how low carbon ‘quick wins’ can play a key role in implementing low carbon transport measures in LICs, by matching local priorities with global co-benefits. However, implementation is still challenging in many countries.

The following key observations are drawn:

- Freight efficiency measures seem less prioritised in literature, policy implementation and by stakeholders;
- Fuel efficiency policies are acknowledged as key in literature, but lack in implementation and priority by stakeholders;
- Though sustainable urban mobility plans and national urban mobility plans are seen as a key option, implementation is lagging behind;
- Non-motorised transport is highly rated by stakeholders but implementation is lacking;
- Attention by stakeholders and literature coverage for electric two- and three wheelers is increasing especially in very recent years, both in Asian and African countries;
- Improving diesel quality standards is considered important in literature and by stakeholders especially from a local air pollution and health perspective, with substantial co-benefits due the climate warming potential of black carbon;
- Little attention is given to low emission zones in the climate change context, even though these may play a key role in promoting electric vehicles;

The chapters that follow use primary data to investigate the knowledge, skills or other interventions needed in order to facilitate broader implementation.

Chapter 5 reports on the primary research and highlights the barriers to implementation of low carbon transport measures, as identified by stakeholders. There is a fundamental difference between the priorities in the cities of high-income countries, where transport demands are mostly satisfied, motorisation levels are mostly stable, and population growth rates are low or even declining, and for developing countries. For the former, the main concerns are levels of pollution and consumption related burdens.

For developing countries, both top-down and bottom-up perspectives identify a lack of clear vision, inadequate leadership, investment, and weak governance structures, lack of skilled personnel, plus ‘the seductiveness of following the high-mobility option’ as challenges to low carbon development.

Key findings of the primary research point to four groups of challenges:

- **Financial/economic challenges**: Targeted finance for low carbon transport is needed to help overcome any addition investment costs together with training and assistance in preparing project and funding proposals. Respondents also mentioned a need for funding for research and promotion of low carbon transport.
- **Political/social challenges**: In many cities, pushing a low carbon agenda presents a political risk since this is often not what constituents are primarily demanding. The lack of political leadership, clear goals, political momentum and fear of change are key barriers to implementation. The lack of capacity to make a low carbon transport business viable is also a

major obstacle. When it comes to social barriers, getting people out of private motorisation into lower carbon modes can be a major challenge.

- **Technical challenges**: Respondents commented that low carbon technologies (such as electric buses) are still not widely deployed, as they are seen as costly, not fully understood by all local decision makers and needing further time to evolve.
- **Institutional / Regulatory challenges:** Limited or lack of coordination between implementing entities and authorities are shared as barriers to low carbon transport. Institutional challenges are evident not only across ministries but also between departments in the same ministry working in silos. Challenges cited include a lack of champions, whether at institutional or political level, and a confusing range of role-players. Particularly when non-traditional government directorates and institutions become involved in implementing LC-HVT actions (e.g. electric mobility), respondents perceive that there are no clear reporting-lines or mandates.

Finally, **Chapter 6** identifies the knowledge required, as identified by stakeholders, to assist in overcoming these barriers and prioritising and implementing low carbon transport measures.

Higher priority knowledge needs among varied stakeholders are related to **how** to implement LC-HVT measures, far more than knowledge on **what** to implement, suggesting that many practitioners know what they should do to accelerate low carbon transport, but do not know how to go about it. Partly this is due to low carbon not being a principal driver of transport interventions amongst their core constituencies such as congestion reduction, improving access and mobility) and partly because they have not built the tacit knowledge on how to implement, that comes from experience in multiple prior projects. Ensuring that mobility interventions are also 'low carbon' is rarely a key consideration among decision-makers. It is a major concern among developing countries that climate mitigation actions impose costs, and quantitative emission reduction targets will adversely affect economic development (2).

Thus, how to make the case for transport measures in general, and how to prioritise low carbon measures, is a key concern among study respondents. Overall, respondents noted an urgent need to know how to influence decision-makers, how to make the case for a focus on low carbon transport, and to know how to prepare bankable proposals for low carbon transport projects, although individual respondents shared their own gaps in technology expertise, countries require a different layer of knowledge and assistance. Study respondents report a difficult time selling low carbon measures to policymakers and society, partly due to difficulty of quantifying these co-benefits in local terms, partly due to the lack of local low carbon targets for transport, and partly due to the need for more awareness raising with key stakeholders.

Finally, the suitable channels for knowledge perceived as most effective among all respondents stress the perceived need for practical tacit knowledge (through workshops for specific organisations or institutions, mentorship programmes, exchange programmes, study tours, local and regional conferences and internships) as opposed to prolonged opportunities for education and training.

Chapter 7 summarises key research findings and research gaps relative to the key research questions set out at the beginning and recommends priority areas for future research based on these findings. In addition to the research findings and gaps identified in this chapter, Table 1110 contains more specific areas for future research (organised by the four categories of challenges introduced in Chapter 5) and assesses relevance for application to specific project countries (as related to intervention scope, mode and type) based on report analysis.

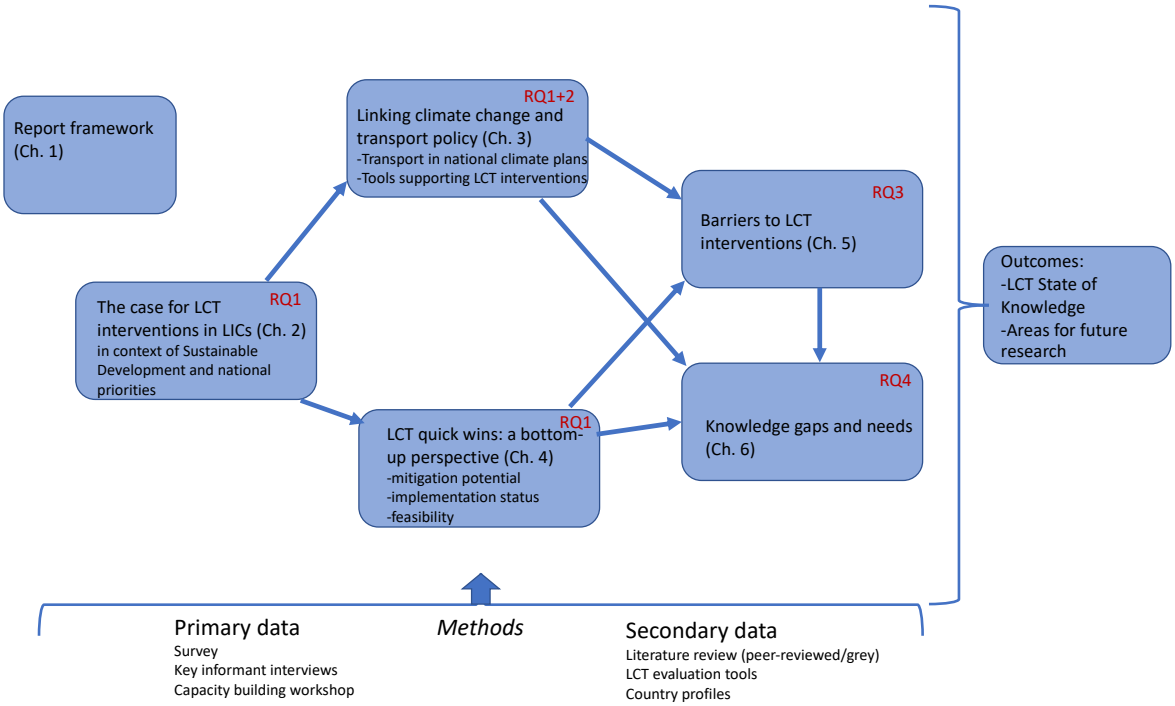

Figure 1: Report elements and research questions

The appendices reflect scoping work undertaken to catalogue current research activities, tools/methodologies and guidelines on low carbon transport; plans, targets, and evaluation mechanisms for low carbon measures in the project countries (national, sub-national and multinational entities); and a high-level analysis thereof, in terms of strengths, gaps and targets.

1. PROJECT INTRODUCTION AND RESEARCH OVERVIEW

1.1. PURPOSE OF THIS DOCUMENT: FINAL REPORT

The Applied Research Programme into High Volume Transport (HVT) was launched by the Department for International Development of the United Kingdom (DFID) in 2017 as a five-year research programme funded by DFID to increase access to transport services, more affordable trade routes, and safer, low carbon transport in low-income countries (LICs) (3).

The HVT programme aims to update technical best practice for transport infrastructure in LICs and actively disseminate it to LIC country authorities so that it is understood and used. This will allow more cost effective and cleaner technical designs of infrastructure investments. This means that the decision-making process for the selection of projects is better informed and ensures an impact on economic development and poverty reduction.

HVT in this context covers road and rail networks from passenger and freight perspectives. It will expand and develop new technologies and solutions and will learn from and adapt existing transport technologies, materials, designs, planning and methods from high and middle-income countries. Part I of the HVT Programme focuses on four themes:

- Long Distance Road and Rail Transport;
- Urban Transport;
- Low Carbon Transport; and
- Gender, Vulnerable Groups and Inclusion which includes Road Safety.

The Partnership on Sustainable, Low Carbon Transport (SLoCaT) was selected as the research supplier for Theme 3 on Low Carbon Transport (Project Reference: HVT/007), which in this report is referred to as 'the project'. The project aims to explore the current state of knowledge and capacity of low carbon transport for HVT in selected priority countries in Africa and South Asia. The project provides a review of potential transport solutions for the selected priority countries to move towards low carbon passenger and freight transport.

The project also provides recommendations to DFID regarding the direction and content for Part 2 of the Applied HVT Research Programme on Low Carbon Transport and evaluate the feasibility of the supporting capacity building and knowledge management strategies for Part 2. The purpose of the Final Report is to present the key findings of this project.

In addition to the Final Report, the project is also developing two scholarly State of Knowledge (SoK) papers based on topics reported in the Final Report, to extend the outputs of this primary research and enable the work to reach the public domain.[1] Moreover, a capacity building programme with recommendations and strategies to close the knowledge gaps identified in this report is also developed under this project.[2]

[1] Please refer to Appendix 8 and 9 for the abstracts of the two SoK papers.
[2] Please refer to Appendix 10 for the abstract of the capacity building programme.

1.2. PROJECT APPROACH AND KEY RESEARCH QUESTIONS

Theme 3 explores the current state of knowledge of, interest in, and capacity to implement LC-HVT in a cohort of countries in Africa and South Asia among selected study respondents (researchers, practitioners and academics[3]) (see Chapter 1.3.1 for details). This project report thus uses primary research to provide a review of the challenges and barriers, interest and knowledge gaps within the cohort relating to the implementation of particular low- carbon transport measures, supported by literature review and relevant case studies.

There are many studies that demonstrate the similarity of transport issues across low income countries with similar climate (1). DFID includes 32 priority countries in Africa and Asia and has China, India and South Africa as development partners. The chosen cohort of nine countries includes two of these development partners and lessons that can be learnt from them, where applicable, are highlighted in this report and in the capacity building strategy.

A further outcome of the project is to provide recommendations to DFID on future research directions for Part 2 of the Applied Research Programme into High Volume Transport. The research directions are proposed in chapter 7.

The project explores the following principal research questions:

- RQ1: What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?
- RQ2: Is it necessary and/or desirable to promote LC-HVT over the coming years? Why is it important (or not) to promote this?
- RQ3: What are the principle barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?
- RQ4: What knowledge is needed to remove these barriers (e.g. developing capacity, and sharing knowledge/good practice/tools)?

The primary focus of this project is LC-HVT in the context of climate change mitigation. Other thematic projects under DFID's HVT programme, such as Long-distance Travel (Theme 1) and Urban Transport (Theme 2), may explore the subject of adaptation in transport (Box 1).

Box 1: Accelerate action on adaptation in the transport sector

Adaptation in the transport sector is necessary for both developed and developing countries, as transport systems worldwide are vulnerable to the increasing impacts of extreme weather, and rapid motorisation increase the potential for catastrophic impacts. Crucially, sustainable transport systems must adapt to climate change to maintain reliability to enable transport's role in economic and social development. Many sustainable transport solutions can combine increased mitigation potential and resilience as mutual benefits (e.g. during the Great East Japan Earthquake in 2011, high-speed rail proved to be more resilient than conventional rail transport infrastructure) (4).

Building blocks for greater action on adaptation in the transport sector are being developed. In the Fifth Assessment Report, the United Nations Intergovernmental Panel on Climate Change (IPCC) Working Group II

[3] The study population comprised researchers, officials, academics and low carbon transport practitioners; the purpose of the research was not to interview marginal or vulnerable transport users regarding their needs or state of knowledge.

Box 1: Accelerate action on adaptation in the transport sector

pointed out that the number of scientific publications available for assessing climate-change impacts, adaptation, and vulnerability more than doubled between 2005 and 2010, with especially rapid increases in publications related to adaptation (5). In addition, studies from developing countries on these topics are on the rise but still represent a small fraction of the total.

On the policy side, negotiating processes of the United Nations Framework Convention on Climate Change (UNFCCC) contain a growing emphasis on adaptation, to balance out an initial focus on mitigation in the process. Climate change adaptation was solidly established in the UNFCCC dialogue through the Least Developed Countries (LDC) Work Programme at the Seventh Conference of the Parties (COP7) in Marrakesh, and has increased in stature through the Cancun Adaptation Framework at COP16.

Recent efforts have helped to expand the knowledge base on adaptation among transport sub-sectors, which is an essential step toward clarifying key concepts and definitions, developing consensus on catalogues of measures, and agreeing on relevant metrics for monitoring progress over time.[4]

Adaptation efforts are focused on a growing set of transport sub-sectors including roadway, railway, public transport, and maritime, and that tools and methodologies are being developed to support both urban and rural transport projects. Examples of tools for transport adaptation projects include the Climate Change Project Screening Criteria developed by the Nordic Development Fund, the Tracking Adaptation to Climate Change Collaboration, the Urban Adaptation Support Tool developed by the Covenant of Mayor, and the Local Government Self-Assessment Tool developed by the United Nations Office for Disaster Risk Reduction for Making Cities Resilient Campaign.

In addition, the Asian Development Bank has developed a risk screening tools that enable rapid risk assessment at the project preparation stage (6). Technical guidelines were developed by ADB for the assessment of climate impacts evaluation of risks, identification and prioritisation of adaptation options, and monitoring and evaluation of adaptation measures (6). It also developed a technology evaluation scoring method (7). The European Bank for Reconstruction and Development has also developed an adaptation toolkit in 2010 for identifying and managing climate change risks to investments (8). The World Bank has developed Climate and Disaster Risk Screening Tools (9), Outcome-based results framework (10), and an Operational Risk Assessment Framework (11).

As no consistent definition of low carbon transport has been found in literature, research for this project was conducted in terms of the following working definition of LC-HVT: **'low carbon transport will emit less carbon than in the business-as-usual (BAU) scenario'**. BAU projections assume that no additional low carbon policy actions are adopted in the countries and that emissions continue to growth in the same intensity as in recent years. This is in line with the concept of 'low carbon development,' (12) in which national or local development priorities are the starting point, and when these can be realised in a way that reduces emissions below BAU (or does not emit GHGs), can be called low carbon development (12).

Although reaching a 1.5 Degree Scenario[5] requires global transport emissions to be 80-90% below BAU in 2050 (see Chapter 2.1), the global and country pathways to reach this target are not clearly

[4] Examples of relevant knowledge products on adaptation in the transport sub-sector include: (210), (211), (212), (213), and (214).

[5] The Paris Agreement has the goal to limit global warming to 2 degree Celsius above pre-industrial levels and pursue efforts to limit the increase to 1.5 degree Celsius. Thus, a 1.5-degree Celsius target implies that transport has to largely decarbonise and reach around 2 Gt by 2050. More details are given in Section 3.1.

established. Therefore, when **low carbon transport interventions** are referred to in this project, this refers to transport measures[6] that either reduce the implicit GHG emissions from baseline, or produce zero GHG emissions. These could include various interventions as categorised under the 'Avoid-Shift-Improve' framework[7]:

'Avoid' interventions:

- Reducing demand for motorised passenger trips/freight loads; reducing trip length through increased urban density and improved access to essential services and opportunities
- Travel Demand Management programmes (comprehensive package of measures for more efficient use of transport resources);
- Road pricing or carbon taxation;
- Land-use planning, e.g. mixed-use development.

'Shift' interventions:

- Shifting trips or loads from current transport mode to another that offers lower GHG emissions per person/km or freight/tonne/km transported.
- Public transport reform programmes (for example quality bus or bus rapid transit projects);
- Facilities and programmes for walking and cycling;
- Investments in multimodal freight infrastructure to promote shift to rail and water
- Greener freight and logistics (also categorised under 'Improve').

'Improve' interventions:

- Fuel and technology changes to current transport modes that reduce the implicit emissions per vehicle km, such as cleaner fuels, greener technology, engine and driving efficiency;
- Incorporating renewable sources of energy; reducing energy intensity (e.g., emissions per person/km or freight/tonne/km, through increased occupancy or zero emission modes);
- Improving vehicles energy efficiency (e.g. through standards, optimised scheduling or eco-driving).

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[6] Study respondents received the following in the introductory documentation on the Definition of Low Carbon Transport:
'When we refer to *low carbon transport* in this project, our focus is on transport interventions that either reduce the implicit GHG emissions from baseline or produce zero GHG emissions. This could include: 1) Fuel and technology changes to current transport modes that reduce the implicit emissions per vehicle km, such as cleaner fuels, greener technology, engine and driving efficiency; 2) Shifting to renewable sources of energy; reducing energy intensity (e.g. reducing implicit emissions per person/km or freight/ton/km, through increased occupancy, or zero emission modes); 3) Improving energy efficiency of vehicles (e.g. though optimised scheduling, fuels, eco-driving); 4) Shifting from current transport mode to another that offers lower GHG emissions per person/km or freight/ton/km transported; 5) Public transport reform programmes (for example quality bus or bus rapid transit projects); 6) Vehicle Recapitalisation programmes; 7) Travel Demand Management programmes; 8) Electric bus and vehicle programmes; 9) Fuel technology programmes; 10) Facilities and programmes for walking and cycling; 11) Greener freight and logistics; 12) Carbon taxation.'
'When we refer to *high volume transport*, we are referring to: 1) Road and rail passenger transport; 2) Two- and three-wheelers; 3) Road and rail freight transport; 4) Air and inland water travel; 5) Incentives and other regulatory programmes.'

[7] The ASI approach (Avoid-Shift-Improve) was developed by sustainable transportation think-tanks in order to replace the traditional supply-side oriented approach to increased transport demand (215). The ASI approach focuses on demand-side, and seeks to achieve significant GHG emission reductions, reduced energy consumption, less congestion, and more liveable cities.

- Vehicle Recapitalisation programmes;
- Electric bus and vehicle programmes;
- Fuel technology programmes.

The primary focus of the project is LICs and lower-middle-income countries (LMICs). LICs are defined as economies with a per capita gross-national income (GNI) of USD 995 or less and LMICs have a per capita GNI between USD 996 and USD 3,895 in 2017 (13). Secondary, the focus was to include all other countries in Africa and South Asia where DFID is active. The majority of these countries come from a relative low baseline in terms of aggregate transport emissions, but transport CO_2 emissions are projected to grow significantly in each country over the next decades, [8] conservatively based on a business-as-usual scenario, which assumes that no new policies towards low-carbon transport will be introduced and thus that transport emissions will continue to grow to the same rate as in recent years.

The research process is divided into three phases:

1. Identifying challenges and barriers to implementing LC-HVT measures, knowledge regarding the importance of LC-HVT and associated measures, and interest in particular measures (identified as 'quick wins') in the selected project countries;
2. Identifying capacity and knowledge needs that would enable the implementation of LC-HVT measures, and transport 'quick wins'[9] in particular;
3. Synthesising outputs, in the forthcoming State of the Knowledge research papers and Capacity Development Strategy (not included in this Final Report).

1.3. DATA COLLECTION

1.3.1. PRIMARY DATA COLLECTION

Primary data is reported as a single source – in other words, unless relevant, the report does not distinguish between data collected by survey, expert interview, or face-to-face. These interviewees are referred to as stakeholders, experts, or (study) respondents interchangeably. The intention is not to differentiate between Africa and South Asia, but to focus on commonalities between the low- and middle-income country cohort, and relevance to low-income countries other than those selected; thus, data is reported by country or region only where exceptions are noted or particular points of interest are evident[10].

At various points in this report, data is presented in the form of charts or graphs.

The main variables of interest in this research are the concerns raised in the key questions: challenges, barriers, constraints and knowledge gaps. Thus, this primary data did not collect variables such as

[8] See Section 3.3. and Appendix 7 for the country profiles.
[9] The 'quick wins' refer to immediate bold and ambitious action that will kick-start the transformation of the transport sector in the desired roadmap directions and limit the lock-in effects of a high-carbon BAU scenario. See Section 4.1 of this report for more information.
[10] Broadly, differences are evident where South Asia is further down the road in terms of electric mobility and ride/bike-share applications.

gender and income, and data is not analysed and reported by such variables unless respondents raised these topics or issues (see box 16 on distributional impacts of LCT measures in Section 5.3).

Analysis and findings presented in this Final Report are drawn from the following three primary sources and activities:

Expert Interviews: 23 interviews were conducted with experts from research institutions, government departments, and implementing agencies in the selected countries[11] between October and December 2018 to gain more detailed insight into the state of knowledge on low carbon transport and capacity needs. The interview protocol and the list of the interviewees is included in Appendix 1. The State of Knowledge papers will build on this data and provide greater analysis and reporting where relevant; in particular, the paper titled "An exploration of knowledge-seeking within the low carbon transport arena: findings from key informant interviews in selected African and South-Asian countries".

Stakeholder Survey: A survey on LC-HVT knowledge and capacity in Africa and South Asia was designed and administered to SLoCaT's expert stakeholder network (from which the expert interviewers were also drawn) from September to October 2018 with qualitative and quantitative questions exploring how low carbon transport knowledge is gained, how capacity is achieved, and how transport users and other affected parties are engaged. A profile of the survey respondents is included in Appendix 2. The State of Knowledge papers will build on this data and provide greater analysis and reporting where relevant.

Capacity-Building Workshop: On 2 October 2018, a Workshop on Capacity Building Strategy for the Implementation of LC-HVT in South Asia was organised under this project to obtain input from relevant national and local stakeholders on the needs and barriers in capacity building for implementing LC-HVT in the region. The workshop was a pre-event to the Eleventh Intergovernmental Regional Environmentally Sustainable Transport (EST) Forum in Asia, hosted by the United Nations Centre for Regional Development (UNCRD) from 2 – 5 October 2018 in Ulaanbaatar, Mongolia. The workshop overview is available in Appendix 3.

1.3.2. Secondary data collection (as Appendices)

In addition to conducting peer-reviewed and grey-literature reviews (see below), four data matrices were developed with the aim to: A) review implementation of quick-win low carbon transport measures in selected countries; B) create an overview of envisioned or planned low carbon transport activities in the selected countries; C) identify what has been implemented so far; D) examine the potential preference for new activities that allow to have 'quick wins' in the selected countries. In other words, it allowed review of LC-HVT on a global scale, to examine the current situation of LC-HVT in the selected countries and potential future strategies.

A. **Literature reviews:** Literature is mostly from 2011-2018. Sources include:
   - Peer-reviewed journal articles
   - Grey literature: reports and policy briefs
   - Government official documents

[11] Nine countries were selected for assessment under this project. Asia: Bangladesh, India, Indonesia; Africa: South Africa, Ghana, Nigeria, Rwanda, Uganda, Kenya. Detailed methodology on the selection of countries is presented udder section 1.5.

- If no other sources available: news articles from online media

The purpose of the research was not to provide a comprehensive or systematic literature review, but to undertake primary research in addition to considering the evidence from the literature. The literature scan was conducted between November 2018 and February 2019, and constituted:

- a keyword search; complemented by
- key informant input; and
- bibliographies of published papers; and
- a call for published papers on social media networks; and
- email request to SLoCaT's organisational database.

The search focused on English language scholarly publications globally. The following four databases were searched:

- Science Direct (www.sciencedirect.com);
- Google Scholar (http://scholar.google.co.za);
- JStor (www.jstor.org); and
- ResearchGate (www.researchgate.net).

Key words include: developing countries, Low-income countries, Africa, transport, mobility, carbon transport/mobility, low-emissions transport/mobility, sustainable transport, good practices, best practices.

B. **Matrix of Low Carbon Transport Good Practices**: Desk research was conducted to investigate low carbon transport good practices worldwide. The good practices have been identified through an online search using key words such as 'best practices'/'good practices' in combination with '(low carbon) transport'. The matrix has compiled implemented or planned projects, policies and programmes as well as official government plans and programs with impacts intended to reducing emissions or avoiding future emissions. The items were collected in the matrix and assessed according to their main characteristics, such as the relevant modes, sub-sectors and mitigation measures, ASI-focus and (if available) emission savings. The overview is provided in Appendix 4.

C. **Matrix of Low Carbon Transport Measures in National Policies, Programmes, Targets and Evaluation Mechanisms**: Desk research was conducted to catalogue low carbon transport-related targets and measures, policies and programmes reported in NDCs, National Communications (NCs), Biennial Update Reports (BURs), and regional, national, and local strategies related to transport mitigation. The approach was to go through the reporting mechanisms for the selected countries and filling out the matrix indicating their economy-wide and transport targets, coverage of transport sectors (passenger and freight transport), sub-sectors and transport low carbon measures. The overview is provided in Appendix 5.

D. **Matrix of Implemented Projects and Selected Case Studies**: Desk research was conducted to compile implemented low carbon transport projects identified through global databases on sustainable transport projects for the selected countries. The global databases suitable for this task were the pipeline projects of the climate finance instruments, BRT database and pipeline

projects by the Multilateral Development Banks (MDBs)[12] in the selected countries from 2011 to 2017. Projects related to low carbon transport implemented by the climate finance instruments[13] from 1992 to 2017 were also compiled in the database and projects related to the 'quick wins' for each country have been conducted. The focus was on projects in recent years and any low carbon transport project in any of the selected countries that has been initiated 2008 or after was included in this matrix. The overview is provided in Appendix 6.

E. **Matrix of Low Carbon Transport 'Quick Wins'**: An indicative assessment was developed to show the status of implementation of 'quick wins' in the selected countries. The assessment is based on existing literature available online (peer-reviewed, grey, government reports, and online news media). Through a desk research the 'quick wins' were researched for each country. The retrieved information was allocated to the categories as follows: none = 'quick win' measure does not exist, * = measure in discussion or small pilot, ** = policy in place or some implementation and *** = full implementation of 'quick win'. In the matrix references are given to show why it was judged in this way. It is discussed in Chapter 4.3 and the full matrix provided in Appendix 7.

1.4. PROJECT COUNTRY SELECTION PROCESS

A subgroup of countries was selected through a robust, quantitative selection process (described below) which focused on identifying DFID countries in Africa and South Asia that have the highest need for low carbon transport. The assumption was that urgency is the highest in countries with high motorisation rates, high current transport emissions, and/or a high projected BAU transport emissions growth.

A country beyond the scope of the research but with relatively high transport emissions and high projected BAU growth is China, which emitted 772 Mt CO_2 in 2016, a 193% growth from 2000, or 0.55 tonnes CO_2 per capita (168% growth in same period). But China offers also many best practices: For example, major Chinese cities work strongly on incorporating transit-oriented development elements into urban planning and transit development. Metros are being built in Chinese cities and at the national level, a large high-speed rail network was built, reducing the need for domestic aviation trips (14). About 98% of electric buses in operation globally are in China.

As described in the project concept that the regional focus is Africa and South Asia, twenty-four countries in Africa and South Asia (in which DFID is active) were included in the initial screening process.[14] This pre-selection process was based on a ranking system with six indicators, each of which contained two sub-indicators with national-level data:

[12] There include the eight members of the MDB Working Group on Sustainable Transport: African Development Bank (AfDB), Asian Development Bank (ADB), Development Bank of Latin America (CAF), European Investment Bank (EIB), European Bank of Reconstruction and Development (EBRD), Inter-American Development Bank (IADB), Islamic Development Bank (IsDB) and World Bank (WB).

[13] These cover climate finance projects by the Clean Development Mechanism (CDM), the Clean Technology Fund (CTF), the Green Climate Fund (GCF), the Global Environment Facility (GEF), The International Mechanism Joint Implementation (JI), Nationally Appropriate Mitigation Actions (NAMA), and the Nordic Development Fund (NDF).

[14] The two countries in Africa and South Asia where DFID is active include Ghana, India, Indonesia, Kenya, Liberia, Malawi, Mozambique, Myanmar, Nepal, Nigeria, Rwanda, Sierra Leone, Somalia, South Africa, South Sudan, Sudan,

- Gross Domestic Product (GDP) per capita in 2017 and GDP per capita growth between 2000 and 2017;[15]
- Motorisation level and motorisation growth between 2005 and 2015;[16]
- Current transport CO_2 emissions per capita in 2016 and per capita emissions growth between 2000 and 2016[17];
- Current (aggregate) transport CO_2 emissions in 2016 and emissions growth between 2000 and 2016;[18]
- Projected transport CO_2 emissions per capita for BAU in 2050 and per capita BAU emissions growth between 2020 and 2050 (15);
- Projected transport CO_2 emissions for BAU in 2050 and BAU emissions growth between 2020 and 2050 (15).

For each sub-indicator, countries were ranked from highest to lowest, with points (24 points for Rank 1, 1 point for Rank 24 (or 0 if data not available)) then summed up in the indicators and multiplied with the weight to develop a total final score.

Due to the Theme 3 focus on low carbon transport and its implementation to avoid transport emission growth, the approach has a focus on per capita transport emissions and weight of 2 for future per capita transport emissions (Figure 2):

Figure 2: Weighting of indicators in country selection

Thus, the country selection process identified the countries with the highest risk of becoming the largest transport emission emitter among the 24 countries with already high per capita transport emissions, income level growth and high motorisation rates. The final list of the selected countries would comprise up to three Asian countries and six African countries, which equals a threshold of 35-40% of each country subset. The top five Asian countries and top ten African countries with the highest weighted scores are shown in Table 1.Table 1: Top five and the top ten of the Asian and African countries with the highest weighted scores

	Countries	Weighted Scores	Data Availability
Top 5 Asian countries	India	204	100%
	Indonesia	187	100%
	Bangladesh	170	100%
	Afghanistan	166	100%
	Myanmar	152	83%
Top 10 African countries	South Africa	177	100%
	Ghana	162	100%
	Nigeria	151	100%
	Mozambique	139	100%

Tanzania, Uganda and Zambia. The following belong to South Asia or Africa: China, Iraq, Jordan, Kyrgyzstan, Lebanon, Palestine, Syria, Tajikistan and Yemen (216).

[15] Based on SLoCaT calculations of (217).

[16] Based on SLoCaT calculations of (218).

[17] Based on SLoCaT calculations of (219).

[18] Based on SLoCaT calculations of (219).

	Countries	Weighted Scores	Data Availability
	Tanzania	132	100%
	Kenya	117	100%
	Rwanda	116	83%
	Uganda	106	100%
	Democratic Republic of the Congo	102	100%
	Sudan	98	86%

The initial results identified India, Indonesia and Bangladesh for Asia and South Africa, Ghana, Nigeria, Mozambique, Tanzania, and Kenya for Africa. Mozambique and Tanzania were replaced by Rwanda (ranked 7th on the list) and Uganda (ranked 8th on the list), in consultation with DFID, due to the difficulty in obtaining further quantitative data for analysis in these two countries.

Based on this analysis, the countries selected for this research are as follows (see Figure 3):

- Asia: Bangladesh, India, Indonesia;
- Africa: South Africa, Ghana, Nigeria, Rwanda, Uganda, Kenya.

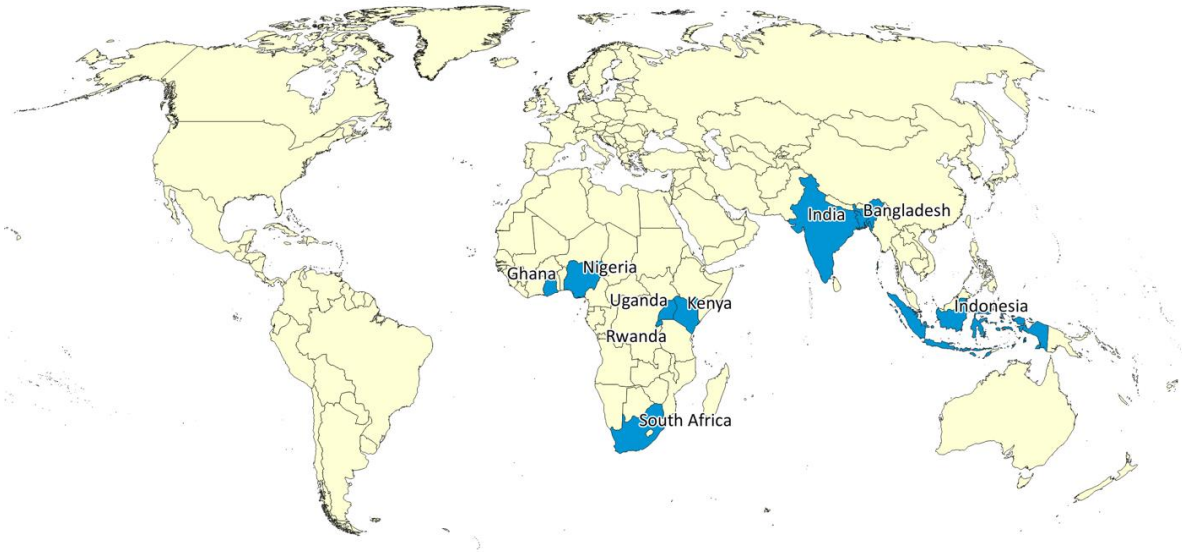

Figure 3: Selected Countries for the project

1.5 SUMMARY AND DISCUSSION

This report explores the current state of knowledge of, interest in, and capacity to implement low carbon, high volume transport in a selected cohort of DFID priority countries in Africa and South Asia among study respondents. It employs primary research to provide a review of the challenges and barriers, interest and knowledge gaps relating to the implementation of low carbon transport measures, supported by literature review. Outcomes of the project are to provide recommendations to DFID on future research directions and propose a capacity building strategy to close the identified knowledge gaps.

The focus of this Theme 3 is climate change mitigation to explore four principal research questions:

- What priority does reducing GHG emissions have in national/ local decisions that affect transport?

- Is it necessary and/or desirable to promote low carbon high volume transport over the coming years? Why is it important (or not) to promote this?
- What are the principle barriers/obstacles that could make broader implementation of low carbon high volume transport difficult to achieve?
- What knowledge is needed to remove these barriers (e.g. developing capacity, and sharing knowledge/good practice/tools)?

The selected cohort of countries for the study included:

- **Asia**: Bangladesh, India, Indonesia;
- **Africa**: South Africa, Ghana, Nigeria, Rwanda, Uganda, Kenya.

The primary research combined findings from expert interviews, stakeholder survey and a Capacity-Building Workshop. Secondary data collection included:

- Literature reviews: Peer-reviewed journal articles, grey literature: reports and policy briefs, government official documents, and news articles

Combined with the development of four matrices:

- Matrix of low carbon transport good practices (Appendix 4);
- Matrix of low carbon transport measures in national policies, programmes, targets and evaluation mechanisms (Appendix 5);
- Matrix of implemented projects and selected case studies (Appendix 6);
- Matrix of low carbon transport 'quick wins'.[19]

[19] The matrix can be downloaded at http://slocat.net/sites/default/files/HVT_Annex_7-Matrix-Low-Carbon-Transport-Quick-Wins.xlsx

2. Low carbon, High volume Transport: Setting the Stage

2.1. Making the case for low carbon, high volume transport interventions in LICs in Africa and South Asia

The IPCC Special Report on Global Warming of 1.5 ºC (1.5 DS) made it clear that rapid and far-reaching transitions in transport (among other sectors) are required, if global warming is to be limited to this figure with no or limited overshoot. Such changes will be unprecedented in terms of scale since they signify that the share of low emission final energy in the sector would have to rise from less than 5% in 2020 to about 35-65% in 2050 (16).

Transport, access and mobility are also key to sustainable development. In July 2012, in its 66th session, the United Nations (UN) adopted a resolution of the 'Future we want', describing the importance of sustainable transport in achieving development goals:

"[The Heads of State and Government and high-level representatives] note that transportation and mobility are central to sustainable development… We recognise the importance of the efficient movement of people and goods and access to environmentally sound, safe and affordable transportation as a means to improve social equity, health, resilience of cities, urban-rural linkages and productivity of rural areas. … We support the development of sustainable transport systems, including energy-efficient multimodal transport systems, notably public mass transportation systems, clean fuels and vehicles, as well as improved transportation systems in rural areas. ...We acknowledge the need for international support to developing countries in this regard."

Meeting sustainable low carbon transport demands is a compelling proposition for an accelerated implementation of LC-HVT across countries, though policy motivations vary widely as described in the following sections.

2.1.1. Definitions of low carbon, high volume transport

Research was conducted in terms of the working definition of low carbon, high volume transport: 'low carbon transport will emit less carbon than in the baseline (BAU)' (see also 1.2, Project Approach).

Study respondents (see 1.3.1) within the selected countries expanded on this definition by including mention of transportation modes, fuels, and systems that would contribute to emissions reductions, and acknowledged the importance of including walking and cycling as low carbon, high volume modes, and suggested a greater focus on spatial urban form, efficient cities, and transit-oriented development. A concern was raised regarding the limits of low carbon definitions; which largely exclude the impact of manufacturing, assembling, and shipping; and the challenge of operating low carbon mass transit vehicles in sprawling cities with high peak-to-base ratios, at low occupancies (for example, running energy-efficient BRT buses during off-peak in an attempt to provide services, but resulting in 'empty mileage' and empty vehicles).

As noted in the introduction, research for this project was conducted in terms of the following working definition of LC-HVT**:** 'low carbon transport will emit less carbon than in the business-as-usual (BAU) scenario'. This is in line with the concept of 'low carbon development' (12), in which national or local

development priorities are the starting point, and when these can be realised in a way that reduces emissions below BAU (or does not emit GHGs), can be called low carbon development.

The commonly expressed view that any alternative to BAU that generates lower GHG emissions is low carbon is concerning since it allows stakeholders to publicly acclaim low carbon actions when those are far from that needed to achieve any climate goal. Yet in the context of adhering with Paris Agreement targets, a more stringent (and perhaps more appropriate) definition of low carbon transport would be to keep emissions sufficiently low to avoid dangerous climate change (i.e. to reduce emissions nearly 90% from a BAU scenario). However, such emission pathways are not defined at the global and country level. In this project low carbon transport interventions refers to transport measures[20] that either reduce the implicit GHG emissions from baseline, or produce zero GHG emissions.

HVT may cover a broad range of transport modes, including road and rail passenger transport; two- and three-wheelers; road and rail freight transport; air and inland waterway transport; and walking and cycling. Figure 4 illustrates the intersection of 'low carbon' and 'high volume' transport modes, demonstrating that motorised modes do not necessarily increase passenger throughout. It also shows that LC-HVT is defined as walking, cycling, tram, and bus, which includes both, which are commonly defined as 'active transport' and 'public transport'.

[20] Study respondents received the following in the introductory documentation on the Definition of Low Carbon Transport (LCT):
' When we refer to *low carbon transport* in this project, our focus is on transport interventions that either reduce the implicit GHG emissions from baseline or produce zero GHG emissions. This could include: 1) Fuel and technology changes to current transport modes that reduce the implicit emissions per vehicle km, such as cleaner fuels, greener technology, engine and driving efficiency; 2) Shifting to renewable sources of energy; reducing energy intensity (e.g. reducing implicit emissions per person/km or freight/ton/km, through increased occupancy, or zero emission modes); 3) Improving energy efficiency of vehicles (e.g though optimised scheduling, fuels, eco-driving); 4) Shifting from current transport mode to another that offers lower GHG emissions per person/km or freight/ton/km transported; 5) Public transport reform programmes (for example quality bus or bus rapid transit projects); 6) Vehicle Recapitalisation programmes; 7) Travel Demand Management programmes; 8) Electric bus and vehicle programmes; 9) Fuel technology programmes; 10) Facilities and programmes for walking and cycling; 11) Greener freight and logistics; 12) Carbon taxation.'
'When we refer to *high volume transport*, we are referring to: 1) Road and rail passenger transport; 2) Two- and three-wheelers; 3) Road and rail freight transport; 4) Air and inland water travel; 5) Incentives and other regulatory programmes.'

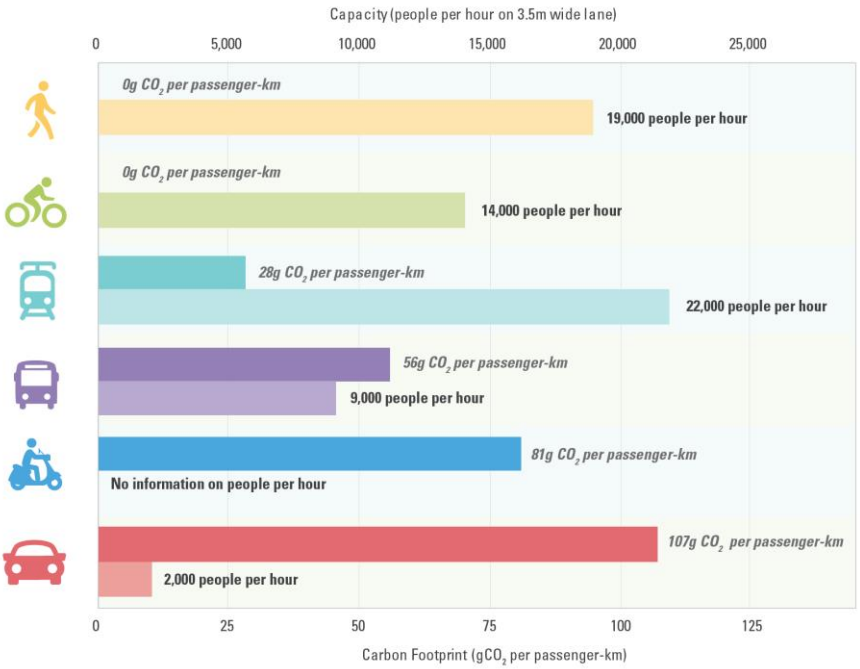

Figure 4: Intersection of low carbon and high volume transport modes (14)[21]

2.1.2 MITIGATION POTENTIAL OF LOW, CARBON TRANSPORT IN DEVELOPED AND DEVELOPING COUNTRIES

GHG emissions from the transport sector are rising more rapidly than any other sector (16)and are projected to increase from currently 8 gigatonnes (Gt) to up to 16 Gt in 2050 in a business as usual scenario. This poses a substantial challenge to reaching long-term climate change objectives included in the Paris Agreement, which aim at limiting global average temperature increase to well below 2 degree Celsius and pursuing efforts to limit it to 1.5 degree Celsius (17). Reductions to a level of 2 to 3 Gt per year in 2050 are required to reach a 1.5-degree scenario (1.5DS)(15) or a level of 6 Gt for a two-degree scenario (2DS) (18).

With emissions projected to rise in most global BAU scenarios, transport is currently off-track to meet Paris Agreement targets, and likely up to 13.6 Gt (19) and potentially up to 18 Gt per year by 2050 under an average scenario (15). This increase will mainly stem from emissions growth in middle-income countries, although per capita emissions in high-income countries (HICs) would still be three times as high. BAU global transport emission projections are roughly 3.5 times higher than a 2-degrees scenario (2DS) goal, and more than nine times higher than a 1.5 degrees scenario (1.5DS) goal (Figure 5).

[21] For illustration purposes only. The carbon footprint for each mode may up to 2-3 times higher or lower than values presented here depending on local circumstances (220).

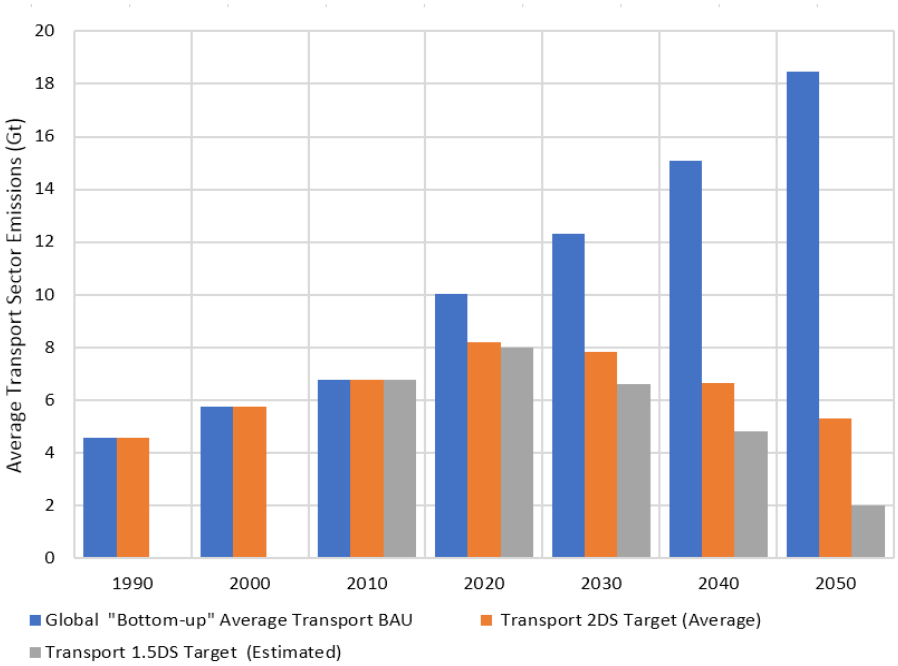

Figure 5: Global transport Emissions BAU Estimates and 2DS-1.5 DS Targets

Unprecedent efforts and far-reaching transitions in all sectors are required to reach the 1.5DS. However, as the IPCC Special Report shows, transport is the most difficult sector to decarbonise and it is a major challenge to the achievement of the 1.5-degree target of the Paris Agreement. Not only does the transport sector have the emissions to decrease, the final energy use by transport has to be reduced by around 15% by 2050 compared to 2015. IPCC cites IEA's figures that a beyond-two degree scenario (developed by IEA) can be reached through efficiency improvement (contributing to 29% of emission reduction), biofuels (contributing 36%), electrification of transport (15%), and a mix of other avoid and shift measures (20%) (16).

Among the transport modes, heavy-duty vehicles, shipping and aviation are regarded as the most difficult modes to decarbonise. Light-duty vehicles produce a significant share of emissions but can reduce their levels by over 80% while heavy-duty vehicles, shipping and aviation are expected to halve their emissions below 2014 levels (16).

Low carbon transport can play a key role in helping to reverse the current emissions trends. Decisions regarding transport infrastructure have the potential to fix development pathways for decades and determine the way in which urbanisation shaped and enabled (20). Thus, policy decisions in the next two to five years will determine whether we are early enough to set on a course for a low carbon transport future (21).

Low carbon transport has the potential to decrease emissions to about 2.5 Gt CO_2 by 2050 in an optimistic low carbon scenario (representing an ambitious, pro-active implementation of low carbon transport), according to a tiered analysis of country-level mitigation potential studies (15). This is still higher than the estimated 2.0 Gt of transport emissions in 2050 required to achieve a 1.5 DS, based on a proportional contribution, noting that the transport pathway will be highly dependent upon other sectors in each country.

In 2012, transport consumed around 28% of global total final energy consumption (2,507 Mtoe out of 8,979 Mtoe) with road transport responsible for 75% of this (1,883 Mtoe). Without action, transport emissions will increase at a faster rate than emissions from other energy end-use sectors and reach up to 18 Gt CO_2 by 2050. To reverse this trend, action is required that will decouple GDP growth – currently driven by growth in passenger and freight activity – from emissions. An example of a country that decoupled economic growth from transport emissions is Singapore where GDP grew by 91% and transport per capita CO2 emissions reduced by 21% (14). This action includes policies to encourage investment in low carbon, high volume transport systems in order to curb energy and emissions growth.

In the case of Africa and Asia, the emission pathways for BAU and a low carbon pathway compatible to 1.5DS show that transport emissions in Asia require a substantive reduction while transport emissions in Africa have to be capped to current levels (Figure 6).

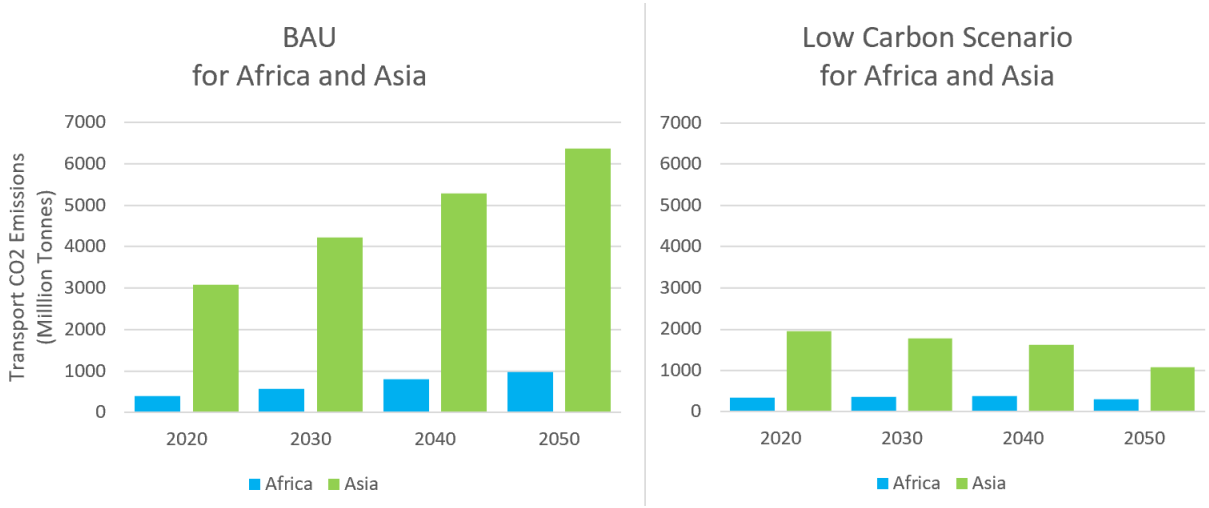

Figure 6: Emission Pathways for Africa and Asia

2.1.3 Priority of Low Carbon Transport in Low Income Countries

Per capita GHG emissions from transport in low- (and lower-middle-) income countries are at a relatively low level (0.1t-0.5t) currently compared to richer countries (1.5t-5t).[22] Moreover, the share of LICs in total global transport emissions was 0.5% in 2010 (15). However, a substantial deviation from projected increases, driven largely by projected rapid motorisation,[23] is required to bring transport sector emissions in line with long-term global climate objectives (0.3t-0.6 t per capita).[24] Motorisation growth and transport emissions growth are correlated to an extent, but emissions growth is driven by other

[22] 0.25 t average for nine project countries in 2016. Based on SLoCaT calculations of (219). See also Section 3.1

[23] In most of these LICs, car-ownership is growing explosively from a low base, driven in part by rising affluence and by poor quality public transport. However, car users are still the minority, and this could be regarded as an opportunity as these countries still have the possibility of designing transport systems for the majority (who use public transport, walking and cycling), and by doing so can develop an urban environment that is less dependent on private motorisation. The split between motorised passenger and freight transport are assumed to be different for Africa and Asia; thus growth rates are also different for the regions and correlation is limited.

[24] For a 1.5- to 2-degree scenario. See also Section 3. Note that these per capita figures have not been published in academic research. However, it's important to note this here for global equity reasons.

factors including vehicle kilometres driven, fleet composition (e.g. share of cars, buses, trucks) and the fuel composition (e.g. diesel vs. gasoline, relative fuel quality).

LICs by and large recognise the need to reduce transport emissions, but this is rarely the measure that drives interventions in the sector. For example, in Accra, Ghana, climate change was omitted as an environmental sub-criterion for the assessment of sustainable urban transport projects, while air and noise pollution were retained (22). In Dhaka, Bangladesh, environmental criteria for sustainable urban transport include noise and air pollution (23), and it is not explicitly stated whether GHG emissions are included. In South Africa, decisions regarding the provision of transport are to be *"consistent with national interests, such as meeting basic needs, growing the economy, developing human resources, and democratising the state and society, while also being environmentally and economically sustainable as well as financially viable"* (24). Nevertheless, particularly local-level authorities see the promotion of cleaner, lower carbon transport, framed as pollution, as a possible 'win' among voters and end-users (as suggested by its inclusion in Dhaka's sustainable urban transport criteria).

As far as interventions on the ground are concerned, mostly these are driven by other (sustainable) development concerns, such as the need to improve mobility/accessibility for a growing urban population, rural connectivity, more efficient logistics, and sometimes energy security (reduction of oil imports) and health (air quality, physical activity).[25] Thus, low carbon transport in LICs can thereby chiefly be seen a co-benefit of sustainable transport (Figure 7). The following response[26] flags the concern interviewees might have, regarding the possible inequitable and unfair distribution of the benefits and disadvantages of low carbon transportation interventions:[27]

"It's a social challenge. For me the question is, what could we have done with that budget instead. If [low carbon public transport] will bring emissions reductions, the [extra] cost might be acceptable – but with the understanding that the mandate is to provide affordable and accessible transport. There must be this balance. It cannot be about deploying the technology to recover the cost of the technology, as you are defeating the whole point of access. We believe that climate change must be mainstreamed, but the additional cost must not be a burden."

[25] See for example (204), (221) and (222).
[26] Expert interview, South Africa
[27] See also Box 16 in Section 5.3

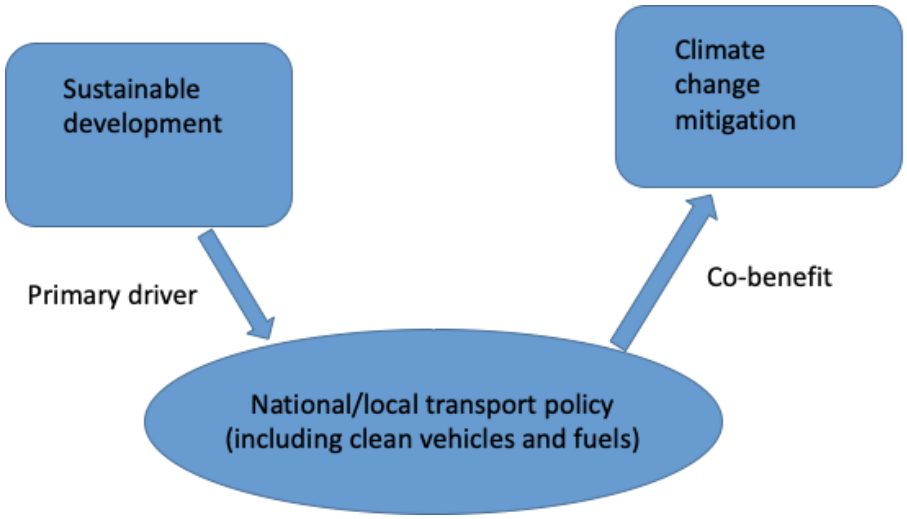

Figure 7: Sustainable development and low carbon transport (adapted from (25)*)*

In LICs, and particularly in Asia, the urgency to develop sustainable transport is driven by the rapid growth of their economies, resulting in ever-increasing transport activity and the accelerated need for infrastructure development. Slowing down the growth in GHG emissions is an international commitment for these countries, and there is a clear understanding, and belief that LC-HVT can lead to the delivery of many other national commitments, such as health. Making the wrong choices now can lead to unsustainable transport pathway that can affect future sustainability for many years to come, noting that impacts to LICs may in large part result from emissions in MICs and HICs.

Congestion is a major concern in most of the large cities in the DFID project countries, and this is where stakeholders are focusing their actions[28]. The importance of liveable cities, air quality and its impact on health is also an issue in most larger cities, but actions to improve it, taken within the transport sector, are lagging in many countries. Some of the larger of the DFID project countries have a national automotive industry, while the others mainly permit the imports of older vehicles, often with outdated vehicle emissions standards.

In most of these LICs, car-ownership is growing explosively from a low base[29], driven in part by rising affluence and by poor quality public transport. However, car users in all of these cities are still the minority, and this could be regarded as an opportunity. It means that these countries still have the possibility of designing transport systems for the majority (who use public transport, walking and cycling), and by doing so can develop an urban environment that is less dependent on private motorisation.

Public sector financing, while an important catalyst for these developments, will not be sufficient to meet these mobility requirements (26). International donor and climate financing, together with public-private partnerships (PPP), have been identified as essential to incentivise different choices in transport provision and to shift growth patterns. The total investment in transport infrastructure in 2011 for 25 Asia-Pacific economies, which represent around 60% of the global population, was around USD 300

[28] Based on primary data collection from study respondents (Section 1.3.1 for details) and findings of (28), (128), (140), (221), (223), (224), and (225).
[29] Based on SLoCaT calculations of (218).

billion (27). In Africa, investments for transport totalled USD 24.5 billion in 2016, down from USD 34.4 billion in 2014 (28). The World Bank estimated that developing regions invested approximately 4% to 8% of their GDP in infrastructure, with the exception of Latin America, which invested less than 3% (29). Public-sector investment represented 42% of the global total for transport in 2010, and private-sector investment therefore represented 58% of the global total (mean value estimate of USD 1.015 trillion) (14). Official Development Assistance (ODA) for transport constituted only 2% of public-sector investments investment in 2010. While 12 transport projects funded by climate finance instruments (CFI) in 2017 totalled only USD 111 million, and 16 climate-related bonds (often referred to as green bonds) enabled an investment volume of USD 6.9 billion.

Box 2: Financing and procurement options for low carbon transport

There is a growing international consensus on the need to reduce transport related GHG and make transport more sustainable in general. There is now also increased understanding on what sustainable transport is. The debate now needs to shift towards the financing required to rapidly scale up the development and operation of sustainable, low carbon transport infrastructure and services.

By 2050, global investment needs for land transport infrastructure are projected to reach a cumulative USD 45 trillion under current policies and while this can deliver enormous environmental, social and economic benefits (beyond GHG reductions) it is clear that they can only be unlocked by enabling private investment. Barriers, however, often limit the attractiveness of investment in sustainable transport projects compared to fossil fuel-based alternatives and new financing and risk reduction mechanisms aim to offset these barriers (30).

Setting **adequate pricing mechanisms** are needed to address market and government failures; such as carbon prices, fuel and vehicle taxes, reform of fossil-fuel subsidies, congestion charges and other road user charges, parking levies, **complemented by supply-side regulations and policies**[30] which help to level the investment field.

- **Public-private partnerships (PPPs)** are procurement methods that allow for private sector participation and risk sharing;
- **Land value capture tools** capture revenues from the indirect and proximity benefits generated by transport infrastructure;
- **Loans, grants and loan guarantees** are traditional financial tools frequently used to leverage private investment in large-scale projects;
- **Green bonds** have the potential to attract institutional investors such as pension funds and insurance companies by tapping into the debt capital markets;
- **Short-run subsidies** can be used to provide transitional support to sustainable transport options and technologies;
- **International government finance** for large transport infrastructure investment (31);
- **Innovative new carbon funding programs** such as the **Transformative Carbon Asset Facility (TCAF)** which is a policy and sectoral results-based carbon market mechanism under Article 6 of the Paris Climate Change Agreement (32).

The **Clean Technology Fund** (CTF) provides new large-scale financial resources to invest in clean technology projects in developing countries (33). The **Global Environment Facility (GEF)** catalyses transformational change by supporting sustainable transport, which reduces GHG emissions (34). The **Global Future Cities Prosperity Fund** was a programme established by the UK government (2017 – 2023)to invest in MICs[31] to improve the way their cities are planned and managed, including providing technical assistance to support cities to develop

[30] Such as; zoning policies, performance based vehicle standards (fuel economy), technology based standards (electric vehicle charging infrastructure), public procurement programmes

[31] Including Brazil, Burma, Indonesia, Malaysia, Nigeria, Philippines, South Africa, Turkey, Thailand and Vietnam.

integrated multi-modal public transport systems and strategies to address the impact of climate change in transport and other sectors (35).

Another programme established by the UK government**, Cities and Infrastructure for Growth** (CIG) (2017-2023), provides technical support on city and regional interventions in Burma, Uganda and Zambia to strengthen investment into infrastructure services, including transport policies and administrative management (36).

Improving the probability of reaching a 1.5DS target will require higher ambition and more comprehensive measures in low carbon transport plans. Growth of absolute transport emissions between 2000 and 2016 was highest in the project's focus regions: Asia (92%) and Africa (84%).[32] This growth is attributed primarily to increased prosperity, which in turn increases passenger and freight transport activities. Africa's contribution to global transport demand has historically been low, though there has been a steady growth rate in motorisation of 33% between 2005 and 2015. On the other hand, most of the global transport demand between 2005 and 2015 was added in Asia, with an 88% increase in its motorisation rate.[33]

Meeting the 2015 Paris Agreement targets will depend to a large extent on whether low carbon, sustainable transport is implemented fast enough in all sub-sectors, including in the project's priority focus areas, as these have recorded rapid emissions and population growth in recent years. Yet, while the primary driver motivating low carbon transport is climate change, the primary drivers of implementing low carbon transport measures tend to be sustainable development benefits. There remains a need for research to show evidence that a context-appropriate shift to low carbon transport solutions has the potential to meet demand on the transport systems and reduce emissions, to allow citizens to experience the benefits of increased access, cleaner air, improved economic development and reduced inequality.[34]

Electric vehicles play a key role in all global transport decarbonisation scenarios. In the current situation, EVs in most electricity grids already save GHG on a lifecycle basis compared to internal combustion engine vehicles (18) (37); for two-wheelers the savings are particularly high. However, a 50 percent reduction of carbon intensity of the power sector by 2030 is necessary to achieve the GHG savings required for the Paris Agreement (37). For LICs, electric cars and trucks are less relevant in the short term due to their high up-front cost and lack of infrastructure. Electric buses, three-wheelers and two-wheelers are more appropriate, especially in Asia where rapid development is taking place. Within the focus countries, this is mainly in India and Bangladesh. Therefore, in this report, with regard to electrification we focus on these three types of vehicles. Reduction of the grid emission factor, e.g. by more renewable energy, is considered important in the long term but for LICs this may not be a priority compared to more pressing development needs. It was not raised by stakeholders in our primary data gathering.

Finally, a note on alternative fuels: natural gas is looked at by many countries including the nine in this study. Although compared to diesel, natural gas is beneficial for local air quality and reduces black carbon, the GHG savings are limited. Therefore, this study does not focus on this fuel. Similarly, first generation biofuels (e.g. from palm oil) have limited GHG savings and potentially adverse impacts on

[32] Based on SLoCaT calculations of (219).

[33] Based on SLoCaT calculations of (218).

[34] A topic for future research is whether and how these factors are jointly considered in project countries and other LICs, e.g. through transport policies that reduce air pollution and carbon emissions or target a shift to local production to cut emissions and deliver (more inclusive gender sensitive, pro-poor) outcomes.

sustainable development. However, many countries have biofuel blending targets though (SLoCaT, 2018). Second and third generation biofuels, e.g. from woody biomass, play a role in transport decarbonisation scenarios (18); yet were not raised in the primary research.

2.2. Existing Quantitative Emission Assessment Tools Supporting Low Carbon Transport Interventions

Measuring CO2 emission reduction and other related SD benefits of transport policies, projects and programmes is essential for driving further action on transport and climate change, through quantification of the potential contribution of low carbon transport infrastructure and services to more carbon-intensive investments. However, research (Table 2) indicates that in many developing countries, the information available on the impact of transport policies and projects on emissions is not only insufficient, but also potentially misleading. Countries can consistently only measure emissions arising from aggregate fuel sales by the type of fuel. But this does not link transport demand and fuel consumption and subsequent evaluation of policies and investments. This is a critical link which is often missing in conventional planning process. Further, many stakeholders consider lack of the modelling capabilities with limited data availability at national and subnational levels has hampered the development of policy interventions and investment in the region.

Table 2: Data and emission quantification in Asia and Africa

Region	Data and emission quantification (quotes from literature)
Africa	“Key stakeholders in many cities in Africa are not sure where best to start to address their transport emission problems because of lack of local data and expertise, a situation which results in holding back progress on green and sustainable transport initiatives” (38).
Africa	“There is a clear lack of urgency from SSA governments in addressing the worsening urban air quality situation in the region possibly owing to the absence of reliable data and local evidence on the environmental and human health impact of air pollution, and the magnitude of the associated health risk” (39).
Africa	"African data are much harder to find than data for other world regions, and transport activity data are even harder to collect and publish than other transport-related parameters” (40).
Kenya	“Uncertainties in the calculations of the mitigation potentials are rather high. A lot of activity data was not readily available. Therefore, the authors were required to make assumptions on sensible parameters for the calculations or use data with high uncertainty” (41).
Asia	“Today, authorities in developing Asian countries cannot adequately measure carbon. Existing aggregate data tell us only approximately how many vehicles of each kind have been at one time registered nationally or by state” (42).
Asia	"Collected data are often not easily accessible, or are incomplete (43)”.
India	“The use of top-down data on fuel consumption in the road transport sector in India may have led to serious errors (44)”.
Indonesia	“Limitations in the quality of input data and the large number of assumptions that dictate the final outcome (45)”.
Asia/ADB	“Data available from recent ADB projects often does not include information needed to estimate CO_2 emissions with reliability (46)”.

To take stock of available methodologies and tools, an assessment on 150 tools and methodologies was conducted and the results show that there is a wide range of tools covering different transport

subsectors and both passenger and freight methodologies.[35] Figure 8 shows the development of CO_2 emission tools and methodologies for transport by release year, which demonstrates a marked increase in methodologies since 2007.

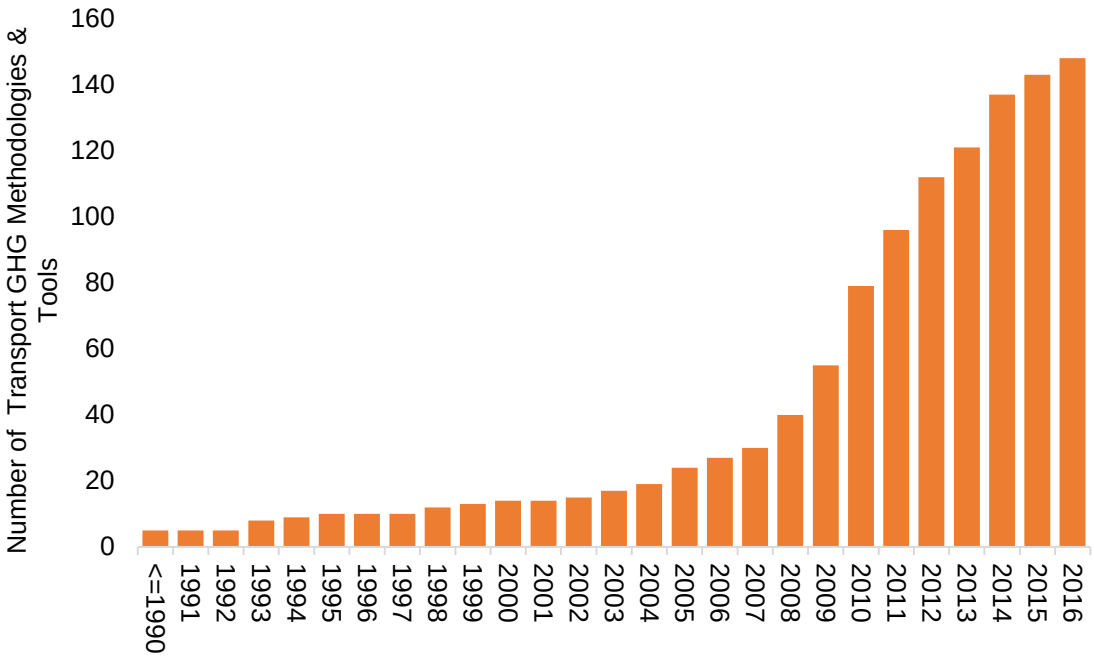

Figure 8: Transport GHG Emission Methodologies and Tools Development from 1990

The number of tools, as well as their scope indicate that action on transport and climate change is not held back by the absence of tools to analyse transport interventions for their climate impact.[36] The typology analysis of the available methodologies and tools are highlighted below:

1. **Modes of transport:** While nearly 90% of tools reviewed in the assessment are related to the road transport sector, a significant percentage of tools consider other modes including railways (50%), waterways (39%) and aviation (31%) (Figure 9). Within the road sector, non-motorised transport (NMT) modes such as walking and cycling are relatively neglected in the methodologies and tools, with about 21% share and with other modes with a more evenly distributed share (between 41% and 65%). About 69% of tools are applicable to the freight sector, and about 96% of tools for the waterway sector are oriented toward freight, due to the rapid growth of freight shipping activities.

[35] The full database can be downloaded here: http://slocat.net/sites/default/files/HVT_Annex_8-Tools-Assessment.xlsx

[36] The full list of tools assessed in this section can be downloaded here: http://slocat.net/sites/default/files/HVT_Annex_8-Tools-Assessment.xlsx

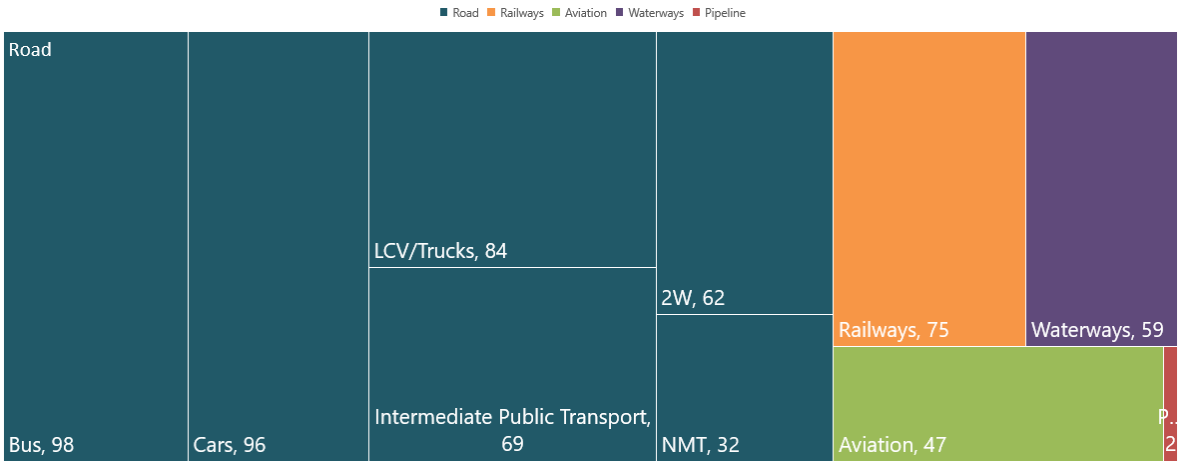

Figure 9: Number of tools categorised by modes of transport

**2W = Two-wheeler motorised transport; NMT = Non-motorised transport (walking and cycling)*

2. **Functions:** Among the 150 tools, 50% of the assessed tools specifically focus on analysing the impact of transport emission strategies. Only about 25% focus on GHG inventories or projections for all economic sectors (where transport is a sub-sector). 23% focusing solely on transport sources with the objective to develop emission factors or carry out comprehensive emission inventories for all gases emitted during vehicle use for the base year.

3. **Application areas:** Tools are evenly distributed among different application areas, with the majority focusing on evaluating impacts of transport policies, and less focusing on evaluating emissions from transport infrastructure, carrying out fleet-level assessment, and organisation-level assessment (Figure 10). Slightly more tools are designed for project-based assessment than programme-based emission impact assessment. A few tools are designed to quantify supply chain emissions integrating various transport modes.

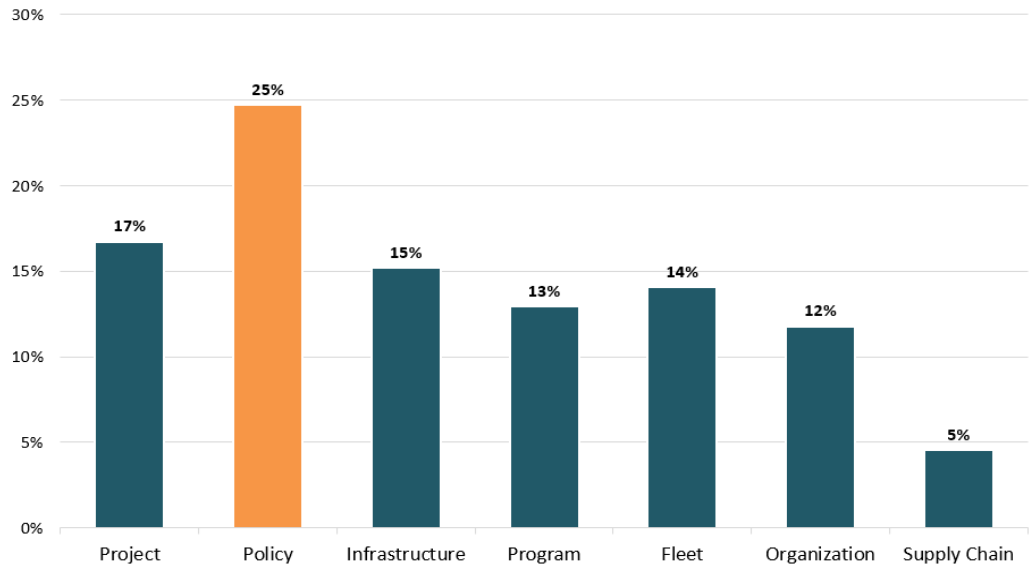

Figure 10: Share of tools categorised by application areas

4. **Development:** Three quarters of tools and methodologies are financed by development agencies and governments. NGOs and academia have financed nearly 27% of these tools, while the private sector has contributed to the development of only 8% of tools and methodologies, of which 90% are primarily freight-oriented

5. **Mitigation Strategies:** The 150 tools in the assessment also cover a broad range of mitigation actions, with the greatest number of tools related to alternative fuel incentives, vehicle efficiency improvement, and comprehensive urban transport programmes and intra-urban mass rapid transit investment (Figure 11). A lesser share of the tools cover pricing policies, developing national fuel economy standards, freight infrastructure investments and inter-urban rail infrastructure.

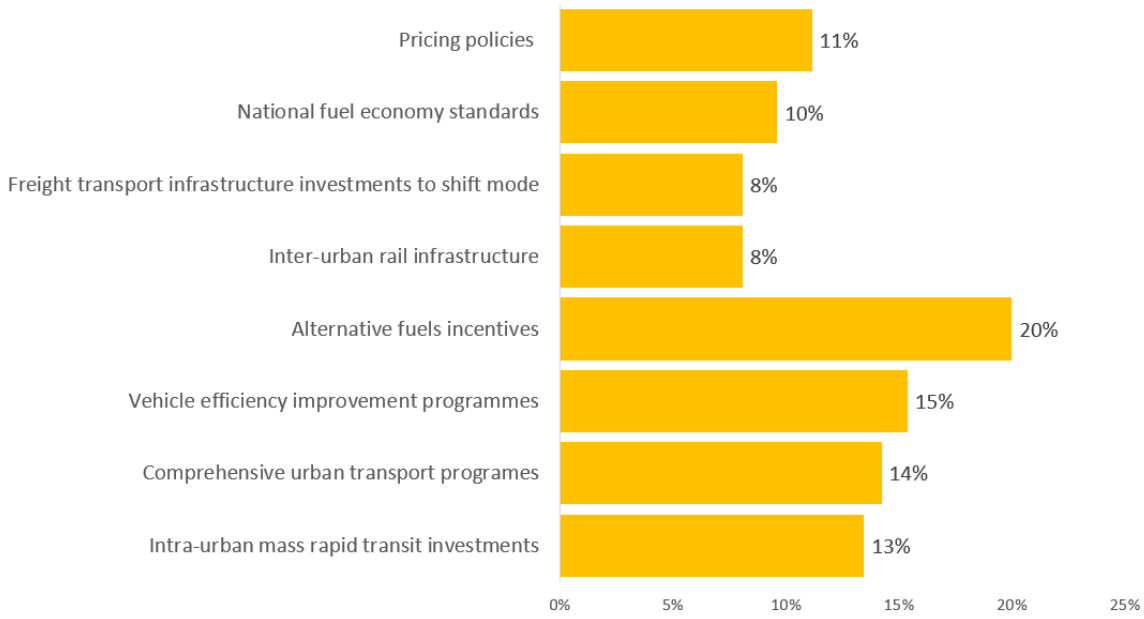

Figure 11: Share of tools categorised based on mitigation actions

6. **Assessing Co-benefits:** More than half of the tools can also be used to assess other benefits of proposed measures (Figure 12). This is an important contribution, as application of SD benefits to climate finance-supported transport sector projects has been limited to date. More than 60 GHG tools in this assessment also quantify air pollutants such as particulate matter (PM) and nitrous oxides (NO_x). Only 10 tools quantify short-lived climate pollutants (SLCPs) like methane and black carbon, which can be critical factors in shifting the balance of a transport investments from infeasible to feasible. A number of tools also capture SD benefits including fuel savings, road safety impacts, and travel time savings.

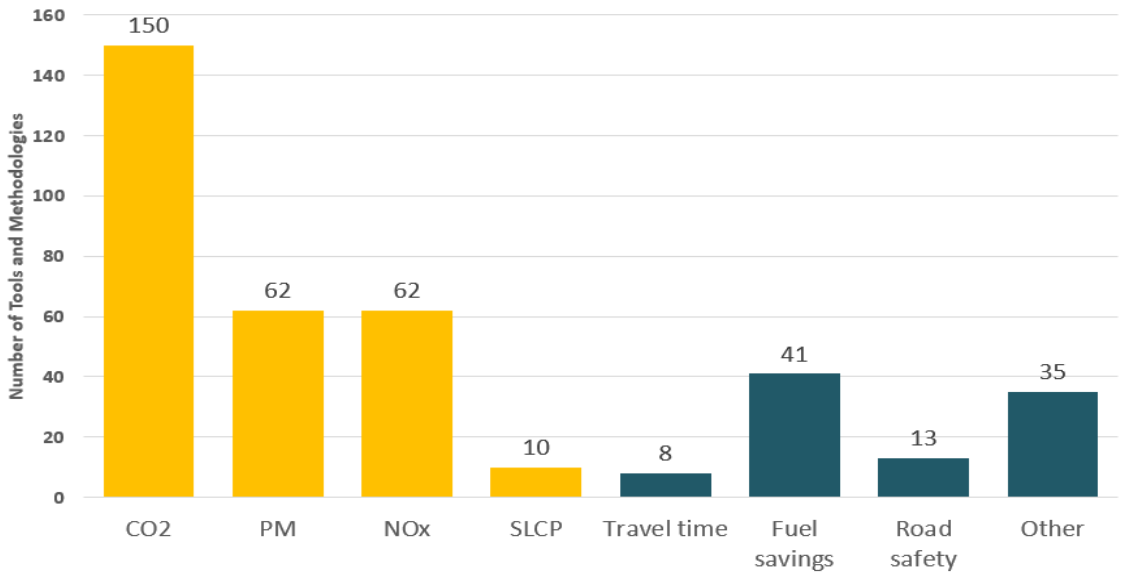

Figure 12: Number of tools with methodologies to assess co-benefits

Detailed assessment especially for the LICs and MICs indicated that not only 99% of the tools are useful for bottom-up modelling but about half of the tools are available free of charge indicating that the modelling assessments could be carried out with less resources. Further, while the majority of tools tend to be detailed in character and data requirements, there are also a growing number of sketch tools (18%) that provide order-of-magnitude emissions estimates where data is scarce (Table 3):

Table 3: Selected list of sketch tools available to assist decision-making in developing countries

Name of Tool	Year	Objective
Avoid		
Analysing Emission Reductions from Travel Efficiency Strategies (TEAM)	2011	Low-cost method to estimate the impact of travel efficiency strategies.
Fuel Economy Policies Implementation Tool (FEPIT)	2015	Allows countries to analyse potential outcomes of different policy options based on the characteristics of their vehicle fleets in a range of different scenarios. Support countries as they seek to promote fuel economy policies.
Trip Reduction Impacts of Mobility Management Strategies (TRIMMS) model	2008	Estimates the impacts of a broad range of transport demand initiatives and provides program cost effectiveness assessment, such as net program benefit and benefit-to-cost ratio analysis.
Transport Emissions Evaluation Models for Projects (TEEMP) Commuter Strategy	2010	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for commute planning and improvement. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.
TEEMP Pay-As-You-Drive (PAYD) Insurance	2010	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for PAYD interventions. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.

Name of Tool	Year	Objective
TEEMP Pricing Strategies	2010	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for pricing policies. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.
Shift		
TEEMP - Bikeshare	2009	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for bikesharing interventions. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.
TEEMP - Bikeways	2010	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for bikeways construction interventions. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.
TEEMP - BRT	2010	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for Bus Rapid Transit (BRT) interventions. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.
TEEMP-Railway	2012	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for railway development. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.
TEEMP – light rail transit/mass rapid transit	2010	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for LRT and MRT projects. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.
Improve		
Quantifying Transit's Impact on GHG Emissions and Energy Use—The Land Use Component	2015	Examines the complex interrelationships between transit and land use patterns to better understand their contribution to compact development and the result
EcoPassenger	2010	A calculator to compare the energy consumption, CO_2 and exhaust atmospheric emissions for planes, cars and trains for passenger transport.
TEEMP Eco-driving	2010	Enables the estimation of emissions in both 'project' and 'no-project' scenarios for introducing eco-driving programmes. Evaluate short to long term impacts of projects. Primarily evaluates CO_2 emissions and air pollutant emissions using data gathered during project feasibility and actual operations.
Freight		
EcoTransIT World	2003	Quantify the emissions and eco-impacts of freight movements by various transport modes.
DEFRA freight transport methodology	2010	Evaluate GHG emissions for the freighting of goods.
Decision-making and policy development		

Name of Tool	Year	Objective
Benchmarking and Energy Savings Tool for Low Carbon Cities	2016	A dynamic decision-making tool, designed to assist local policy makers and urban planners in prioritizing strategies for energy and carbon saving at the city level.
Tool for Rapid Assessment of City Energy	2008	Decision-support tool designed to help cities quickly identify under-performing sectors, evaluate improvement and cost-saving potential, and prioritise sectors and actions for energy efficiency (EE) intervention including transport.
Urban Transport Roadmaps	2016	Supports authorities of small and medium sized cities who may not have the resource to major policy assessment and modelling work. Help local transport policy-makers to identify, develop, screen and assess different measures and policies scenarios and the scale of impacts that could be expected.
Toolkit for Local Governments on Developing Sustainable Transport Policies and Strategies	2013	Assist local governments in developing sustainable transport policies and strategies at the local level in order to reduce GHG and air pollutant emissions from the urban transport sector.
United Nations Environment Programme (UNEP) Clean Fleet Toolkit	2006	Facilitate the development of strategy for reducing the environmental impacts of fleet.
CCAP Transport Emissions Guidebook	2005	Engage state and local officials in understanding the extent to which policy decisions impact air pollution, energy use, and GHG emissions.
Financing		
Guidelines for Measurement, Reporting and Verification of GHG Emission Reductions in JBIC GREEN Operation	2012	Assesses eligibility of the projects for financing based on measurement, reporting and verification of the GHG emission reductions in the projects.
IFC GHG Reduction Accounting Guidance for Climate Related Projects	2013	Provides technical guidance for IFC investment and advisory staff to conduct GHG emission reduction calculations for climate-related projects.
Monitoring, Reporting, and Verification		
Calculating CO_2 Emissions from Mobile Sources	2005	Facilitate corporate-level measurement and reporting of GHG emissions from transport and other mobile sources.
GHG Emissions Calculation Methodology and GHG Audit	2011	Explain the options of stating GHG emissions along the supply chain and to provide the methodology, rules and guidelines for calculating and verifying GHG emissions and emission reductions.

A sketch methodology is usually adopted when the user does not have any data on the avoid-shift-improve-related parameters and still needs to assess the likely impact of project, policy, and/or investments. These sketch models are particularly useful in developing countries where data availability and institutional capacity are generally low. Box 3 discusses the use of sketch modelling in transport sector.

Box 3: Use of Sketch Modelling in Transport Sector
For example, to develop a simple sketch model for quantifying co-benefits including CO_2 emissions from transport projects and investments, Clean Air Asia, together with partners such as the Institute for Transport Development Policy (ITDP), ADB, Cambridge Systematics and the UNEP – GEF Scientific and Technical Advisory

Box 3: Use of Sketch Modelling in Transport Sector

Panel, developed excel-based, free-of-charge spreadsheet models collectively called as 'Transport Emissions Evaluation Models for Projects' (TEEMP)(46) (47).

The TEEMP tools are 'sketch' models which enable the estimation of emissions in both 'project' and 'no-project' scenarios and can be used for evaluating short to long term impacts of transport projects. The main objective of TEEMP tools is to support the implementation of the sustainable transport policies to improve air quality and mitigate climate change. TEEMP primarily evaluates the impacts of transport projects on CO2 emissions and to some extent air pollutant emissions (PM and NOx) using data gathered during project feasibility and actual operations. Co-benefits such as travel time savings, fuel savings, CO2/PM/NOX emissions and accident savings are quantified in these TEEMP tools.

The following table summarises types of co-benefits which could be quantified in TEEMP suite of tools:

TEEMP Tool	Fuel savings	Travel time savings	CO2 Emissions	PM and NOx Emissions	Noise	Fatalities and Injuries	Increased Productivity	Land Use Impacts	Heath Impact
BRT	✓	✓	✓	✓	NA	✓	NA	✓	NA
Metro	✓	✓	✓	✓	NA	✓	NA	✓	NA
Roadways	✓	✓	✓	✓	NA	NA	NA	NA	NA
Railways	✓	✓	✓	✓	NA	NA	NA	NA	NA
Bikeways	✓	✓	✓	✓	NA	NA	NA	NA	NA
Bike share	✓	✓	✓	✓	NA	NA	NA	NA	NA
Walkability	✓	✓	✓	✓	NA	NA	NA	NA	NA
City	✓	✓	✓	✓	NA	✓	NA	NA	NA

Note – '✓' indicates quantification possible and 'NA' indicates quantification not possible in TEEMP model

Using TEEMP BRT model, World Bank estimated the impacts of 1,000 km of new BRT corridor deployed in 20 or more Indian cities (48):

- 1,100 to 1,350 reduced traffic fatalities per year;
- 1.9 to 2.3 million tons/year of CO2 emissions reduction;
- annual savings of 300 tons of black carbon;
- USD 6.4 to 8.1 billion in macroeconomic benefits (over 20 years);
- 50,000 to 90,000 short-term jobs rising to 128,000 permanent new jobs;
- more than 175 avoided deaths annually in India because of improved air quality;
- more than USD 500,000 in annual avoided crop losses because of air pollution;
- 500 million hours/year of time savings because of shortened trips

Findings: The assessment shows that there is a wide range of tools available to help transport practitioners and planners to assess opportunities and impacts, prioritise planning, assess alternative options, create a baseline, and implement, evaluate and monitor the performance of transport projects.

First, is noted that most methodologies are project based, which runs counter to the current trend toward more programmatic approaches (e.g. as incorporated in an increasing number of Nationally Appropriate Mitigation Actions – NAMAs) and sector wide approaches (e.g. as mandated in the development of Nationally Determined Contributions – NDCs).

Second, it is noted that there are relatively few methodologies to quantify impacts of transport demand management, NMT, and urban freight, which are essential pieces of a comprehensive set of sustainable transport infrastructure and services.

Third, it is important for methodologies to allow 'business-as-usual' project baselines which reflect likely investment trajectories based on past investments and current policy frameworks (as opposed to simple 'no action' scenarios), so that sound transport investments can be advanced and unsound investments can be avoided.

Fourth, while about 60% of methodologies reviewed (e.g. city level inventories, fleet level assessments, freight supply chains) consider an analysis period of more than a single year, there is still 40% of methodologies that limit analysis to one year. It is crucial to consider longer term impacts, since almost all transport projects may yield positive impacts after several decades, a timeframe well within a project's useful life.

Fifth, most of these available tools do not convert quantified emission impacts into monetary context for detailed economic analysis. Ideally, decision-making for low carbon transport should be based on the results of the economic evaluation, i.e. a course of action should only be pursued if its net present value is positive. However, most of the emission quantification tools do not consider such an assessment.

Sixth, transport emission quantification and monitoring can be complex, time-consuming and costly and thus it is important to select a set of key indicators and data parameters that will be used to evaluate the impact of policy and/or project. Further, considering varied availability of different data parameters in countries, suitable default values for various mitigation activities could be identified for use in Low- and Middle-Income Countries. Further, a global sketch tool for policy impact could be developed with default data which could be used for sketch mitigation analysis in countries with limited data for NDC and SDG priority action identification and implementation.

Finally, it is important that co-benefits be increasingly prioritised in decision-making processes for transport policies, and thus it is essential that the growing trend toward incorporating co-benefits into GHG methodologies be even more far-reaching. A broader incorporation of social co-benefits (including air quality, travel time, road safety, and fuel savings) into GHG emission methodologies offers the potential to improve cost-benefit ratios of sustainable transport investments, and to better reflect the contribution of such investments toward a range of sustainable development goals. Further, considering the data-related constraints and poor integration of SD benefits in low carbon transport projects, policies and investments assessment, there is a growing demand for multi-criteria assessment tools. These tools are generally used in the transport sector assessment to determine which policy or project or investment option meets the desired and stated objectives and the targets. Multi-criteria assessments can incorporate both quantitative and qualitative criteria, used when goals are different or even conflicting and when impacts cannot be converted to a monetary basis.

2.3 SUMMARY AND DISCUSSION

This chapter makes the case for why low carbon high volume transport should be considered by lower-income and lower-middle-income countries in Africa and Asia, discussing the mitigation potential and priorities for implementation. It closes with a discussion on the available tools to quantify the emissions reduction from low carbon transport interventions.

As the chapter sets the stage for the study, it starts by defining low carbon high volume transport, where:

- ***High volume transport*** is defined as including to a broad range of transport modes, including road and rail passenger transport; two- and three-wheelers; road and rail freight transport; air and inland waterway transport; and walking and cycling.
- ***Low carbon transport*** is defined, in line with the concept of 'low carbon development'(12), as 'transport that will emit less carbon than the alternative in the business-as-usual (BAU) scenario'.

The need to consider the adoption of low carbon, high volume transport derives from the internationally agreed target (through the UNFCCC-led Paris agreement) of limiting global warming to a maximum of 1.5 ºC. Meeting this requires a significant worldwide reduction in GHG emissions from all sectors, including transport. Over the past half century, transport sector emissions have growth at a rate faster than any other energy end-use sector with the highest increase coming from middle-income countries due to rapid motorisation and economic growth[37]. Growth of absolute transport emissions between 2000 and 2016 was highest in the project's focus regions – Asia (92%) and Africa (84%) – but transport is a difficult sector to decarbonise due to its high dependence on fossil fuels and its disperse nature – where changes in modal usage can affect millions of persons – however not doing so can lock-in GHG emissions to a high trajectory for many decades.

Transport, access and mobility are key to sustainable development and transport interventions are mostly driven by development concerns, such as the need to reduce congestion, improve mobility/accessibility for a growing urban population, rural connectivity, and logistics to support an expanding industrial and economic activity. Thus, low carbon transport in LICs is usually seen as a desirable co-benefit but not as a driver of transport interventions and this study sets out to explore the current state of knowledge of, interest in, and capacity to implement low carbon, high volume transport in selected countries in Africa and South Asia and what could be done to enhance its implementation.

The chapter also looks at the analytical tools that are available to support an enhanced implementation of low carbon solutions. It compares over 150 tools and methodologies used for quantitative assessment finding a wide range of tools covering all transport subsectors for both passenger and freight. It highlights the differences between sketch models that are useful for ex-ante assessments with limited data and more complete bottom-up methodologies that can analyse from a Monitoring, Reporting and Verification (MRV) perspective the mitigation achieved.

The greatest number of tools relate to alternative fuel incentives, vehicle efficiency improvement, and comprehensive urban transport programmes and intra-urban mass rapid transit investment. A lesser share of the tools cover pricing policies, developing national fuel economy standards, freight infrastructure investments and inter-urban rail infrastructure. Many of the tools also quantify criteria pollutants such as PM and NO_x and/or allow the economic or financial cost of the low carbon alternative and marginal cost of abatement to be calculated.

[37] Although the per capita emissions in high income countries are stabilising but still three times higher.

3. AMBITION WITHIN THE SELECTED COUNTRIES TO IMPLEMENT LOW CARBON, HIGH VOLUME TRANSPORT MEASURES

At the 21st Conference of the Parties (COP21) in 2015, Parties to the UNFCCC reached a landmark agreement to accelerate and intensify the actions and investments needed for a sustainable, low carbon future (49). The Paris Agreement (2015) pursues efforts to limit the temperature increase to 1.5DS above pre-industrial levels. The Agreement calls for appropriate financial flows, a new technology framework, and an enhanced capacity building framework to support actions taken by countries based on their own national objectives (or known as the NDCs).

Although the text of the Paris Agreement itself makes no specific reference to transport sector, it is a strong call to accelerate the decarbonisation of the transport sector, which is responsible for nearly one-quarter of energy-related CO_2 emissions. The Agreement offers opportunities for the transport sector to contribute to its ambitious goals for GHG emissions reduction.

This chapter gives an overview of the mitigation potential of low carbon transport and associated measures, and summarises the targets and measures reported in the NDCs, NCs, and BURs submitted by the selected countries under UNFCCC mechanisms. These commitments have led to the incorporation of low carbon transport plans in national plans for climate change, and the emergence of a number of regional, national, and local plans for low carbon transport in the nine countries.[38]

3.1. THE MAGNITUDE OF REQUIRED AMBITION AND ACTION

SLoCaT has previously developed a global meta-analysis of transport sector emissions by aggregating 'bottom-up' country transport CO_2 estimates for the timeframe of 2020 to 2050 (50). Estimates for the BAU and a Low Carbon Scenario (LCS) have been developed in order to show the magnitude of required actions to reduce emission in the transport sector.

Emissions in the BAU projections assume that no additional low carbon policy actions are adopted in the countries. Emissions in the LCS shown are based on the assumption that significant additional policy measures and investments in low carbon modes will be introduced in an extended, ambitious manner that will lead to emission levels compatible to the 1.5DS target of the Paris Agreement (50). However, the current commitments from these countries (conditional and unconditional targets as well as actions in NDC submissions) are not ambitious enough to meet this this goal, with GHG emissions significantly increasing in real terms over this period.

A bottom-up analysis of the needed transport emission scenarios for the nine countries shows that the transport emissions in the LCS compatible to the 1.5 DS target of the Paris Agreement would have to be 83% below the BAU by 2050 (Figure 13). In this desirable LCS, transport emissions would subsequently have to decrease. To contribute proportionally to the estimated 1.5 DS target of 2 Gt by 2050, the selected countries can achieve a transport emissions level of 356 Mt CO_2 (per methodology described in

[38] The summary is based on the information collected in the Matrix of Low Carbon Transport Measures in National Policies, Programmes, Targets and Evaluation Mechanisms. More details on the matrix are provided in Appendix 5.

previous paragraphs). Examining all current LICs and lower middle-income countries (LMICs), the 1.5 DS target requires 77% below the 2050 BAU. Transport emissions by these two country groups have to be limited to under 737 Mt CO_2 (15).[39]

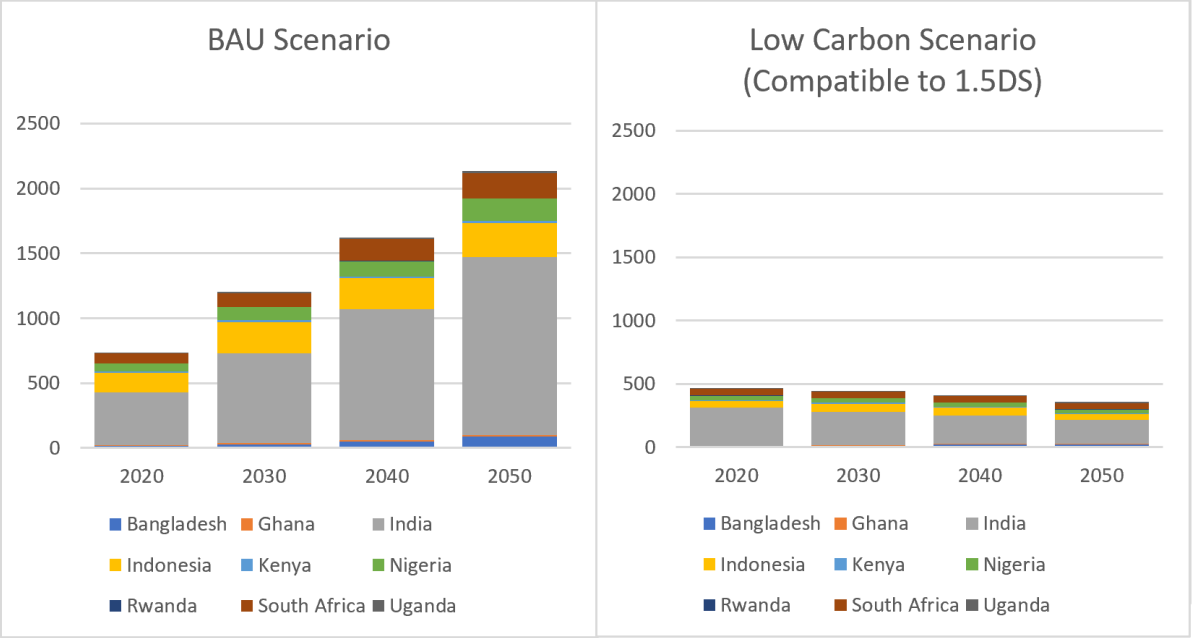

Figure 13: Comparison between BAU and Low Carbon Scenarios of project countries (15)

Comparing the BAU in 2050 and the 1.5 compatible level of transport emission for each country, it shows that all countries can contribute and reduce emissions by a large extent. In countries with a low baseline (Ghana, Kenya, Rwanda and Uganda), the reductions can be between 59% and 66% below the BAU by 2050, while medium-sized emitters (Indonesia, Nigeria and South Africa) need to reduce by 75% to 83% and large emitter India by over 86% below the BAU by 2050 (Figure 14).

[39] The scope of this project does not explore whether these countries are aware of the level of emissions reductions required for their interventions to be low carbon; it is also not within the scope of this study to explore the current status of private sector investment in each of the project countries.

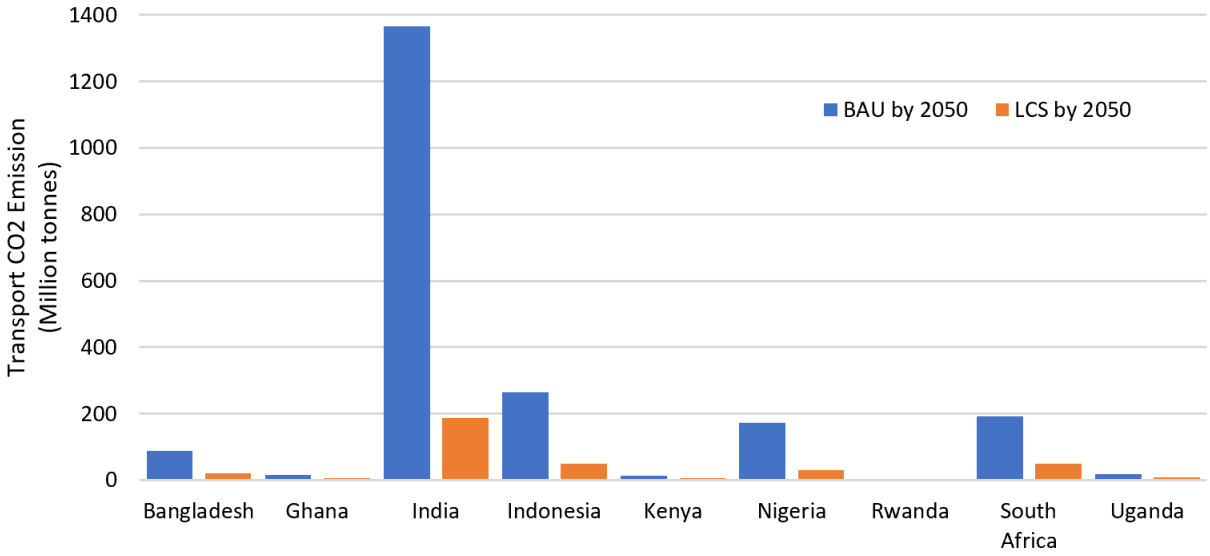

Figure 14: Comparison of BAU and LCS by 2050 for Selected Countries (15)

Transport emissions per capita were on average at a level of 0.25 tonnes per capita in the nine countries and in the bottom-up approach, national efforts can lead to reducing the transport per capita emission to roughly 0.2 tonnes by 2050 (to make a proportional contribution to Paris Agreement 1.5 degree target) (Figure 15).[40] The figure below compares the per capita emission for each country. Significant decreases will be necessary for Ghana, Indonesia, Nigeria and South Africa where future population size is expected to increase strongly in the next decades.

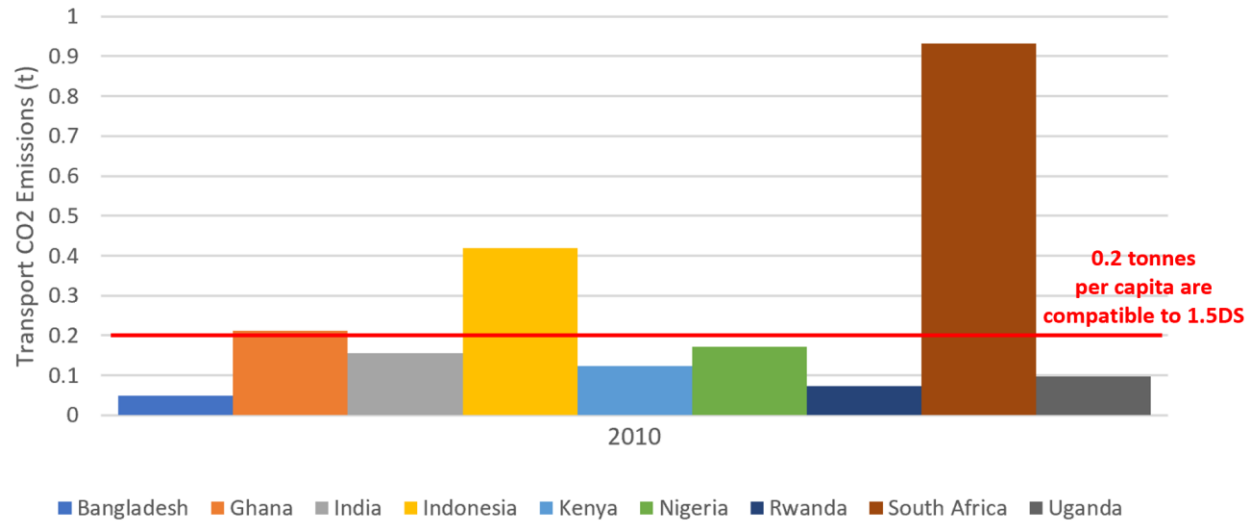

Figure 15: Per Capita transport emissions of the project countries in 2010 (15)

[40] Based on metadata Implications of 2DS and 1.5DS for Land Transport Carbon Emissions in 2050 (50) and average emission for the nine DFID countries.

3.2. ACTIONS AND COMMITMENTS TO LOW CARBON TRANSPORT REPORTED UNDER THE UNFCCC PROCESS

The Paris Agreement was reached by Parties to the UNFCCC[41] at COP21 in 2015 in Paris to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. It calls for ambitious goals to set up appropriate financial flows, a new technology framework and an enhanced capacity building framework to support actions taken by countries based on their own national objectives through the NDCs.

The Agreement entails empowering opportunities for the transport sector to contribute to its ambitious goals for GHG emissions reduction through the NDCs submitted by Parties and non-Party stakeholder involvement in the UNFCCC process. In addition, Parties have been submitting reports to communicate the progress made to reduce GHG emissions in their countries. These national reports include the Biennial Reports (BR),[42] Biennial Update Reports (BUR),[43] and National Communications (NC).[44] In addition, National Adaptation Plans (NAPs)[45] and National Adaptation Programmes of Action (NAPAs)[46] are plans submitted by developing and developed countries to identify strategies and actions for adaptation.

The Paris Agreement requires all Parties to report regularly on their emissions and on their implementation efforts based on their respective NDCs. In addition, countries have started to submit communications of long-term strategies in late 2016 to identify mid-century, long-term low GHG emission development strategies for mitigation and adaptation. Facilitative Dialogues to review the progress made under the NDCs were conducted starting from 2018. There will also be a global stocktake every five years to assess the collective progress towards achieving the purpose of the agreement and to inform further individual actions by Parties.

Figure 16 compares the number of NDCs, NCs and BURs[47] covering passenger and freight transport and major transport sub-sectors with a high relevance for low carbon transport. While there are each nine

[41] The UNFCCC is the leading international environmental treaty adopted in 1992 with the purpose to 'stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. More information at: https://unfccc.int/

[42] Submitted by Annex I Parties to outline progress in achieving emission reductions and the provision of financial, technology and capacity-building support to non-Annex I Parties, building on existing reporting and review guidelines, processes and experiences.

[43] Submitted by non-Annex I Parties with updates of national GHG inventories, including a national inventory report and information on mitigation actions, needs and support received.

[44] Submitted by non-Annex I Parties to provide information on GHG inventories, measures to mitigate and to facilitate adequate adaptation to climate change, and any other information that the Party considers relevant to the achievement of the objective of the Convention.

[45] A means of identifying medium- and long-term adaptation needs and developing and implementing strategies and programs to address those needs

[46] A process for the Least Developed Countries (LDC) to identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change – those needs for which further delay could increase vulnerability or lead to increased costs at a later stage.

[47] The five selected countries which have submitted BURs as of January 2019 are India, Indonesia, Ghana, Nigeria, and South Africa.

NDCs and nine NCs, only five BURs have been submitted. Bangladesh, Kenya, Rwanda and Uganda did not submit any BUR to date.

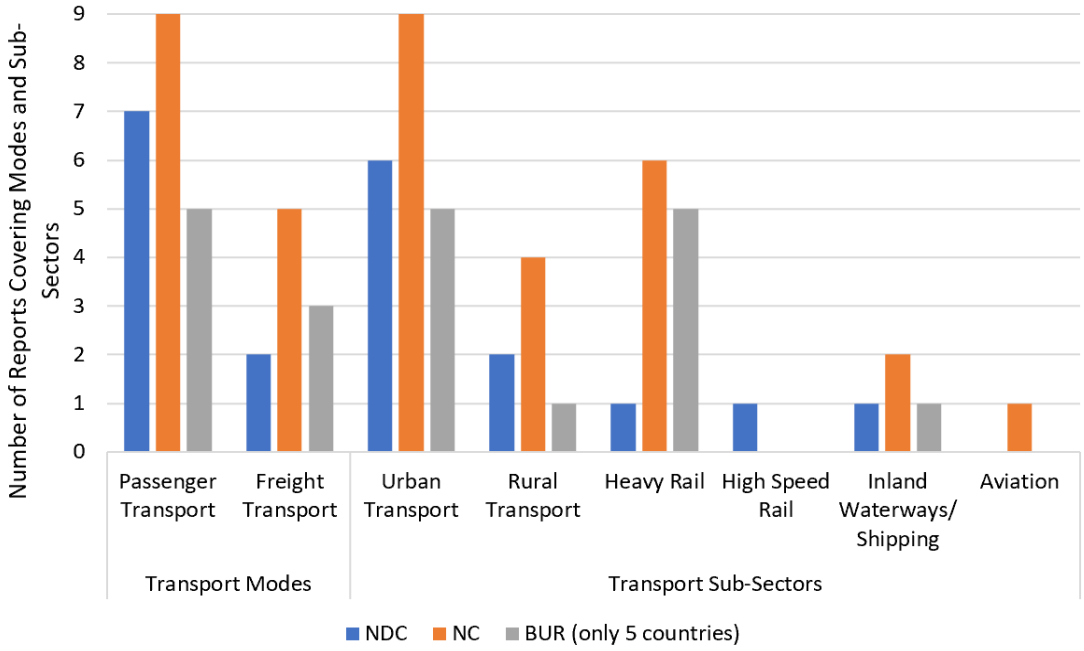

Figure 16: References to transport modes and sub-sectors in NDCs, NCs, and BURs submitted by project countries (51)

The NDCs of Indonesia and Kenya have only general statements on transport without attributing any details to transport modes or sub-sectors. In all three reporting mechanisms passenger transport is referred to more often than freight transport and while urban transport dominates clearly in in NDCs, the NCs also highlight heavy rail and rural transport besides urban mobility (Figure 16).

Passenger transport is covered in all NCs and all BURs that were submitted and all NCs refer to urban transport, showing that urbanisation and the mobility of urban dwellers is regarded as important. The only country mentioning high-speed rail was Nigeria, with the ambition to develop a high-speed rail network. Only South Africa included aviation in their reporting, and the plan is to consider biofuels for aviation. All five submitted BURs include measures on urban transport and heavy rail. Single measures without a comprehensive package will not be sufficient to reach significant emission reduction and the 1.5DS of the Paris Agreement, as shown in Chapter 2.

In addition, a SLoCaT analysis of 166 NDCs submitted by 193 countries around the world shows that 76% highlight transport as a mitigation sector and only 8% of countries (14 countries) have specific transport GHG mitigation targets (51). Among these 14 countries with transport emission targets, two are LICs: Burkina Faso and Ethiopia. All of the countries in the SLoCaT analysis highlight transport mitigation. Bangladesh has the only NDC among the nine selected countries with a target on transport mitigation: 24% below 2030 BAU. The fact that most countries include a list of mitigation actions in transport (even though climate change is not a primary driver) shows that there are a lot of options for climate change mitigation in the transport sector, which can be lessons learned even for LIC with low per capita emissions and other key development priorities.

Passenger transport is mentioned in 63% of NDCs and freight is covered in 21%, while in the NDCs of the this project's priority countries shares a similar ratio can be identified (77% for passenger and 22% for

freight). However, freight transport currently accounts for about 36% of global land transport emissions (19) and thus in theory should receive a proportionate share of mitigation measures (relative to passenger transport) (14). However, in practice there is observed a relative lack of attention to freight in the UNFCCC process, which appears to be a result of two general factors: (1) a lack of policy attention and (2) less literature compared to passenger transport.

The following section gives an overview on the targets, measures, plans and strategies related to the transport sector in the NDCs, National Communications, and BURs of the selected countries.[48]

3.2.1. TRANSPORT TARGETS REPORTED IN NDCS, NCS, AND BURS BY THE PROJECT COUNTRIES

Setting specific, quantified targets is an important element in establishing a vision and tracking progress toward sustainable transport development. A number of targets were set by the selected countries via various reporting (e.g. NDCs, BURs, and NCs) for GHG emissions reductions in the transport sector. In one example, Bangladesh set a conditional target (that is dependent on obtaining international help and financing) to reduce 24% of GHG emissions in the transport sector by 2030 compared to BAU (52); Indonesia set a conditional target to reduce GHG emissions in the transport sector by 26% 2020 compared to BAU (53); Rwanda has set an ambitious conditional target in their 2nd NC's mitigation scenario to reduce 64% of GHG emissions in the transport sector by 2030 compared to BAU (54).[49]

Table 4 below gives an overview of the transport emission mitigation targets by the selected countries:

Table 4: Transport emission mitigation targets set by project countries (51)[50]

Country	Year	Transport Mitigation Target
Bangladesh (52)	2015	24% below BAU by 2030 Shift of passenger transport from road to rail by 20% by 2030 compared to BAU
Ghana (55)	2015	80% of all trips in cities to be by public transport
India (56)	2015	Reduce emissions from transport Increase share of railways in total land transport from 36% to 45%
Indonesia (53)	2015	26% below BAU by 2020
Kenya	N/A	No Targets
Nigeria	N/A	No Targets

[48] All nine countries have submitted NDCs and NCs to the UNFCCC. Five countries have submitted BURs to UNFCCC. Countries that did not submit BURs as of October 2018 are: Bangladesh, Kenya, Rwanda, Uganda (226).
[49] It may be argued that there is an incentive for developing country stakeholders to inflate BAU emissions and offer a small reduction so they can meet more easily any later mitigation commitments with existing or planned measures. Initial NDC submissions were intended to get countries involved in the mitigation process; and it was not a requirement for any country to have BAUs independently verified, which will come later in the process.
[50] Note that while setting targets may be helpful in raising mitigation ambition, it does not imply the presence of having sufficient policies in place to reach these targets. The scope of this project does not explore the impacts of each of these transport mitigation targets on the individual emissions of each country.

Country	Year	Transport Mitigation Target
Rwanda (54)	2012	Mitigation Scenario sees 64% below BAU
South Africa (57)	2016	To have 20% hybrid-electric vehicles by 2030
Uganda (58)	2015	Fuel efficiency to reduce emissions between 24% and 34% of 2030 BAU for road transport

Other targets were set by the project countries to show their commitment towards shifting to low carbon transport. For example, Bangladesh aims to achieve a shift in passenger traffic from road to rail of up to around 20% by 2030 compared to BAU (52). India has also set a target to increase the share of railways in total land transport from 36% to 45% in order to decrease reliance on less efficient diesel operated road traffic (56).

The Emissions Gap Report by the UN Environment Programme shows that emissions must peak by 2020 to have a good chance to keep warming between 1.5 to 2 degrees (59). However, the submitted NDCs and the development of the Paris Rulebook have yet to fully address this goal with the same level of ambition in climate action (60). For the project countries, transport emissions would have to be 63% below BAU for 2030 in order to make a proportional contribution to a 1.5DS; thus, even the most ambitious project country targets fall well short of emission reductions levels required to avoid dangerous climate change.

To bridge the gap between reported targets and actual implementation for climate change, negotiations during the 24th Conference of the Partiers to the UNFCCC (COP24) in 2018 focused on producing a more uniform and mitigation-centric NDC guidance favoured by developed countries while spelling out improved processes for financial support for developing countries. Agreement centred around a common set of elements to be applied to each country based on the type of its NDC (e.g. absolute emission reduction targets vs. relative emission intensity targets) as opposed to separate sets of rules for developed and developing countries (61). These outcomes have the potential to alleviate the inconsistency across reporting by countries and monitor actual progress in achieving the targets of the Paris Agreement.

3.2.2. Transport Mitigation Measures reported in NDCs, NDCs, and BURs

Since transport infrastructure related decisions 'lock-in' transport demand for decades to come, policy decisions in the next two to five years will determine whether we are set on a course for a low carbon transport future (21). Improving the probability of reaching a 1.5 DS target will require higher ambition and more comprehensive measures in low carbon transport plans. This will involve defining and implementing a balanced set of strategies to 'Avoid' unnecessary transport trips; to 'Shift' existing trips to more efficient means, and to' Improve' those trips that are not easy to 'Avoid' or 'Shift'.

'Avoid' measures seek to improve the efficiency of the transport system as a whole through integrated land-use planning, optimising logistics and transport-demand management to reduce the need to travel and the length of transport trips. India is working on the integration of congestion charges and parking in its urban transport strategy and integrating transport planning with spatial planning for urban environment. Indonesia is also applying a number of localised avoid measures to reduce transport

demand, including the application of Traffic Impact Control, parking management, congestion charging and road pricing (combined with its metro system).

'Shift' measures seek to improve trip efficiency by increasing modal shift from the most energy consuming transport modes (e.g. private motorised vehicles) to more environmentally friendly modes (e.g. rail freight, public transport, cycling and walking).

'Improve' measures focus on vehicle fuel efficiency as well as on the optimisation of transport infrastructure through related technology and alternative energy use.

Figure 17 shows the low carbon transport measures reported by the selected countries in their submitted NDCs, NCs, and BURs. It counts how often each measure appears in a document and in theory, the maximum would be 27 references (reported three times by each of the nine project countries) but there were only 5 BURs leading to a total sample size of 23 references. The distribution shows that measures related to public transport (bus-base) have been reported by the highest number of reports (16 reports), followed by rail infrastructure development (nine reports), use of biofuels in transport (nine reports), public transport (metro) development (eight reports) and green freight (eight reports). The distribution also points to the fact that LC-HVT options play a key role in decarbonising the transport sector and contributing to achieve the targets and goals of the Paris Agreement.

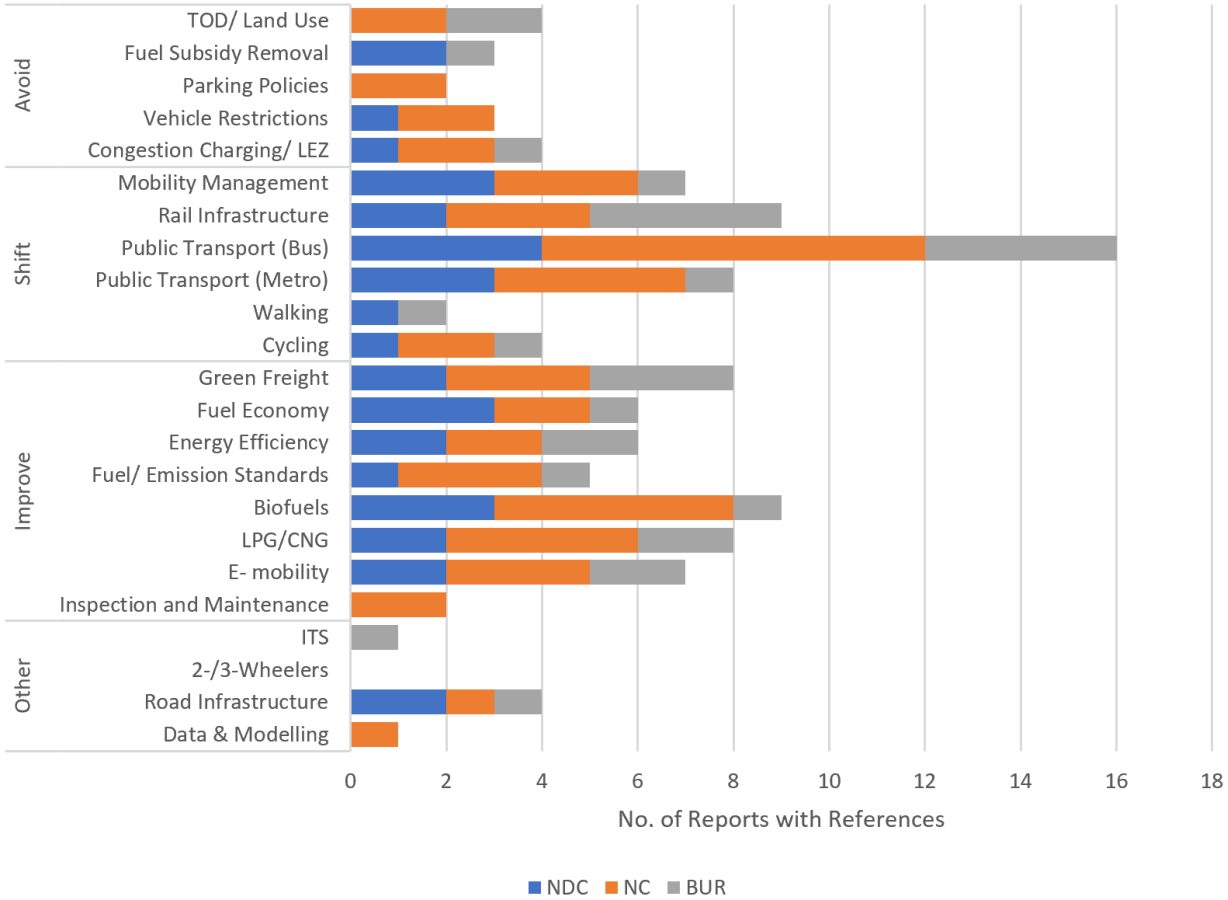

Figure 17: Low carbon transport measures reported by the project countries in NDCs, NCs, and BURs (51)

In total, there are 54 transport mitigation measures in NCs, 35 in NDCs and 30 in BURs for the project countries. It shows that NCs are the richest sources for climate action and that countries report in more detail in NCs about how they aim to achieve emission reductions. However, as noted in Table 5 below, only Nigeria shows a *historic* decrease in per-capita emissions (from 2000 to 2016), and only Kenya shows a *projected* decrease in BAU transport emissions (to 2050), with other project countries showing projected BAU growth rates between 50% and 200%.

Table 5: Transport Mitigation Measures summarised from NDC, NC and BURs (51)

Country	Avoid	Shift	Improve
Bangladesh	Mobility Management	Public Transport (Bus and Urban Rail), Green Freight Measures	Energy Efficiency Standards, Vehicle Emission Standards, Road Infrastructure Development, Railway Infrastructure Development
Ghana	Vehicle Import Restrictions	Public Transport (Bus and Urban Rail), Walking, Cycling	Fuel Quality Improvements, Inspections, E-Mobility, Rail Infrastructure Development
India	Integrated Land Use Planning, Fuel Subsidy Removal, Parking Policies, Congestion Charging, Mobility Management	Public Metro, Walking Measures, Cycling Measures, Green Freight Measures	Energy Efficiency Standards, Feebate, Ecodriving Fuel Quality and Vehicle Emission Standards Improvement, Biofuels, E-Mobility, Road Infrastructure Development, Rail Infrastructure Development
Indonesia	Integrated Land Use Planning, Parking Policies, Congestion Charging, Mobility Management	Public Transport (Bus and Urban Rail), Walking Measures, Cycling Measures	Ecodriving, Fuel Quality and Vehicle Emission Standards Improvement, Biofuels, Railway Infrastructure Development, Improvement of Data
Kenya	Vehicle Restrictions	Public Transport (Bus and Urban Rail), Green Freight Measures, Railway Infrastructure Development	Fuel Economy/ Energy Efficiency Standards, Biofuels
Nigeria	Integrated Land Use Planning, Fuel Subsidy Removal, Road Pricing	Public Bus Transport, Walking Measures, Cycling Measures, Green Freight Measures	Fuel Economy/ Energy Efficiency Standards, Biofuels, LPG/CNG, Road Infrastructure Development, Rail Infrastructure Development
Rwanda	Integrated Land Use Planning, Vehicle Restrictions (Import), Mobility Management	Public Transport (Bus and Urban Rail), Walking Measures, Cycling Measures	Fuel Quality and Vehicle Emission Standards Improvement, CNG, Other Measures to Improve Energy Efficiency (Feebate, Ecodriving), Road Infrastructure Development, Railway Infrastructure Development

Country	Avoid	Shift	Improve
South Africa	Integrated Land Use Planning	Public Transport (Bus and Urban Rail), Walking Measures, Cycling Measures, Green Freight Measures	Measures to Improve Efficiency, Biofuels, CNG, E-Mobility, Intelligent Transport System, Rail Infrastructure Development
Uganda	N/A	Public Transport, Green Freight Measures	Other Measures to Improve Energy Efficiency (Fuel Efficiency), Maintenance and Inspection

The transport measures included in the NDCs, NCs and BURs do not necessarily reflect all activities and actions on transport. These documents focus on measures that are regarded beneficial for climate action (mitigation and adaptation). In addition, as these are national plans, they might miss local action directly developed and implemented by cities and subnational entities.

3.2.3 Transport Mitigation Measures Implemented in Recent Years

To allow for a comparison between the envisioned low carbon transport measures through NDCs, NCs and BURs and what is been implemented, recently implemented (2008 or later) low carbon transport projects listed in major global databases have been collected.

Summarising the implemented projects gives a similar picture of what has been shown in the NDCs, NCs and BURs (Figure 21): passenger transport-related projects dominates over freight transport projects and urban transport is the most relevant transport subsector. The categories of high-speed rail and aviation have not been included in the chart as none of the projects belong to any of these two subsectors.

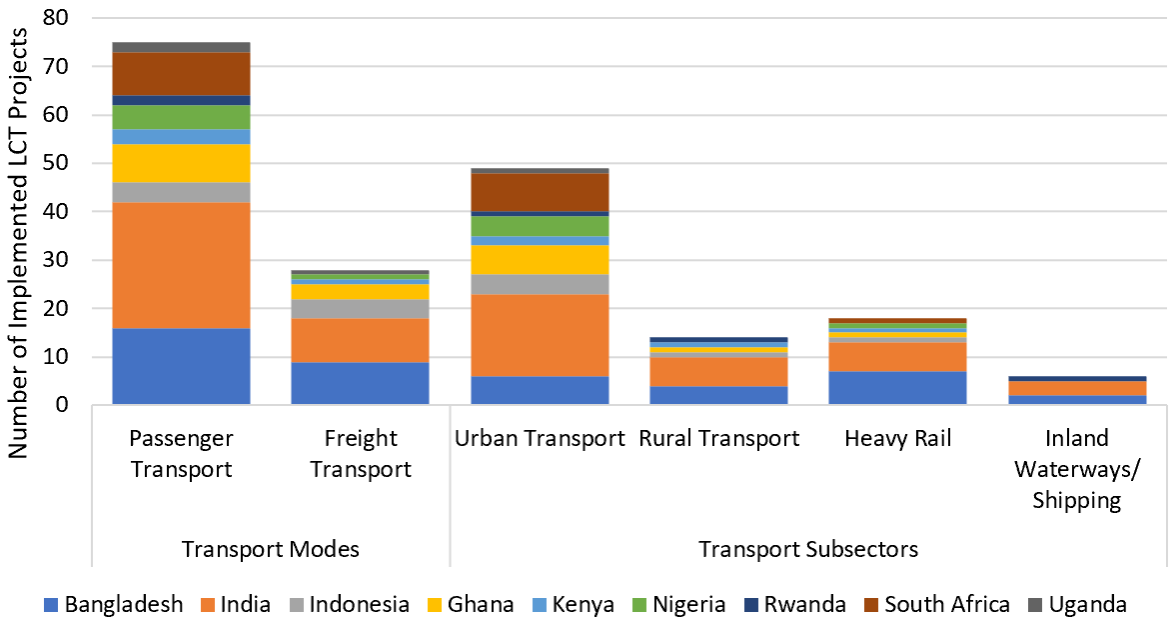

Figure 18: Transport modes and subsectors of implemented LCT projects

Such measures can be supported through climate finance instruments. From 2005 until now there have been 41 projects supported by climate finance in the selected countries. In each country around 4 to 6 projects have been implemented. These projects covered over USD 5 billion in investment volume. An example is the Abuja Mass Transit, a CTF-supported urban transport project in Nigeria (62).

Details on measures as well as projects financed via climate finance can be retrieved in Appendix 6.

3.2.4 Adaptation activities expressed in NAPs and NAPAs

Transport systems are vulnerable to the impacts of climate change and resilient transport is regarded as an important contributor to disaster recovery. Climate-related events are already causing severe disruptions to transport systems and there is a growing number of incidents in developed and developing countries around the world (14).

Policies responding to the impacts of climate change are expressed in national adaptation plans (NAPs) and National Adaptation Programme of Actions (NAPAs). Among the project countries, only Kenya has submitted a NAP (63). It includes short-term, medium-term and long-term actions to enhance climate proofing of the infrastructure. The actions cover short-term activities, such as risk and vulnerability assessments of existing as well as planned infrastructure, compatibility assessment of infrastructure assets with a low carbon climate resilient economy and capacity building on these topics. In the medium-term climate proofing of all roads, railways, marine infrastructure and aviation is envisioned and in the long-term action the infrastructure vulnerability and possibilities to upgrade infrastructure will be re-assessed.

NAPAs have been submitted by Bangladesh (64), Rwanda (65) and Uganda (66). All of them lack a focus on adaptation in the transport sector despite referring to the threats of climate change and extreme weather hazards. Bangladesh and Uganda mention the damage caused to infrastructure due to flooding, Rwanda recorded destruction of road infrastructure, bridges and infrastructure in low-lying areas.

3.3. Country profiles

The nine countries selected from Africa and Asia are diverse in terms of population size, income levels and GDP (see Table 6). Rwanda and Uganda are LICs, Bangladesh, Ghana, India, Indonesia, Kenya and Nigeria are lower MICs and South Africa is an upper MIC. Rwanda has the smallest population with 12.2 million people and its GDP per capita is the second-lowest (USD 765 per person) among the countries. On the contrary, in the largest country, India, there are 1.3 billion people. Uganda has the lowest GDP per capita of USD 666 while South Africa has the highest GDP with USD 7,524 per person.

However, despite different baselines, all countries have a strong population and GDP per capita growth in common. The strongest growth of GDP per capita were in India (158%), Bangladesh (115%) and Rwanda (134%). Population increased in the selected countries from 2000 to 2017 between 25% (Bangladesh, Indonesia) and 78% (Uganda), showing that the African countries experienced a stronger population increase than the three Asian countries. Such rapid population increases are major challenges for the countries and they add significant pressure to its cities and transport systems.

Table 6: Demographic background of the project countries[51]

Country	Population Size (million people) (2017)	Population Growth (2000 to 2017)	GDP per Capita (2017)	GDP per Capita Growth (2000 to 2017)
Bangladesh	164.7	25%	1093	115%
Ghana	28.8	52%	1814	87%
India	1,339.2	27%	1964	158%
Indonesia	264	25%	4130	93%
Kenya	49.7	58%	1169	40%
Nigeria	190.9	56%	2412	87%
Rwanda	12.2	52%	765	134%
South Africa	56.7	24%	7525	29%
Uganda	42.9	78%	667	62%

Examining motorisation trends and transport CO_2 emissions (see Table 7), the project countries show even larger differences. In Bangladesh there were 3.8 cars per 1,000 people in 2015, while there were 173.6 cars per 1,000 people in South Africa. The motorisation rate in Bangladesh grew by 31% between 2005 and 2015 and tripled (337% increase) in Ghana. Absolute transport CO_2 emissions grew in all selected project countries but relative to capita, Nigeria saw a decrease of 22% (which may be due to statistical issues or simply that population growth outpaces emission growth). In this case the population grew stronger (56%, the second strongest growth among the nine countries) than transport CO_2 emissions. The future BAU projections will have a negative trend in Kenya through similar reasons while all other countries are expected to see substantial increase in emissions.

Table 7: Transport-related data of project countries[52, 53]

Country	Motorisation Rate, cars/1000 population (2015)	Motorisation Growth (2005-2015)	Transport CO_2 Emissions per Capita (t) 2016	Transport CO_2 Emission per Capita Growth (2000-2016)	Transport CO_2/Capita BAU in Mt (2050)	Future BAU Transport Emission Growth (from 2020 and 2050)
Bangladesh	3.84	31%	0.063	178%	0.435	413%
Ghana	32.26	337%	0.258	70%	0.287	32%

[51] Based on SLoCaT calculations of (227) and (217).
[52] Based on SLoCaT calculations of (227) and (218); SLoCaT calculations of (219); and (15).
[53] Note potential statistical limitations (e.g. 8-12% annual motorisation growth rate is common for LICs/MICs)).

Country	Motorisation Rate, cars/1000 population (2015)	Motorisation Growth (2005-2015)	Transport CO_2 Emissions per Capita (t) 2016	Transport CO_2 Emission per Capita Growth (2000-2016)	Transport CO_2/Capita BAU in Mt (2050)	Future BAU Transport Emission Growth (from 2020 and 2050)
India	22.04	144%	0.204	126%	0.801	174%
Indonesia	87.20	118%	0.602	94%	0.819	45%
Kenya	29.24	64%	0.126	45%	0.146	-23%
Nigeria	20.69	65%	0.141	-22%	0.435	54%
Rwanda	N/A	N/A	0.065	26%	0.195	121%
South Africa	173.63	23%	0.896	14%	2.917	107%
Uganda	12.21	53%	0.0542	17%	0.173	62%

The summaries show that there are different dynamics in place for each country. Bangladesh had a lower motorisation growth than India but transport CO_2 emission grew stronger. The reason can be that Bangladesh comes from a very low baseline and small increases translate to large growth rates. Further, a growth in emissions can be more intensive in countries with lower economic growth than in other countries if even basic sustainable transport methods (e.g. rail transport for freight) are not in place.[54]

Detailed profiles of the selected countries can be found in Appendix 7.

3.4. Summary and Discussion

While the concept of environmental sustainability in transport development (e.g. congestion, air pollution, road safety, social equity) initiated international attention dated back to the 1992 Rio+ 20 Summit, climate change mitigation and adaptation are relatively new and emerging concepts and criteria for transport development. With the 2015 Paris Agreement, new mechanisms (NDCs, NCs, BURs) provide opportunities to establish a link between transport policy and climate policy in low income countries, thereby creating a foundation to scale up implementation of low carbon transport. These policy realms are usually covered by different ministries (e.g. transport vs environment/energy). This chapter shows that the climate change reports submitted to date by the nine project countries include the transport sector, indicating both an emerging link between transport and climate change and a scope for strengthening it. However, efforts to date fall well short of the transformational change

[54] It is noted that many of the countries are investing in large road building programmes being funded through loans. Effort to ensure that low carbon measures are the norm include the joint MDB Joint Commitment to sustainable transport framework; which is used for monitoring investments. This tool can be strengthened, based on more research into carbon impact of investments (e.g. the European Investment Bank is also doing this currently) and through further communication with the member countries.

required to optimise and align efforts to create low carbon and climate resilient pathways in these and other LICs and LMICs.

The fact that most of the nine countries include a list of mitigation actions for the transport sector (even though climate change is not a primary policy driver) shows that there are options for climate change mitigation in the transport sector, which can serve as useful examples even for LICs with low per capita emissions and other key development priorities. However, the current targets and activities on transport by the selected project countries are still incompatible with the 1.5-degree Celsius target of the Paris Agreement. While various countries lack a specific target for transport emission mitigation, most of the countries with existing 2030 emission targets have to increase their level of ambition.

The reports include a substantial a number of low carbon transport policies and measures, mainly in the realm of 'Shift' and 'Improve' (e.g. biofuels, vehicle energy efficiency measures and public). In 77% of the NDCs, passenger transport is included, while only 22% identify freight measures, even though freight contributes almost half of global transport emissions. The reports do not cover all low carbon transport measures that countries are taking. For example, no mitigation measures for two- and three-wheelers were found, even though some countries are developing measures on electric two- and three-wheelers (as will be shown in Chapter 4). Another area where relevant transport developments are not adequately reflected in climate change mechanisms is the Sustainable Urban Mobility Plans and National Urban Mobility Programmes.[55]

[55] Whether in turn climate change is reflected in these policies falls beyond the scope of this research.

4. 'Quick Wins' for low carbon transport measures and their relevance to the selected countries

4.1 Application of low carbon transport to LICs through 'Quick Wins'

As discussed in Chapter 2, climate change mitigation is not generally a primary driver for transport or energy policies in LICs (notwithstanding detailed transport measures in the NDCs of some LICs). It is more likely to be acknowledged as a consideration for decision makers in transport in developing countries, including transport authorities, ministries of energy, industry and finance. This consideration is mainly based on the global policy framework on climate change and sustainable development of which these countries are part, for example through their Nationally Determined Contributions (see Chapter 3). Therefore, low carbon transport could be seen as co-benefit of sustainable mobility policies and measures, with accessibility, equity, air quality and energy security as key drivers.

One way to operationalise the application of low carbon transport in LICs is through so-called transport 'quick wins'. Transport 'quick wins'[56] are actions that can be taken in the short to medium term and which are seen by many experts as contributing to moving the transport sector toward a long-term low carbon transformation. 'Quick wins' have been tested at scale (e.g. Sustainable Urban Mobility Plans have been developed in around 800 cities worldwide (67)) and are replicable with the possibility for large-scale impact (e.g. fossil fuel subsidy reform has the potential to reduce country carbon emissions by up to 10% (see Table 8)). They are technically and economically feasible in both developed and developing countries using available technologies. Finally, 'quick wins' address both passenger and freight transport, with a reasonable balance between the two, and they should have relevance to the 'Avoid-Shift-Improve' concept (68). Thus, as mentioned above, they reflect that sustainable development benefits[57] are the main policy drivers, with climate change mitigation as an additional benefit.

'Quick wins' have a key role to play in climate change mitigation, however they are only part of the package of measures that is required to bring the transport sector onto a 1.5-degree pathway. Moreover, QWs do not substitute for investments in low carbon infrastructure and vehicles that have to be taken in the short to medium term in order to avoid a lock-in into high-carbon transport systems. Examples include rail, waterways, and EV charging infrastructure. Decision-making processes also need a focus on QWs due to the long lead time of planning for these infrastructure to be operational.

This chapter reviews literature on mitigation potential of the 'quick wins', reviews implementation of these actions in the selected countries through literature review and assesses the feasibility of broader implementation based on primary data.

4.2 Selection of the 10 'Quick Wins'

[56] Often used in business management literature, a 'quick win' is 'an improvement that is visible, has immediate benefit, and can be delivered quickly after the project begins. The 'quick win' does not have to be profound or have a long-term impact on your organisation but needs to be something that many stakeholders agree is a good thing. […] (228).

[57] Which can be divided into Access, Efficiency, Safety and Environment benefits (68).

The following six steps were taken to develop a list of 'quick wins', in a process carried out from March to July 2016.[58] First, a list of over 100 measures was compiled from inputs through an email invitation sent to over 100 organisations working on sustainable transport at a global scale. Second, through grouping and balancing the measures across themes, modes and world regions, the list was reduced to about 40 options. In the third step, through literature review, these measures were evaluated against sustainable development benefits, implementation barriers and coverage of Avoid-Shift-Improve strategies, and potential implications for both passenger and freight transport. The fourth step consisted of expert feedback on the remaining 23 measures, while in the fifth step, more than 100 stakeholders provided feedback in a survey on the definition and feasibility of the 'quick wins', which ultimately resulted in a list of 20 'quick wins'.

For the purpose of the current study, a list of 10 'quick wins' perceived to have greatest relevance for LICs was made (the 'short-list'), starting from the list of 20 actions described in the study[59], and narrowed further based on the following selection criteria:

- Sustainable development benefits, such as air quality, improved accessibility;
- Applicability in priority countries: they should reflect policy priorities and the local transport system context;
- Climate change mitigation potential;
- Inclusion of passenger and freight options;[60] and
- Inclusion of Avoid-Shift-Improve measures.

The selection process resulted in the following 'quick wins' short-list for the purpose and context of the current analysis (i.e. this is not to be taken as an exhaustive list for all purposes and contexts):[61]

- QW1: Accelerate phase-out of fossil fuel subsidies;
- QW2: Formulate Sustainable Urban Mobility Plans (SUMPs) in primary and secondary cities, supported by a National Urban Mobility Policy or programme;
- QW3: Promote electric two- and three wheelers, including e-vehicle sharing systems in primary and secondary cities as well as rural areas;
- QW4: Limit import of inefficient and polluting second hand trucks;
- QW5: Implement (ultra-) low emission zones, including car-free zones in city centres;
- QW6: Introduce and scale up pricing for car-related travel options (e.g. congestion/road charging, parking pricing, workplace parking levy) in primary and secondary cities;
- QW7: Tighten fuel economy standards for passenger cars, coupled with labelling schemes and fiscal incentives such as CO_2-based vehicle taxation;
- QW8: Provide and improve walking and cycling infrastructure (e.g. connected walking paths, protected cycle lanes, safe intersections),[62] reallocating road space where necessary;
- QW9: Improve freight efficiency (e.g. reduce empty load running by freight trucks) through route optimisation, asset sharing between companies, and increased use of ICT solutions;

[58] Please refer to (68) for further details.

[59] Some options were adapted to fit the needs of LICs.

[60] Note that there are two quick wins specific to freight transport and four that cover both passenger and freight transport (in addition to four that are specific to passenger transport).

[61] Ten 'quick wins' were considered the maximum number feasible for the assessment by stakeholder (see Section 4.4). The short-listed options correspond well to preferences by developing country stakeholders, as confirmed in a survey done in (68): all ten are in the top-13 out of 23 in that survey.

[62] See for example WHO's Global Action Plan on Physical Activity: https://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf

- QW10: Accelerate deployment of tighter diesel fuel quality standards to reduce emissions of black carbon and other short-lived climate pollutants.

4.3 MITIGATION POTENTIAL OF 'QUICK WINS'

This chapter discusses a literature review on the mitigation potential of the 10 'quick wins' covering both global studies as well as research for the nine countries. It focuses on available GHG reduction potential estimates for the various measures, while noting that estimating mitigation potential of individual measures is complex; often specific measures are included as part of broader policy packages. However, it also includes studies on the implementation potential of such measures, i.e. those without specific estimates of GHG reduction, yet which highlight the role in low carbon scenarios. The review covers both peer-reviewed literature as well as 'grey' literature, which are mostly technical reports from international organisations. Literature from the past five years, i.e. 2013-2018, is included, with a few sources from before that period if recent sources are unavailable. Table 8 shows the results of the literature review.

Table 8: State of knowledge related to mitigation potential of 'quick wins'

Quick Win	Key points from mitigation potential literature (global)	Mitigation literature country-specific	
1. Fossil fuel subsidy phase out	Burniaux & Chateau (2014): Removal of fossil fuel consumption subsidies could lead to global GHG emission reductions of 2-4% by 2020, rising to 8-12% by 2050 (74). IEA (2017a): Removal of fossil fuel subsidies is a prerequisite to carbon taxation, which is required to achieve a Beyond 2 Degree Scenario (18).	ADB (2016)	For India and Indonesia, fuel subsidy reform could lead to between 1 and 9% GHG savings in 2030 (75).
		Cooke et al. (2014)	For Ghana, removal of subsidies could result in negative impact on household welfare (76).
		Durand-Lasserve et al. (2015)	Phasing out energy subsidies could reduce Indonesian CO_2 emissions from fuel combustion by 11-13% in 2020 (77).
2. Sustainable Urban Mobility Plans, National Urban Mobility programme	Urban passenger transport emits about 25% of total transport sector emissions. SUMPs mainly focus on non-technology options, i.e. 'avoid' and 'shift', which contribute 2-40% of emission reductions in the 2050 low-carbon scenario (19). Implementation of a SUMP in Burgos (Spain) resulted in 17% lower CO_2 emissions (67). Pisoni et al. (2019) model impact of SUMPs on air quality (78).	Dhar et al. (2017)	For the 1.5 degree scenario, demand-side urban transport measures are essential in India (79).
		MoUD (2014) GIZ, MoT (2014)	CO_2 emissions is one of the key indicators in Comprehensive Mobility Plans in india (80). Urban transport measures in 7 Indonesian cities, supported by a national urban transport framework, can save 0.1-0.2 tCO_2 per capita in 2030 (81).

Quick Win	Key points from mitigation potential literature (global)	Mitigation literature country-specific	
3. Electric two- and three-wheelers	Over 80% of the 29 Mt CO_2 savings in 2017 by all types of EVs globally are due to e-bikes in China (37). Full decarbonisation of 2 and 3 wheelers is necessary for B2DS (18). For Vietnam, e-bikes are the mitigation option with the second-largest potential in the transport sector (ADB, 2017). In Thailand, deploying electric motorcycles could reduce two-wheeler life cycle CO_2-eq emissions by 42-46% (82).	Saxena et al. (2014)	Estimates energy-use of 2 and 3 wheelers in India under various conditions (83).
		David et al. (2016)	Estimates savings in cost and CO_2 emissions for electric tricycles in Nigeria (84).
		Black et al. (2018)	General policy brief on the benefits of electric two-wheelers for Africa (no CO_2 estimates) (85).
		Nugroho & Zusman (2018)	Show benefits for ojek (motorcycle taxi) drivers by switching to electric vehicles in Indonesia (86).
		Sietchiping et al. (2012)	Show rapidly expanding market in Africa for motorcycles and boda boda (motorcycle taxis) in particular (87).
4. Limit import of inefficient and polluting second hand trucks	Miller & Li (2018) include import restrictions for 2nd hand vehicles as a key part of the policy package in the global low-sulphur scenario (88). Fuel efficiency of vehicles declines rapidly after 15 years of use, up to 50% by 25 years (89).	Gota & Anthapur (2015)	Green freight Bangladesh (fuel efficiency scenario) (70)
		Sudmant et al. (2017)	Low-carbon scenario for Kigali (Rwanda) considers vehicle age restrictions (90).
5. Low-emission zones	Calvert (2016) and Pisoni et al. (2019) review environmental zones in EU cities on the impact on PM/soot emissions (91) (78). Further climate benefits would accrue from more EV deployment, however no study has been found estimating the GHG impact.		
6. Pricing of car use	In Singapore, a package of measures including congestion charging and CO_2-based vehicle taxation results in low transport emissions per capita (IPCC, 2018). There is a relatively strong knowledge base of ex-post and ex-ante studies on road pricing and parking management (92) (93).	Swamy (2016)	Study on congestion pricing in Delhi, with shift from private vehicles to public transport estimates (94).

Quick Win	Key points from mitigation potential literature (global)	Mitigation literature country-specific	
7.Fuel economy standards and incentives	IEA (2017a): regulation on the energy-use and lifecycle GHG emissions of vehicles is necessary for a Beyond 2 Degrees Scenario (18). Sims et al (2014) presents emission intensity reduction potentials for different types of diesel and petrol vehicles (95).	GFEI (2017)	Reviews progress in fuel economy policies in major markets, including India, Indonesia and South Africa (96).
		Dhar et al. (2017)	Includes fuel efficiency strategies in low-carbon transport scenario for India (79).
8. NMT infrastructure	Globally, it is estimated that in 2050, 22% of urban passenger travel can be by (e)bike, compared to 6% in the base case. This results in 300 MtCO2 reductions in 2050, and USD 1 trillion in savings from vehicle purchase and operation and construction and maintenance of infrastructure ((97). For walking, no specific mitigation potential estimates have been found, however it is acknowledged for its key role in mitigation (95) and reaching public transport modal shift targets.	Shastry & Pai (2016) Sudmant et al. (2017)	Sustainable urban transport scenario for Bangalore includes NMT and TOD and CO_2 estimates (98). Low-carbon scenario for Kigali (Rwanda) quantifies CO_2 savings from bikelane investments (90).
		Aceampong (2016)	Study on propensity to cycle in Ghana: three out of four would not cycling to social events for public image; health is driver (99).
		Mitullah et al. (2017)	Research on walking and cycling in African cities, including in Kenya and South-Africa (100).
9. Logistics optimization / freight efficiency	IEA (2017b) analyses 15 measures, e.g. urban consolidation centres, platooning, co-modality, backhauling, retiming of deliveries, etc. Most of these could have a best-case impact of up to about 5% emission reductions, while some measures may have a reduction potential over 10% (101).	Gota & Anthapur (2015)	Includes CO_2 scenario with freight efficiency for Bangladesh (70)
		NITI Aayog (2018)	Highlights many measures, no mitigation potential calculation but general note that logistics is 7% of India's total CO_2 emissions and 67% of transport PM (102).
		CCAC et al. (2017)	Green freight programme for Northern Corridor (including Rwanda, Kenya) with measures, in context of mitigation and air pollution (objective of 10% reduction in CO_2 per ton-km) (103).
10. Diesel quality standards	Klimont & Shindell (2017): a mitigation scenario for Black Carbon reduces such emissions by about half, corresponding to about 4 $GtCO_2$-eq (GWP100) in 2050 (104). Diesel road vehicles and ships are one of the main sources of BC emissions	Malins et al. (2016)	Includes country level market analysis for low-sulphur diesel for Bangladesh, Ghana, India, Indonesia, Kenya, Nigeria, Rwanda, South Africa, and Uganda (105).

Quick Win	Key points from mitigation potential literature (global)	Mitigation literature country-specific	
	with 19% of global BC emissions (95). Miller & Li (2018) show that a global sulphur scenario reduces BC emission from diesel road transport by about 90% from the baseline in 2040 (88). Such strategies will result substantial health benefits from reduced exposure to air pollution.	USEPA (2012)	Diesel vehicles contribute 20-55% of total BC in South Asian cities (106).

In addition to the literature in Table 8, country studies on GHG mitigation scenarios for the transport sector have been carried out. These include a range of mitigation option sets, yet not necessarily most of the QWs:

- **India**: Dhar et al. (2018) modelled low carbon scenarios for transport for a 1.5 DS, with vehicle fuel efficiency, transport demand management in passenger and freight, biofuels, and modal shift in passenger and freight, and electric vehicles (including two-wheelers) play a key role (69);
- **Bangladesh**: Gota & Anthapur (2017) developed low carbon freight scenarios, also estimating black carbon emissions, that consider broad avoid, shift and improve strategies (70);
- **Indonesia**: Siagian (2017) modelled economy-wide scenario, in which energy efficiency and biofuel use in transport can help achieving the NDC targets (71);
- **Kenya**: Notter et al. (2018) considered for example e-scooters and LDV and HDV efficiency in their transport sector low carbon scenarios (41).

As shown in Table 8, The global literature on transport sector GHG mitigation clearly shows the importance and potential of all 10 'quick wins', even though for some specific options (limit imports of used trucks, LEZ) more analysis would be beneficial. Although not specifically highlighted here, the sustainable benefits, in particular for health, are well-researched as well. Amman et al. (2017) for example, analyse air pollution and associated health impacts – as well as climate benefits – for air quality management scenarios, which include transport sector interventions, in Delhi (72). Mittal et al. (2015) assess local air pollution co-benefits of low carbon policies in road transport in India (73).

For the nine selected countries, the mitigation potential literature for the 'quick wins' varies. For India, most mitigation options are included in low carbon scenarios or studies for specific measures. For Indonesia, several studies are available as well. For Bangladesh and the six African countries, literature is scarce, except for options related to fuel efficiency and fuel standards, where international organisations have done extensive analysis (even if not specifically on GHG mitigation potential).

4.4 'QUICK WIN' IMPLEMENTATION STATUS IN LICS

This section reviews planning and implementation of the 'quick wins' in the nine selected countries. The analysis is based on recent literature, mostly from 2017-2018, but not older than five years. Sources include:

- Grey literature: reports and policy briefs;
- Government official documents;
- If no other sources available: news articles from online media.

All sources are included in a matrix developed under this project,[63] with Table presenting the summary assessment. Grey literature and government documents are included as well in the reference list in this report, while media articles are only included through hyperlink in the matrix.

[63] The full matrix can be downloaded here: http://slocat.net/sites/default/files/HVT_Annex_7-Matrix-Low-Carbon-Transport-Quick-Wins.xlsx

Methodology for the rating of the implementation status:

0 No implementation or discussion of the options in the policy domain
* Measure in discussion or pilot implementation
** Policy partial in place or planned, or partial implementation
*** Full-scale implementation

The rating was done by three researchers from the project team, independently, based on the same information.

The detailed application of this methodology varies depending on the nature of each 'quick win'. For example, regulatory measures such as diesel quality standards or limiting used truck import are more straightforward than improving freight efficiency or NMT infrastructure, which are more diverse and require a multitude of smaller projects.

Table 9: Literature assessment of implementation status of 'quick wins' in project countries

Quick Win Measure	Implementation status								
	Bangladesh	Ghana	India	Indonesia	Kenya	Nigeria	Rwanda	South Africa	Uganda
Accelerate phase-out of fossil fuel subsidies.	**	**	***	**	***	*	**	*	*
Accelerate deployment of tighter diesel fuel quality standards to reduce emissions of black carbon and other short-lived climate pollutants	**	**	***	**	***	**	***	**	***
Promote electric two- and three wheelers, including e-vehicle sharing systems in primary and secondary cities as well as rural areas.	**	**	***	*	**	*	**	**	**
Introduce and scale up pricing for car-related travel options (e.g. congestion/road charging, parking pricing) in primary and secondary cities.	*	*	**	**	*	**	*	**	*
Formulate Sustainable Urban Mobility Plans (SUMPs) in primary and secondary cities, supported by a National Urban Mobility Policy or Programme.	**	*	***	**	**	0	*	***	*
Implement (ultra-) low emission zones,	0	0	0	0	0	0	0	0	0
Provide and improve walking and cycling infrastructure (e.g. connected walking paths, protected cycle lanes, safe intersections), reallocating road space where necessary.	*	**	**	**	**	**	**	**	**
Limit import of inefficient and polluting second hand trucks	**	*	***	***	**	**	*	***	*
Improve freight efficiency (e.g. reduce empty load running by freight trucks) through route optimization, asset sharing between companies, and increased use of ICT solutions.	*	*	**	**	*	*	*	**	*
Tighten fuel economy standards for passenger cars, coupled with labelling schemes and fiscal incentives such as CO2-based vehicle taxation	*	*	***	**	*	*	*	**	*

Observations from Table and the matrix[64] shows that there is progress across most or all countries for QW 10 Diesel quality standards and QW 4 Limiting imports of used trucks. This could point to increased attention for air pollution concerns, with both these options playing a key role in addressing diesel emissions. International organisations are promoting these actions as well.

Options where progress varies among the nine countries are the following:

- QW 3 (Promoting electric two and three wheelers): two-wheelers are not popular with policymakers, who see motorcycle drivers as reckless and often involved in traffic crashes, rather than a flexible, fast and space and energy-efficient mode of transport. On the other hand, electrification is increasingly acknowledged as part of air quality and energy security strategies.
- QW 1 (Fossil fuel subsidy reduction): this is a politically challenging option, where public opposition can be expected.
- QW 2 (SUMPs and NUMP): India and South Africa have a nationally-guided programme for cities, while in other countries only a few cities develop SUMP-like mobility plans. Awareness of SUMPs and NUMP as a key policy tool is picking up in recent years. NUMPs are challenging especially because the national government is often reluctant to allocate financial resources to cities, with the local governments in turn not seeing the benefit of planning guidelines from a higher-level authority.
- QW 8 (NMT infrastructure): many cities are looking at this option and consider it important, yet implementation is patchy, with unsafe and inconvenient conditions for walking and cycling. Allocation of government budget to the various transport modes is a key issue, with for example the political economy in Ghana favouring road investments over NMT and rail (107).
- QW7 (Fuel economy policies), with for example India adopting relatively ambitious standards. Fuel economy policies are beneficial to the economy, however due to potential impacts on the car market and manufacturers it can be politically challenging.

Little progress is seen these options:

- QW 5 (Low-emission zones): not discussed in any project country yet. We are not aware of LEZ examples in peer countries;
- QW 6 (Pricing for car-related travel): being considered and discussed but little implementation; and
- QW 9 (Freight efficiency improvements), with progress limited to isolated projects in some countries. This may be due to governments considering freight as mostly the domain of the private sector, and the complexity of such projects and plans.

There are some caveats of the assessment. First, literature and news media may not capture all relevant developments, and may be outdated quickly, e.g. when an option is being planned that has not been in policy discussions before. Second, the rating should be considered a very broad assessment, and is particularly complex for some options such as NMT (with Jennings et al. (2016) for example, an assessment based on 20 indicators only for NMT) (108). The more detailed information in the matrix is therefore a valuable resource, as it provides the necessary additional qualitative information.

[64] The full matrix can be downloaded here: http://slocat.net/sites/default/files/HVT_Annex_7-Matrix-Low-Carbon-Transport-Quick-Wins.xlsx

Box 4: New Mobility Services

The transport 'quick wins' in this chapter represent short- to medium-term measures that have been tested at scale and can be replicated for large-scale impact. Besides these, there are many cities in various countries implementing new mobility services in recent years. Such new mobility services are bikesharing, carsharing, ridesharing, ridesourcing, micromobility and shared automated vehicles among others. Especially the topics of micromobility and ridesourcing are not included in 'quick wins' due to a high uncertainty about their emission mitigation impact. New mobility services can lead to an increase of lower occupancy vehicle trips and decrease of public transport usage. On the other hand, due their higher annual mileage, shared vehicles are cheaper to electrify. Until now, the majority of new mobility services can be found in East Asia, North America and Europe. For example, bikesharing enjoys a large popularity in China and received a new boost in 2016 with dockless bikesharing services by private companies (14). Dockless bikesharing expanded to Europe and North America in 2017 and 2018. Electric kick scooter sharing, a type of micromobility, was introduced around 2017-2018 and reached over 30 cities mainly in North America by mid-2018.

In the selected countries, new mobility services are still largely absent. An exception are the ridehailing services Grab and Go-Jek in Indonesia: These services are being used by up to 250 million Indonesians and Go-Jek has operations in over 50 cities with over a half million drivers (109). There is no evidence nor research on the environmental impact of ridehailing in Indonesia. However, Go-Jek experiments with electric motorcycles and explores their feasibility in daily operations (110).
In India, ride-hailing services for taxis include Ola and Uber. On the other hand, only few dockless bikesharing services have been embraced and there are still many barriers, for example lack of national framework for bikesharing systems, from a wide adaptation of bikesharing in Indian cities (111).

4.5 Feasibility assessment

Figure 19 below shows perceived feasibility of transport 'quick wins' according to the online survey responses to the question: "Please rank the feasibility of the following transport 'quick wins' in order of most promising to least promising in your city/country."

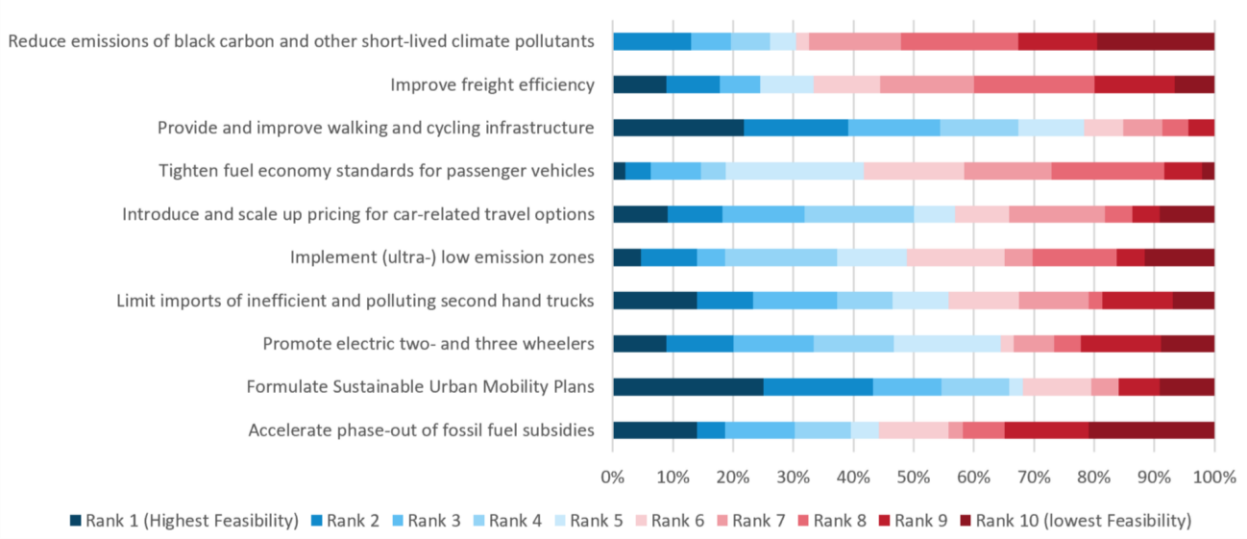

Figure 19: Perceived feasibility of the transport 'quick wins' by respondents

Respondents, including policymakers, researchers and practitioners from the transport sector in the nine countries,[65] regarded the following 'quick wins' (in random order) as most feasible in their countries (noting that data are not sufficient to suggest a proposed ranking of these 'quick wins' on a country or regional basis):

- QW 2 Formulate Sustainable Urban Mobility Plans (SUMPs) in primary and secondary cities, supported by a National Urban Mobility Policy or programme
- QW 8 Provide and improve walking and cycling infrastructure (e.g. connected walking paths, protected bicycle lanes), reallocating road space where necessary
- QW 4 Limit imports of inefficient and polluting second hand trucks, complemented by age limitations for the existing fleet
- QW 3 Promote electric two- and three wheelers (including shared e-vehicles) in primary and secondary cities
- QW 1 Accelerate phase-out of fossil fuel subsidies

Comparing the survey with key informant interview results,[66] walking and cycling (QW 3), SUMPs/NUMP (QW 2), pricing strategies QW 6) and limiting imports of vehicles (QW 4) also score high in interviews, while electric two/three-wheeler scores (QW 3) high but not in the top 5. Other key options from interviews include diesel quality standards (QW 10), increasing freight efficiency (QW 9) and paratransit reform and regulation. The latter is an additional option not mentioned several times in the interviews.

4.6 Summary and Discussion

This chapter has shown how low carbon 'quick wins' can play a key role in implementing low carbon transport measures in LICs, by matching local priorities with global co-benefits. However, implementation is still challenging in many countries.

[65] Further background on study participants and ratings of quick wins is given in Appendix 2.
[66] In which respondents were asked to rate every 'quick win' on a scale from 1 to 5 (see Appendix 2).

From looking at Section 4.3 (QW mitigation potential), 4.4 (QW implementation), and 4.5 (QW stakeholder priorities) together, the following observations can be made:

- Freight efficiency measures seem less prioritised in literature, policy implementation and by stakeholders.
- Fuel efficiency policies are acknowledged as key in literature, but lack implementation and priority by stakeholders.
- SUMPs and NUMP on the other hand are seen as a key option, however implementation is lagging behind.
- NMT is highly rated by stakeholders[67] but implementation is lacking.
- Attention by stakeholders and literature coverage for electric two- and three wheelers is increasing especially in very recent years, both in Asian and African countries.
- Improving diesel quality standards is considered important in literature and by stakeholders especially from a local air pollution and health perspective, with substantial co-benefits due the climate warming potential of black carbon.
- Little attention is given to LEZs in the climate change context, even though these may play a key role in promoting EVs.

Could there be a difference in interest and priority by country? Although our primary and secondary data are not sufficient to draw country-level conclusions, there are general considerations that may impact countries' priorities. These may include presence of car manufacturing industry (e.g. India, Indonesia, South Africa – see also Box 9 in Chapter 5), vehicle fleet characteristics (e.g. share of two-wheelers, high in Asian countries), and fuel prices.

The next chapters will examine barriers to low carbon transport and how these could be overcome and are applicable to QWs. From the current analysis, preliminary recommendations include the following. First, more country-level analysis on the costs and benefits of QWs would be beneficial in enhancing the knowledge base and awareness. Second, dissemination of the key insights from such analysis should be shared with the key stakeholders, including decisionmakers at the national and local level. Third, each QW requires a more detailed analysis of design options to implement the measure, specific for each local context. An impact analysis can be carried out for each design options so as to maximise the benefits for various societal groups.

[67] It should be noted that most of the survey respondents are transport experts (particularly urban transport) with few energy/environment stakeholders represented. This may be why diesel quality standard is a lower priority in survey.

5. CHALLENGES AND BARRIERS RELATING TO LC-HVT IMPLEMENTATION IN THE SELECTED COUNTRIES

After a brief overview of key challenges identified in the literature, this chapter summarises the primary data regarding challenges to implementing LC-HVT in the selected countries and highlights perceived barriers to implementation of low carbon transport measures. Where respondents gave examples of low carbon transport measures in their countries that reflect a particular challenge or resolution, these are included as case examples (typeset at boxed text). The chapter that follows (chapter 6) will identify the knowledge areas that will assist in overcoming these barriers and lead to the prioritising and implementation of low carbon transport measures in the selected countries.

5.1 BROAD CHALLENGES IDENTIFIED THROUGH LITERATURE REVIEW

The 'real challenge' of implementing low carbon transport measures is often not so much the acceptance of the links between mobility and climate change, but an under-estimation of the scale of the problem, and inadequate actions being taken to address the challenge (112). The real question is whether there is the commitment and leadership to follow such a path, as a move to a low carbon development pathway ultimately requires that the transport sector makes a considerable effort (20). Global power structures also create significant challenges, where until recently transport did not feature highly in climate change summits, and few binding commitments were made.

Low-income countries face a "fairly typical plethora of inter-related urban malaises" (113): high levels of poverty, social segregation, oil dependency, and road crashes, "extremely poor air quality, serious traffic congestion, limited transport choices, little to no planning for pedestrians and cyclists, and a historical failure to invest in and plan for formal bus and train services". Reducing GHG emissions is therefore not necessarily the highest priority when it comes to transport decision-making. Congestion and air quality do nevertheless lead to major concerns regarding efficiency, productivity, fuel-consumption and urban health. Thus, road building, and air quality,[68] take perhaps the highest priority, and "actors with strong interests and focus on rapid road construction and large-scale infrastructure development are at the core of decision making about transportation policy (113)."

The nature of city planning, and the spatial structures of developing countries and cities, means that up to half the total energy consumption in cities such as Jakarta and Cape Town is transport-based (114), while in European cities, it is a quarter of total consumption (112). This is largely the consequence of long travel distances, a function of colonial/Apartheid patterns of locating labour on the extreme periphery of urban areas (115). Low-density sprawl is a continuing feature of the emerging mega-cities of the developing world, such as the Gauteng agglomeration in South Africa, Lagos, and Kampala, which are replicating the car-dependent cities of the developed world and building more highways, freeways,

[68] For the majority of cities, IMHO air quality is not a primary driver for transport investment. If it was all the developing world would be EURO VI and not EURO II.

and roads (87).[69] This trend was predicted by among others, Wright and Fulton (116), who noted with concern that the sum effect of poor public transport and worse conditions for walking and cycling in developing cities would mean that people would shift to private cars the moment this became affordable; finding a mechanism merely to preserve the high existing walking, cycling and public transport mode shares in developing countries, such as investing in these modes, would have been a significant means towards GHG stabilisation (117) (87). Improved planning and design of walking and cycling infrastructure and policy environments need to change this, from a captive use for the poor to a choice use (118). Until then, the poor status of walking and cycling, seen as illegitimate modes evident of continued poverty (119), and the association of motorised transportation with education, affluence and elevated status in society (108), will remain ongoing concerns.[70] Although compact city design yields considerable impacts to facilitating walking, cycling and public transport (20), and low carbon development, it is a challenge retro-fit sprawling emerging cities – resistance to city densification and infill development is common; the high peak-to-base ratios of sprawling cities render public transport financially unviable; and walking and cycling distances remain long.

There is also a fundamental difference between the priorities in high income cities, where the main concerns are levels of pollution and consumption related burdens, and those in low-income cities, where the concerns are more short term and health related (112), and focus on clean water, electricity supply, waste management and sanitation. The need for pro-poor basic urban services take precedence over environmental concerns; thus, the challenge is to design a development pathway that is pro-poor, climate resilient and low carbon. How to do so has been identified by study respondents as a key challenge.

A lack of clear vision, "the seductiveness of following the high-mobility option" (112), and inadequate leadership, investment, governance structures, continue to hamper lower-carbon development: "Achieving ambitious transport goals in urban Africa is worrying in view of the poor record of success"(120). The alarm is compounded by the backlog of investment in transport and continued rapid urbanisation' (120) along with poor-alternatives analysis, vested interests and political interference (121,122)(123)(107)(124).

Technological innovation is unlikely to be a simple answer to the challenges, despite growth (albeit slow) of bus electrification in developing cities in South Asia (125), and there is relatively little evidence in the projected trends for anything other than continued motorisation (116).

A further challenge is that while there is a wealth of experience in sustainable transport policy measures, there are rarely mutually enforcing policy and infrastructure measures across all tiers of government (20). Only an integrated approach can generate the sustainable development benefits (such as air quality, safety, energy efficiency, access to mobility services, and energy security) that ultimately drive policy intervention. Inconsistency, poor policy packaging, and inadequate coalitions across national and local government mean that policy interventions are not up to the challenge. The high degrees of political will evident in Bogota (Colombia) or Curitiba (Brazil) is rarely seen elsewhere (116)(126) (127), although the Lagos BRT has been hailed as benefitting from "strong, forceful support from a politically

[69] Between 1950 and 2014, Africa's urban population increased more than 14-fold, rising from 35 million to 455 million while the urban population of Asia increased by eight-fold, from 245 million to 2.1 billion.

[70] The impact of poor walking and cycling facilities on women, children, and vulnerable/marginal groups, is investigated in Theme 4, 'Gender, Vulnerable Groups and Inclusion which includes Road Safety'.

astute champion" backed by "a solid organisation with superior administrative and technical skills and public transport experience" (128); and South Africa's BRT services were set in motion by strong political intent (129,130). Political will can put pressure on technical teams to develop unsustainable solutions, however. In Kenya, for example, transportation decision-making has been influenced by the way in which power and institutions operate, both formally and informally, with bus services shifting even in relation to elections (131). Challenges to low carbon decision-making include what Klopp describes as the large and distorting role of external actors; fragmentation in institutions, policymaking and projects; closed and top-down planning processes; the absence of mobilisation for policies and projects that serve the majority of city residents, especially the poorer segments (122).

Another challenge is the need for essential decision support tools, such as strategic environmental assessments (SEA) as a review for selected countries shows. SEA is regarded as a promising process for mainstreaming of environmental concerns in policy development and planning and transport is a sector with many experiences on SEA (132). Nevertheless, the review of national transport plans of the selected countries shows that references to SEA and sustainability appraisal exist but little detail is given nor is the GHG mitigation aspect highlighted. South Africa's National Transport Master Plan mentions the importance of environmental assessment in the project planning phase (133). In India a toolkit for SEA was developed for sustainable urban transport planning (81). Kigali includes environmental impact assessment in for land transport projects (134).

In work conducted for the Swedish Energy Agency evaluating transport interventions in developing countries, researchers (135) identified significant challenges relating to institutional roles and responsibilities, the availability of personal and financial resources, and the knowledge and perspectives applied. Overall, travel data coverage, quality and availability were found to be uneven and variable. There are some very dominant project types (BRT, MRT) within developing countries, the authors note, while for example the promotion of walking and cycling are absent; the authors suggest that this could relate to the way in which Clean Development Mechanism (CDM) projects were initially structured, and the challenging requirement to prove 'additionality' (136).

While the additional capital costs of new, low carbon technologies such as electric buses and other vehicles can be seen as a substantial barrier, practitioners and policy makers in developing countries do not always shave access to research regarding lifecycle costs, and the balancing of upfront costs versus economy-wide benefits (20)(125)(137,138). In India, this may be less of a barrier, where the FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) support scheme has been extended with a new phase and an overall budget of USD 1.4 billion, mainly for electric buses, three-wheelers and two-wheelers.

The challenges identified in the literature review are summarised in Figure 20:

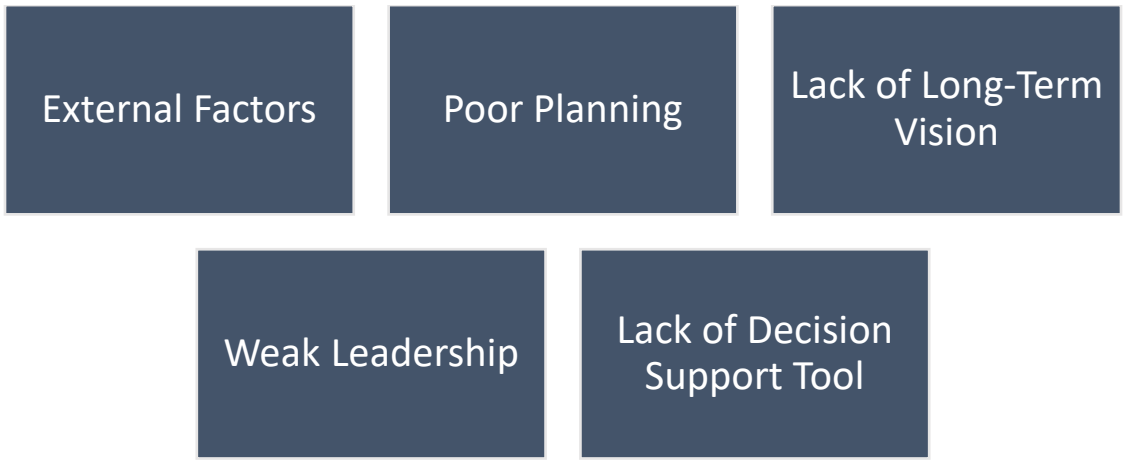

Figure 20: Summary of Challenges identified in Literature Review

5.2 SPECIFIC CHALLENGES IDENTIFIED THROUGH PRIMARY DATA COLLECTION

Key findings of the primary data are reported by financial/economic challenges; political/social challenges; technical challenges; and institutional/regulatory challenges. In many respects, these challenges mirror those identified in the literature.

During the primary data collection for this report (refer chapter 1.3, Data Collection), respondents were presented with a list of 14 challenges (see Figure 21, below) plus the option of 'other (developed as a result of a literature review and corroborated by a peer-review process) and asked to rank these in order of importance. The findings are presented in graphic format below (Figure 21). Qualitative interviews complemented the survey work.

Overall, respondents noted an urgent need to understand how to prepare bankable[71] proposals for low carbon transport projects, how to influence decision-makers, and how to make the case for a focus on low carbon transport. Individual respondents mostly noted their own lack of technology expertise relating to electric-mobility in particular.

[71] The bankability of a project or proposal depends on it having sufficient collateral, future cashflow, and high probability of success, to be acceptable to institutional lenders for financing (source: http://www.businessdictionary.com). Its bankability is improved by reducing all uncertainties to the lender and mitigating any risks to the project's successful completion.

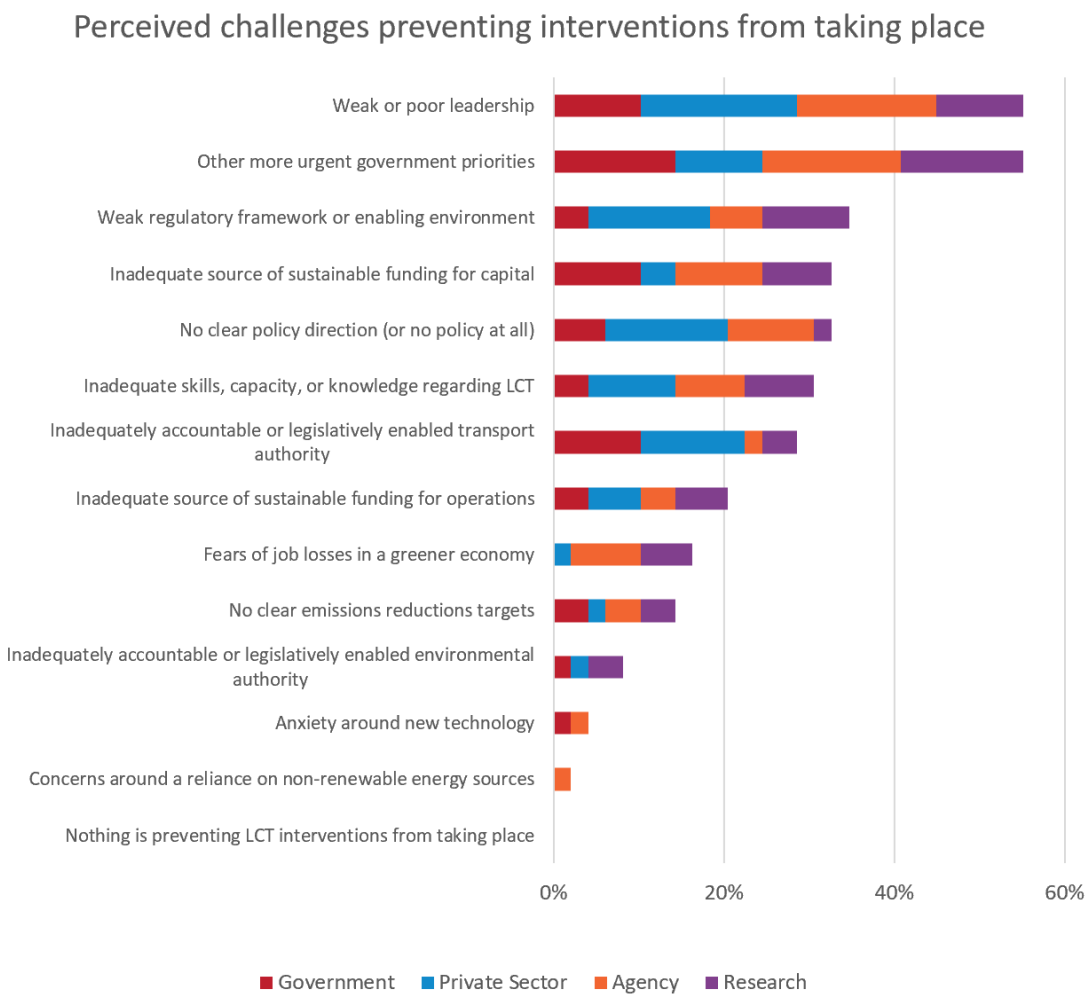

Figure 21: Perceived challenges preventing such interventions from taking place

5.2.1. FINANCIAL / ECONOMIC CHALLENGES

Overall, the lack of funding is the primary financial/economic challenge. When asked in what way cooperation with donors could help accelerate and / or streamline the adoption and implementation of eventual research findings regarding LC-HVT, respondents by and large had the same basic answer, "In short, nothing happens without the money"[72]. Yet while donors are essential in many instances for financing public transport capital costs, operating costs fall to the relevant local, regional or national authorities. It is not easy to finance public transport operations in the sprawling, low-density cities of many developing countries, where the urban form generates low passenger volumes and high peak/off-peak ratios. In South Africa, for example, BRT systems are, at best, recovering 40% of their operating costs through fares; even the most-used BRT system (by daily ridership) in South Africa, MyCiTi, required a 75% operating subsidy in the 2016/17 financial year (139).

[72] Expert Interview, South Africa (see Appendix 1).

As indicated in Section 3, developing countries have to deal with multiple unmet needs; decision- and policy-makers face almost insurmountable challenges in delivering urban services, of which transport reflects only one public good (140) (also see Box 9). Redirecting existing transport sector spend might seem an option, but the reality is that there is only limited public funding. The following quotation from a political leader highlights the constant trade-offs not only within the transport sector, but in financing urban services as a whole:

> "We won't build bicycle lanes when people live in shacks… You must be ashamed that you want bicycling lanes when there are people who [are] without flushing toilets!" (141).

Climate finance might help overcome any funding barriers, but respondents indicated that they need training and assistance in preparing project or funding proposals. Respondents also mentioned a lack of money available for research and promotion, and investment capital to implement solutions.

While sharing concerns about project financing, respondents cautioned that donors need to be held accountable. It was stated that donors generally prioritise the 'physical tangibles' of big projects such as BRTs and highways (an assertion to be substantiated with further research). Upon project completion, donors normally allocate limited financing for continued evaluation and maintenance – a scenario substantiated in interviews with donors and development banks themselves.

The Nigerian BRT case was highlighted as a project that was financially attractive to passengers and to the state, but financially punitive to operators, who have endured operational cost increases for years with no increase in state-set fares. This case is a good example of an authority that has understood that "transportation is a social service … and needs a subsidy", but risks failure as a result, unless "government finds a formula that guarantees the sustainability of public transport, that works for [Nigeria].[73] "

Study respondents expressed hesitation around the financial sustainability of projects. When asked about 'cautionary tales' – LC-HVT programmes that had raised hopes and expectations but proven financially unsustainable – respondents in Africa all mentioned the continent's BRT projects, and South Africa in particular. During the course of 2017, South Africa's National Department of Transport and the National Treasury raised the alarm that the country's BRTs were making losses "significantly higher than anticipated." These systems were, at best, recovering 40% of their operating costs through fares. Even the most-used BRT system (by daily ridership) in South Africa, MyCiTi in Cape Town, required a 75% operating subsidy in the 2016/17 financial year (139). The challenges these systems have faced, particularly around operations financing, led interviewees to champion an approach to improve, regulate and reform existing paratransit services (e.g. minibus-taxi, *matatus*, or *tro tros*) in their cities or countries. Box 5 illustrates parallel challenges with South Africa's taxi recapitalisation programme.

[73] Expert interview, Nigeria (see Appendix 1).

Box 5: Overcoming challenges with current transport services: South Africa's taxi recapitalisation programme

Most respondents recognise that 'working with what you have' and 'building what you can afford' are the most likely donor-independent ways of attaining financial sustainability. For most countries, this means reforming and regulating the paratransit sector. The aged paratransit fleets (variously known in the selected countries as *matatus*, *tro tros, danfos* or *taxis*) was universally cited by respondents as one of the causes of poor air quality and carbon emissions in cities and larger towns in Africa. A number of respondents mentioned the success of South Africa's fleet renewal programme as one way of overcoming this challenge.

In **South Africa**, some 60-70% of public transport trips are provided by paratransit (minibus-taxi) services – small, privately owned minibuses that do not follow fixed schedules (142). Although the dominant public transport mode, the service has been decried by commuters as unsafe and expensive; ageing, old, polluting vehicles, '*skorokoros*', were colloquially referred to as 'moving coffins', or 'death traps', and use the cheapest diesel fuel available (500 ppm sulphur) (143) (144).

In 2006 the national departments of Transport, Minerals & Energy, and Finance, intervened with the Taxi Recapitalisation Programme (TRP), to introduce new, higher-occupancy vehicles that would improve air quality and reduce emissions, but would also improve passenger safety and comfort (regulating the carrying capacity and seat size), and eventually offer wheelchair access. New vehicles include anti-lock braking systems and emergency exits.

The goal was to replace the entire fleet of 135,000 14-16-seater vehicles by 2015 with new, 18-35 seaters (145). Owners with valid operation licence and a vehicle registration certificate to surrender their legal vehicles for scrapping, in return for USD 6,328 (ZAR 87,600) (approximately 20% of the cost of the most popular new vehicle, a Toyota Quantum) (144).

The programme did not come without challenges, including suggestions that the cost of new vehicles has driven out small-scale taxi owners, and led to direct and indirect unemployment, and the development of cartels of large-scale businesses (143). Other concerns include the poor accommodation of passengers with special needs, and access to vehicle financing (at times, only at prohibitive interest rates of 28%).

Nevertheless, there is little doubt that the TRP has substantively contributed to improved road safety and air quality, and reduced vehicle emissions. By the end of 2017, around 70,000 minibuses had been scrapped, at a cost of USD 245 million (ZAR 3.4 billion). Take-up has declined over the last years, as few vehicles older than the 2006 cut-off remain on the roads.

The TRP was scheduled to come to an end in 2018, although the NDoT intends to continue the programme in some way. Among discussions for the way forward is the introduction for an age limit for taxis to operate, and a review of the scrapping allowance.

Regarding investment: respondents see a need for substantial investments to introduce the game-changing adoption of LC-HVT projects, such as transit-oriented development. Government support generally earmarks financing for expensive infrastructure projects with long-term financial return rather lower-cost projects with minimal return. This leads to a need for a bankable, resilient transport sector. Resilience in transport services and infrastructure is important for obtaining loans at good rates. Shorter payback periods are important as small firms cannot borrow money to reduce emissions, as illustrated in bus contracting structures in Rwanda (Box 6). There is a clear sense among Asian respondents that governments are not willing to 'walk the talk' and invest in resilient transport projects, which leads to investor reluctance.

Box 6: Bus contracting structures – an institutional and financial barrier

The structure of bus contracting can be both an institutional and a financial barrier to emissions reductions. In **Rwanda**, for example, private bus companies are contracted for three years. The short contracts disincentivise bus operators from investing in fleet recapitalisation and improvement. In other countries where bus contracts have been introduced (e.g. in newer generation bus contracts in South Africa), the duration of negotiated bus contracts are in the region of 10-12 year to allow for operator investment in fleet renewal. The upfront capital cost of an electric bus, or a new minibus for paratransit operations, can also be prohibitive (see case examples of electric bus pilots and fleet renewal programmes above), and respondents have indicated that poor understanding, and lack of comparative data, means that the financial implications of overall lifecycle costs are a hard sell'.

Prohibitive duties on the import of EVs (three-wheelers, and buses) and all bicycles (i.e., not only electric bicycles) is identified as a barrier to low carbon transport uptake in each project country. Additionally, the lack of financial barriers to the import of aged buses and private vehicles in many LICs disincentivises transitional investments to low carbon transport technologies, as illustrated by the case of electric bus fleet in Surat, India (Box 7).

Box 7: Private-Public-Partnership models for electric buses

Surat, India, a city which is still buying mostly diesel-powered buses, is considering procuring about 50 electric buses through a PPP model or the complete capital investment model. The proposal has a cost of USD 0.56 to USD 0.63 (Indian Rupee (INR) 40 to INR 45) per kilometre in diesel and USD 0.84 (INR 60) for electric. That means per kilometre they need to pay about USD 0.21 to USD 0.28 (INR 15 to INR 20) higher than what they pay today. This is the consideration which they need to take a decision, based on the indirect sustainable development benefit impact on local emissions, health, and the social impact, amongst others. As a local government, it is never possible to measure these benefits in terms of money. The decision has to be taken looking at the larger interests of the people in the city, although it is not easy to place a value on these benefits.[74]

5.2.2. Political / Social challenges

Respondents identified 'low carbon' as not being a priority driver for transport interventions. It is usually seen as a positive co-benefit but not a deciding factor on what to implement. Respondents indicated that they perceive the private sector, donors, or 'international pressure' as the ones pushing the low carbon narrative, which does present a risk in terms of political acceptability, as illustrated in efforts to introduce bus rapid transit in Delhi, India (146) and Nairobi, Kenya (Box 8). In Delhi, pressure from constituents forced the BRT to be removed. Election promises and political tenure is fought over public transport promises, and paratransit service providers and motorists wield extraordinary voting power (122). [75] On the other hand, as mentioned in 5.1, India is implementing a large-scale support scheme for electric and hybrid vehicles.

Although not explicitly described as a barrier by the respondents, the drivers of low carbon transport in cities are rarely local political or government authorities. The lack of political leadership, clear goals, political momentum and fear of change are key barriers to implementation. The lack of capacity to make business viable is also a major obstacle. When it comes to social barriers, the disruptions caused by system constructions were a further concern.

[74] Expert interview, India (see Appendix 1).
[75] See for example (229).

Box 8: Political and socio-economic implications of Bus Rapid Transit– the case of Nairobi

At a public meeting ahead of BRT-related stakeholder engagement in **Nairobi, Kenya**, *matatu* operators have demanded that the Kenyan President Uhuru Kenyatta intervene so that they are assured continued access to the lucrative Nairobi CBD custom. The *matatu* operators say the BRT 'will adversely affect them' and 'push them out of business' (147).

The Nairobi governor Mike Sonko had in December 2018 barred all *matatus* from accessing the city centre, to decongest the city – a decision that lasted all of two days.

"The move to introduce these buses will render over one million Kenyans who depend on the transport industry jobless. The BRT is not an emergency and should not be treated as such," warned *matatu* leadership. *Matatu* operators' patron, Kiambu governor Ferdinand Waititu, has said he will initiate talks with the President and the Transport Cabinet Secretary to have the BRT postponed until all parties have been fully consulted.

"We will be meeting with the Cabinet Secretary together with matatu owners' representatives from Mt Kenya and the BRT affected counties later this month to chart the way forward on this matter," Waititu said. He also said that nobody has the right to bar the 14-seater matatus from accessing Nairobi's CBD, arguing that as the country's capital every Kenyan should have unfettered access to it. "You cannot wake up and tell people all of a sudden that they cannot access the CBD. *Matatus* will operate from there and no one will stop us."
Mwaniki Gichere, who represented Laikipia, Nyeri and Nyandarua counties at the public meeting, told President Kenyatta to "return the favour" and address their plight as *matatu* operators played a big role in his re-election. "During voter registration which was a major concern for our President, we ferried people for free to their respective areas as well as during the election day to ensure that Uhuru got his second term. We plead with him to remember our contribution and end the tribulations facing us," Mwaniki said.

Overall, poverty alleviation, the provision of mobility and access, and dealing with congestion, is seen as more important than attending to the low carbon aspect or impact of any such interventions. The different regions for the projects have identified different priorities as key policy drivers for LC-HVT. Among Asian respondents, political will was seen as the most critical barrier that makes low carbon transport difficult to achieve. While tangible problems can be addressed, such as congestion, air quality and health, climate change is seen as an intangible that can only be promoted as a co-benefit of one of the others. In African countries, respondents believe that mitigation measures are less a priority of resilience measures as the impacts of resilience projects are more immediate: "Mitigation is not our thing. We will suffer the consequences, but we didn't cause it. It's about building resilience to something that is already on its way. … We have other priorities, and it is right – when your population is dying of malaria, when you are stuck in congestion, why care about climate change."[76] And another responded that, "we have poverty, violence, insecurity, those are urgencies. And then, you have long-term goals of reducing carbon emissions, but let's fix what's really urgent right now.[77]"

At the same time, there are a number of possible low carbon interventions that study respondents said could directly affect the poor – either negatively or positively – and are politically risky. In South Africa, the national government has capped price increases on low-grade fuel in the face of recession, monthly fuel price increases and a national election, which will have an impact on emissions and air quality. In other African countries where there are fewer limits on the age of vehicle imports and poorly regulated

[76] Expert interview, Ghana (see Appendix 1).
[77] Expert interview, Ghana (see Appendix 1).

fuel quality, the lack of regulations allows for private vehicles to be more affordable for its citizens and for whom public transport is a poor-quality alternative; however, the increase in car ownership could have negative impacts of society in general (e.g. congestion, poor air quality, increased emissions). One interviewee responded, "These are not even conscious trade-offs – as low carbon is just not on the agenda[78]…" Project countries face various trade-offs in engaging with a vehicle industry at different stages and to different degrees, as illustrated in Box 9.

Box 9: Barriers and opportunities within the vehicle industries

South Africa is one of three of the project countries that has a new vehicle industry. The protectionist approach of South Africa's national Department of Trade and Industry (DTI) was cited as a direct barrier to the uptake of electric mobility. "There is a big resistance to change, there is fear, and they are protecting the local manufacturing industry – the most jobs in the country are provided within the automotive sector".[79] In the same vein, however, study respondents saw this as an opportunity – to develop a new components, manufacture and assembly industry, in the face of a possible substantial market on the rest of the continent.

Indonesia incentivised the production of smaller and more fuel efficient 'Low Cost Green Cars' to support the domestic vehicle industry. The objective may have been to reduce emissions; however, because the policies were not harmonised the result has been a fast-growing car population that is leading to increased congestion.

To many respondents in countries without an automotive industry, such as **Rwanda** and **Ghana**, the move to electric mobility was seen as an opportunity that could allow the country to start assembling and later manufacturing vehicles for its home market. As politicians are not pressured by an existing industry to conserve jobs, they are open to welcome change provided that it does not reduce their tax base.

Study respondents say that decision-makers and those influencing them seldom understand the consequences of inaction around climate mitigation, which leads to a limited focus on low carbon transport; assistance in learning to 'sell' the value of low carbon transport to decision-makers is requested. The results of the interviews indicate there is a need to provide knowledge of the sustainable development benefits of the mitigation efforts for LC-HVT actions. There are also times when low carbon transport itself is poorly understood: associated with disaster management in too many instances rather than climate resilience.

Respondents discussed the inadequate regulatory environment within most selected countries, and the concern that political officials are afraid of making decisions that could resolve a problem but might be politically unpalatable. The political risk was evident; that politicians may sell out/ compromise if low carbon vehicles become too expensive or the implementation process too complicated. The social risk of promoting these programmes was felt to be high because low carbon is long-term venture with no direct individual benefit that accrues to the policy maker or to the transport user.[80] Yet private investors and operators will not take action until the political actors have taken a decision, and clearly marked a long term, firm committed pathway that allows the private operator to invest. But once there is clear leadership and there is a strategy to do things, it can start to snowball, and it works because once the trajectory is clear, it can also be fashionable; respondents in Bangladesh and India in particular said that people would buy an e-bike once this become an established trend. India is now home to about 1.5 million battery-powered, three-wheeled rickshaws – a fleet bigger than the total number of electric passenger cars sold in China since 2011 (148).

[78] Expert interview, Ghana (see Appendix 1).

[79] Expert interview, South Africa (see Appendix 1).

[80] Workshop Input from workshop participants (see Appendix 3).

As evidenced in the literature, car use and land-use issues are among the critical barriers to the successful implementation of low carbon transport measures. Car use in most developing countries is heavily subsidised. For example, parking fee structures and taxes and fees such as registration, allow a minority of travellers in private vehicles to occupy a majority of road space to the detriment of other passengers. These subsidies increase private vehicle trips and make it more complicated for public transport to compete. Car users are notably reluctant to give up their vehicles and shift to more efficient transport means. Land-use regulation is also a critical variable because it limits the supply of land, which raises costs, causing the poor to be priced-out and having to live far away from essential services and opportunities.

5.2.3. TECHNICAL CHALLENGES

Most study respondents commented that low carbon technologies (e.g. electric buses) are still costly and need time to evolve, as illustrated in South-South technology transfer efforts in South Asia (Box 10). While Asian respondents were more comfortable with new technology, most respondents from African cities mentioned technical barriers to implementing electric mobility and shared a personal interest in knowing more about electric mobility technology.

Box 10: Technology transfer on electric buses

In **Bangladesh**, China Shanghai Technology has supplied three experimental electric buses for Dhaka, while in **India** the 'Smart Cities Mission' is doing this on a wider scale; of the 100 winning proposals in terms of the Mission, some are low carbon transport friendly such as electric buses, automatic fare collection systems, automated bicycles sharing stations, parking management, smart bus shelters, and intermodal transport hubs.[81] .

While acknowledging that countries face challenges regarding access and mobility, respondents identified the implementation of electric mobility options as an opportunity to deal with the poor air quality, dependence on fuel imports, and 'terrible' fuel quality concerns despite the high investment costs. Technical knowledge, however, is a significant barrier: from comparative studies to lifecycle costs, to the basis of how EVs work, to formatting project plans and implementing pilots to gather data in Cape Town (Box 11) and to map and improve *matatu* networks in Nairobi and elsewhere (Box 12), everyone wished to know more than they do in this regard.

Box 11: Implementing pilot projects to gather transport data in the City of Cape Town

Each responding African country is looking to **Cape Town, South Africa**'s pilot electric bus project (which has been placed on hold due to a legal challenge). One respondent pointed to South Africa's burgeoning wind-energy sector: "We also have skills challenges: think for example about our challenges with the wind farms, there is no skills set to maintain them – and they have to import technicians to maintain them – we have to avoid this for EVs".[82]

In October 2017, the City of Cape Town signed the C40 Cities Fossil-Free-Streets Declaration (149). By doing so, Cape Town undertook a 'pledge to transition to Fossil-Fuel-Free Streets by procuring only zero-emission buses from 2025; and ensuring a major area of Cape Town is zero emission by 2030."

In anticipation of this commitment, a year earlier, the City had started the process of procuring 11 battery-electric, 12-m buses for a pilot phase in Cape Town, as part of its MyCiTi BRT service (150). Overall, the City is

[81] Expert interview, India (see Appendix 1).
[82] Expert interview, South Africa (see Appendix 1).

Box 11: Implementing pilot projects to gather transport data in the City of Cape Town

weighing up the long-term benefit environmentally, in addition to maintenance and energy savings, against the short-term capital expenditure (which is in the order of three times the cost of a diesel vehicle). At the same time, the City anticipates that the price of vehicles and batteries will reduce rapidly (151).

However, there is little operations, emissions or comparative data available locally, and like other South African cities considering electric public transportation, **Cape Town** has struggled to make a defensible case for fleet expansion (151).

The City has therefore developed detailed parameters for a commissioning and pilot study, where it will test the vehicles for six months under a number of different operating environments – hilly or flat routes, low or high average speeds, and longer or shorter distances. Vehicles have been fitted with telematics with which to collect operational performance data, and drivers have been trained in record-keeping and other relevant skills (152).

If, as a result of this pilot, the business case can be made, the City will consider replacing a percentage of its diesel fleet with e-buses and include e-buses in further MyCiTi phases. The projection is that the buses will achieve operational cost savings of more than 30%.

Box 12: The Digital Matatu project – using known technology for better planning

Reforming, transforming, or making more efficient the current public transport services has been a consistent comment from African respondents – how to streamline and regulate the paratransit services that already serve the majority of commuters in Africa cities. Expert interviewees (in Kenya in particular) shared with us that while there are clearly gaps in technical knowledge regarding electric mobility, there is already well-known technology that offers substantial and quick-win low carbon opportunities in addition to quantifying and streamlining paratransit.[83]

One of the biggest challenges for studying and modelling transport (whether formal or informal) is accessing data without the traditionally costly outlay for the required technology. It is rare that this data is collected formally. In this example, **Nairobi**'s paratransit (matatu) system includes more than official 135 routes, although as the city has grown and more roads built, new (unofficial) routes have emerged. Drivers do not have fixed schedules and fares, and often take detours to avoid traffic police, or road congestion. They also are known to improvise stops and other routes.

The Digital *Matatu* Project, a collaboration between the University of Columbia (Centre for Sustainable Urban Development) and the University of Nairobi, captured route data, developed mobile apps, and prepared a map showing not only where *matatus* currently travel, but how they could travel more efficiently instead (153).

To do this, the technical team devised a standard data collection protocol and methodology, using General Transit Feed Specification compatible data structure, and University of Nairobi students rode every matatu route, with their hand-held cell phones.

This ultimately enables authorities to see where they can have the most impact and devise more efficient routes with fewer transfers and shorter wait times. “This whole information angle has been neglected in Africa – yet there are so few technical barriers here. Our project, for example – by creating this information system, is showing that if people have this travel information, they can make more energy efficient trips and they wait for less. They are more likely to take public transport if they actually know how it works”.[84]

[83] Expert interviews, Kenya (see Appendix 1).
[84] Expert interviews, Kenya (see Appendix 1).

Box 12: The Digital Matatu project – using known technology for better planning

Project strengths included releasing data in an open data standard, to encourage development of technology, such as route apps, and including the local community in data development, which created trust in the data allowing it to be more widely used.

The project has already been replicated in some form or other in **Addis Ababa, Ethiopia**, in **Cairo, Egypt**, and in a number of **South and Southern African cities**.

5.2.4. Institutional / Regulatory challenges

Limited or lack of coordination between implementing entities and authorities are shared as barriers to low carbon transport, as illustrated by opposing perspectives on cycling networks in Johannesburg (Box 13). One respondent highlighted the challenges of a three-tier government system in Nigeria, with differing skills and capacity levels, decreasing from Federal to State to City level; in this instance, the Federal entity develops guidelines, and each State can determine context-specific policy. While this enables a nuanced approach, "a lot gets lost in the process, and poorer states are not going to implement anything…"[85] The situation worsens when the country, state and/or city are governed by people with different political affiliations.

Box 13: Where strong institutional support mitigates party political interference: Johannesburg bicycle promotion

While respondents frequently mention the challenge of creating and nurturing political will to support low carbon transport measures, high-profile political support can have unintended consequences (24).

In the mayorship of Parks Tau from 2011-2016, bicycle advocates in South Africa's most populous Gauteng province found an unexpected political champion for bicycle infrastructure. As the Executive Mayor of the **City of Johannesburg,** representing the African National Congress party, Tau recognised the possible poverty alleviation impact of utility cycling, and threw himself behind a bicycle infrastructure build programme that aimed to "facilitate equitable access for the marginalised sectors of our society". Designs were prepared for a cycling lane from low-income Alexandra to high-income Sandton, and another 20km linking the high-income areas to one another. The City of Johannesburg's 2016-2017 Annual Report notes that the City had constructed or retrofitted streets to accommodate all road users (pedestrians, cyclists, public transport commuters and motorists). In this financial year, the designs for Complete Streets projects were finalised, the preliminary design for NMT links to railway stations were finalised, and 1.6km of Complete Streets projects were completed.

But the programme proved to be too closely identified with the ANC, and the infrastructure build came to an abrupt halt when the ANC was succeeded by a coalition of two opposition parties (the Democratic Alliance, or DA, and Economic Freedom Fighters, or EFF) in August 2016. In his inaugural speech, the new Executive Mayor, Democratic Alliance (DA)-backed Herman Mashaba, cancelled the programme… Only "when every road in Johannesburg is tarred, maybe then we will look at bicycle lanes again," he said. EFF chief Julius Malema expressed opposition more strongly: "We are taking the bicycle lanes; we are going to give the people of [low-income area in Johannesburg] Alexandra water" (24).

City officials have been able to continue with bicycle awareness and distribution programmes nevertheless, because of strong policy support at local, provincial and national institutional level. South Africa has had a

[85] Expert interview, Nigeria (see Appendix 1).

Box 13: Where strong institutional support mitigates party political interference: Johannesburg bicycle promotion

national NMT policy in place since 2008, and Johannesburg an NMT Framework since 2009. The national Department of Transport is developing a cycling-specific promotion strategy in 2019.

Respondents cite as challenges a lack of champions, whether at institutional or political level, and no clear reporting-lines or mandates, particularly when non-traditional government directorates and institutions become involved in implementing LC-HVT actions (e.g. electric mobility). In South Africa, for example, the burgeoning interest in EVs has seen national, provincial and local departments of energy, technology, trade & industry, environmental affairs, industrial research, industrial development, and labour become involved in an arena in which they have previously played only minor roles.

Institutional challenges are evident not only across ministries but also between departments in the same ministry working in silos. For LC-HVT to succeed, its needs have to be addressed through national planning across all sectors. Each actor cannot be approached individually. There is in many countries a lack of coordination among agencies/ industries and a lack of commitment from policy makers which presents a definite obstacle to change, for instance through the absence of regulations on second-hand vehicle importation (Box 14). Similar challenges are reported by each selected country, when it comes to paratransit regulation and reform.

Box 14: Regulating used-car imports, despite importer-objections: the case in African cities

Fleet renewal, air quality, and emissions reduction are hampered in most African countries selected for this project by the absence of regulations regarding the import-age of second-hand vehicles.

Almost all respondents indicated that a 'quick win' route to reducing carbon emissions in African countries would be a prohibition on importing aged vehicles, with their fuel inefficiencies and preference for low-grade petrol or diesel (see Chapter 3). Respondents particularly within the research community, had noted that air quality is one of the biggest concerns in African cities.

In September 2018, **Uganda**, did just that: despite objections from vehicle importers, and a concern that such a policy would deny access to private vehicles for low-income earners and contribute to unemployment, the Traffic and Road Safety (Amendment) Act 2018 bans the import of all vehicles older than 15 years. In addition, any vehicle older than eight years is required to pay an environmental levy (154). Heavy industrial and agricultural vehicles are exempt.[86]

Although the ban was motivated by road safety concerns – a UN Road Safety Performance Review of **Uganda** estimated USD 1.2 billion (UGX 4.4 trillion) as the overall annual cost of road crashes in the country – Parliament's Finance Committee has seen the ban in the context of black carbon, or 'high levels of pollution'. In 2016 the shadow minister of Finance had proposed a ban on all used cars, and reduction on taxes on new vehicles (currently 50%).

Earlier in 2018, **Kenya** stopped importing vehicles older than eight years, and a new draft policy intends to restrict imports of cars to vehicles that are three years old or newer by 2021. This does not necessarily reflect a commitment to low carbon transport priority, however, as the policy is reported to aimed at boosting the domestic automotive sector by reducing the dominance of the used car market.[87]

[86] See for example https://www.theeastafrican.co.ke/business/Uganda-bans-import-of-old-cars/2560-4590814-wkfhr2z/index.html

[87] See for example https://www.businesslive.co.za/bd/world/africa/2019-01-23-kenya-to-change-car-import-policy-to-boost-domestic-sector/

Box 14: Regulating used-car imports, despite importer-objections: the case in African cities

In **South Africa**, no used or second-hand vehicle may be imported without a strict permitting process.

In Indonesia, the Ministry of Energy is more active in transport regulations when it comes to fuel efficiency policy and biofuels (including in domestic aviation). The strong push for biofuel production and use is mainly to reduce oil consumption and promote rural development. Indonesia's climate change policy has led to increased political will and momentum to implement transport policies that were developed for various other policy objectives, for example fuel efficiency standards, investments in rail, and BRT. The 5-year strategic plan of the Ministry of Transport also has a CO_2 reduction target (Box 15)[88].

Box 15: National targets – Indonesia's climate strategy and its relevance to low carbon transport policy

In 2011, Indonesia issued a Presidential Regulation that set national targets for GHG emission reductions for 2020, by domestic efforts and with international support. One year later, each of its 33 provinces had to submit their plans to reduce emissions (RAD-GRK). In the Intended Nationally Determined Contribution (INDC) process, the targets were updated to 29% (domestic) and 41% (with international support) by 2030 (155).

Each sector, including transport, had to develop sectoral action plans that would contribute to these targets. This process, arguably top-down, led to sectoral bottom actions. Each ministry had to come with existing plans and strategies and feed these into the climate change discussions. Actions proposed in national and provincial transport plans, such as BRT, Intelligent transportation system (ITS), NMT, rail development were proposed as part of the transport contribution to the RAN-GRK. However, local governments in Indonesia have been struggling to translate national climate targets to local action in the transport sector (156). Figure 22 below illustrates the responsibilities of various stakeholders involved in this process:

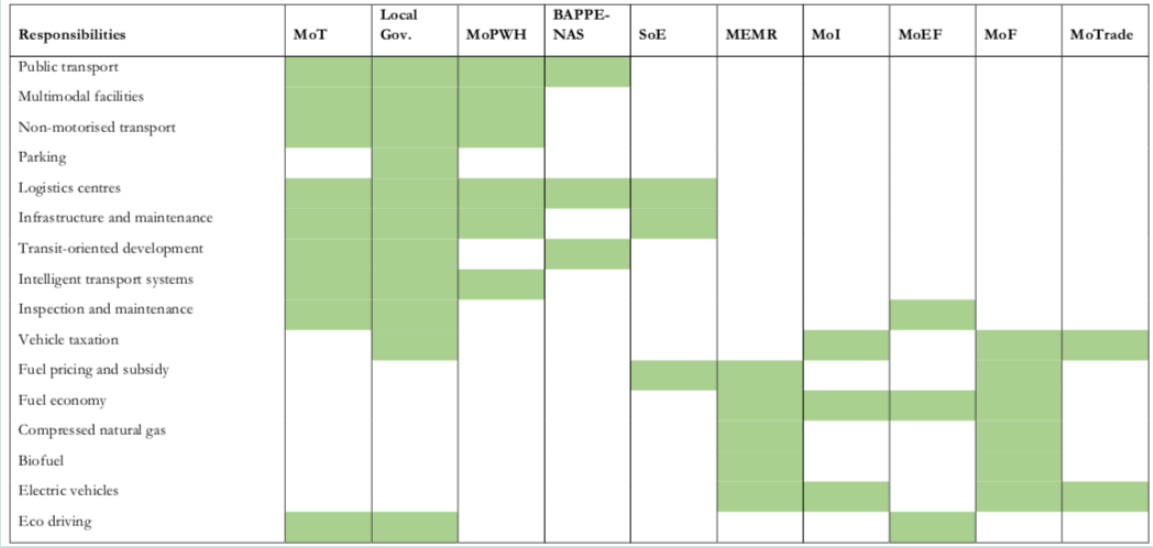

Figure 22: Matrix of sustainable transport government stakeholders and responsibilities (157)

As the impact on GHG emissions of these actions would need to be estimated ex-ante, and monitored when implemented, led to development of MRV methodologies, understanding of GHG emissions in the Ministry of Transport increased through capacity building. The BUR includes ex-post evaluations (2010-2012) and ex-ante emission reduction potential estimates for over 20 actions in the transport sector (53). Another impact of the RAN-GRK and later NDC/BUR processes was that different ministries, such as energy, planning, transport and environment, were increasingly communicating and coordinating.

[88] Interviews with Indonesian experts, (see Appendix 1), see also Box 15.

Box 15: National targets – Indonesia's climate strategy and its relevance to low carbon transport policy

Finally, although climate change mitigation is not a main driver of transport policy, the RAN-GRK agenda gave policy entrepreneurs additional options to put forward policy ideas. Climate change became a more important driver, as it is understood widely that the Paris Agreement is something that does not go away (158) (159).

5.3 Summary and Discussion

After a brief overview of key challenges identified in the literature, this chapter summarises the primary data regarding challenges to implementing LC-HVT in the selected countries and highlights perceived barriers to implementation of low carbon transport measures.

The literature review discovered many key challenges as viewed from the top-down approach. This starts with the understanding that the world is committed to the decarbonisation required by the Paris agreement and thus if this is not happening fast enough it is because there is an under-estimation of the scale of the problem, inadequate actions to address the challenge, lack of inclusion of transport in climate change summits, and few top-level binding commitments.

From the bottom-up developing country perspective, the problem is seen more as one where the project implementors have higher and more immediate local priorities such as congestion reduction, rapid road construction and large-scale infrastructure development to try and keep pace with the demands of fast economic development and a growing urban population. From their point of view, it is difficult to convince local constituents that mitigating GHG emissions should be reason for transport interventions when so many direct transport needs remain unsatisfied.

This is a fundamental difference between the priorities in the cities of HICs where transport demands are mostly satisfied, motorisation levels are mostly stable, and population growth rates are low or even declining. For them the main concerns are levels of pollution and consumption related burdens.

For the developing countries, both top-down and bottom-up perspectives identify a lack of clear vision, inadequate leadership, investment, and weak governance structures, lack of skilled personnel, plus 'the seductiveness of following the high-mobility option' as challenges to low carbon development.

Key findings of the primary research point to four groups of challenges:

- **Financial/economic challenges**: Targeted finance for low carbon transport to help overcome any addition investment costs together with training and assistance in preparing project and funding proposals. Respondents also mentioned a need for funding for research and promotion.
- **Political/social challenges**: In many cities, pushing a low carbon agenda presents a political risk since this is often not what constituents are primarily demanding. The lack of political leadership, clear goals, political momentum and fear of change are key barriers to implementation. The lack of capacity to make a low carbon transport business viable is also a major obstacle. Regarding social barriers, shifting people private motorisation to lower carbon modes can be a major challenge.
- **Technical challenges**: Respondents commented that low carbon technologies (such as electric buses) are still not widely deployed are costly and are not fully understood by all local decision makers, and need further time to evolve. Further, potential inequitable distribution of the

benefits and costs of low carbon transport interventions (such as electric buses) remains a concern (see box below).

- **Institutional / Regulatory challenges:** Limited or lack of coordination between implementing entities and authorities are shared as barriers to low carbon transport. Institutional challenges are evident not only across ministries but also between departments in the same ministry working in silos. Respondents also cite as challenges a lack of champions, whether at institutional or political level, and a confusing range of role-players. Particularly when non-traditional government directorates and institutions become involved in implementing LC-HVT actions (e.g. electric mobility), respondents perceive that there are no clear reporting-lines or mandates.

Box 16: Distributional impacts of low-carbon transport measures

Primary research for this report[89] has revealed concerns about the possible inequitable distribution of the benefits and costs of low carbon transport interventions (as exemplified in the following respondent quote):

> *"It's a social challenge. [Of electric buses] - for me the question is, what could we have done with that budget instead. If [low carbon public transport] will bring emissions reductions, the [extra] cost might be acceptable – but with the understanding that the mandate is to provide affordable and accessible transport. There must be this balance. It cannot be about deploying the technology to recover the cost of the technology, as you are defeating the whole point of access. We believe that climate change must be mainstreamed, but the additional cost must not be a burden."*

While neither this report nor its underlying research focused specifically on the distributional impacts of low-carbon transport measures, it is likely that climate change impacts and issues of access and transport disadvantage will significantly affect women, children, vulnerable and marginal groups (115,160–168); in this sense, interventions that reduce carbon emissions may ultimately have a positive impact for these groups. Most low-carbon transport measures have the potential to increase social equity (or remain neutral) and help to reduce poverty (16), especially if they are well implemented with consideration for equity. In other words, the overall impact of an intervention will depend on the local context and how it is implemented.

However, there remains a need to investigate the immediate distributional or equity impacts of climate mitigation interventions, including low-carbon transport. There is a substantial body of work in the literature that describes the value of a just transition to a low-carbon economy. There are many synergies as well as trade-offs between social and environmental sustainability (16), where the outcome of low-carbon or sustainable interventions can inadvertently increase or entrench disadvantage, or only marginally redress inequity. At the same time, a large share of the population belonging to disadvantaged groups is currently dependent on low-carbon modes such as walking, cycling and public transport; however, they may not continue to use these modes when incomes rise, and thus demand-side approaches (including integrated land-use planning) are required to avoid a subsequent shift to higher-carbon modes (169–176).

The impacts of inequitable distribution of the costs and benefits of transport systems are well documented (for example (177–179)); these include travel times and mobility rates, travel costs, and health and financial impacts, as well as inter-generational costs of implementation and infrastructure. More recently, a body of work has developed focusing on the distributional impacts of carbon taxes and fuel subsidies (and reform) in developing countries (76)(180)(181)(182), while accessibility (rather than mobility) metrics have emerged as a new research focus (183,184). Overall, the literature cautions that high-volume or improved mobility interventions can be but are not necessarily more socially just, as the distributional impacts may not be equitable (19), and that measures such as Bus Rapid Transit (BRT) or light rail may impose longer travel times, greater numbers of transfers, higher costs and reduced accessibility (183,184,186–189). However, it is noted

[89] Expert interview, South Africa

that in general current mobility systems are inequitable, and LCT measures have the potential to improve upon this situation by offering a set of mobility options for a broader range of users.

Study respondents have mentioned some low-carbon measures that could have financial implications for the poor. For instance, in South Africa, the national government has capped price increases on low-grade fuel in the face of recession, monthly fuel price increases and a national election, which will have an impact on emissions and air quality. In other African countries where there are fewer limits on the age of vehicle imports and poorly regulated fuel quality, the lack of regulations allows for private vehicles to be more affordable for its citizens and for whom public transport is a poor-quality alternative; however, the increase in car ownership could have negative impacts of society in general (e.g. congestion, poor air quality, increased emissions). Especially in Asia, two- and three-wheelers provide affordable mobility to large parts of the population. Switching to electric vehicles may save costs (see Chapter 4, Table 8), and incentives are required to mitigate potential accessibility impacts if and where this is not the case.

Questions have been raised by researchers and policy-makers regarding for example prevailing assumptions that BRT and bicycle infrastructure deliver social justice or poverty alleviation impacts (see for example (187,188,190)). Findings from Africa, Asia, and Latin America all suggest that while BRT does offer significant benefits to low-income groups, these are often "skewed toward medium-income users and thus less progressive than they might be. Pro-poor outcomes only materialise if BRT implementers pay specific and sustained attention to equity." (188) Referring to BRT in African cities, Wilkinson *et al* (191) note that without careful assessment, such systems are likely to be unaffordable without a major diversion of already constrained public resources, and may also offer a poorer ratio of overall benefits to cost than may have been claimed initially in terms of abstract models (121,192–194).

Vasconcellos (177) suggests several key questions to ask ahead of programme design to increase the probability of equitable impacts of urban transport programmes.

- How will this promote and facilitate meeting the needs of vulnerable groups?
- How will this influence social interaction?
- How will this influence mobility rates, and for whom?
- How will this intervention distribute space among different categories of people?
- How will this change the way in which different social classes and groups use the space?
- How will this change the way in which inhabitants access key and/or major destinations?
- How will this influence motorised vehicle speed? Waiting time and frequency? Travel cost?
- How will this reduce harm in terms of road crashes, injury and death, and for whom?
- How will this reduce harm in terms of air pollution, and for whom?
- From where have resources been diverted in order to finance this particular intervention, and how has this impact been assessed?

6. IDENTIFYING KNOWLEDGE GAPS AND NEEDS REQUIRED TO PRIORITISE AND IMPLEMENT LOW CARBON, HIGH VOLUME TRANSPORT MEASURES

After a brief overview of key challenges and proposed solutions identified in the literature, this chapter summarises the primary data regarding knowledge gaps and knowledge needs in order to prioritise and implement LC-HVT in the selected countries.

6.1. BROAD NEEDS AND KNOWLEDGE GAPS IDENTIFIED THROUGH LITERATURE REVIEW

The Africa Transport Policy Programme (SSATP) (140) summarises the most common and relatively widely documented barriers for improving urban mobility in the developing world as (A) lack of awareness and political will; (B) unclear responsibilities, lack of coordination and the predominance of short-term individual interests; (C) scarce human resources, know-how and data; and (D) scarce financial means.

Framed this way, these barriers are not necessarily insurmountable, and the authors of a recent work looking at policies for sustainable mobility in African cities (140) propose a fairly straightforward action to counter each key challenge identified (Table 9).

Table 90: Barriers for improving urban mobility in the developing world

Challenge/barrier	Action
(A) Lack of awareness and political will	Improve understanding of key urban accessibility and mobility issues and of actual levers for action in order to generate strong and sustained commitment from decision-makers.
(B) Unclear responsibilities, lack of coordination and predominance of short-term individual interests	Put in place a well-conceived governance framework and a clear decision-making process, enforced through proper legislation, favouring integrated trans-sectoral and multi-modal approaches, cooperation, and systematic accountability.
(C) Scarce human resources, know-how and data	Build capacity of a sufficient number of well trained and experienced professionals able to conceive, implement and monitor data informed policies, strategies and projects, according to internationally recognised best practice and locally suited norms and practices.
(D) Scarce financial means	Implement appropriate funding mechanisms to sustain efficient and inclusive urban transport.

Other broad evaluative work (195), in work conducted for the Swedish Energy Agency evaluating transport interventions in developing countries, identified significant challenges relating to institutional roles and responsibilities, the availability of personal and financial resources, and the knowledge and perspectives applied – and proposed actions such as the coordination of MRV efforts under government guidance, that these build on existing structures, that guidelines and standards are developed, that training and capacity building is funded, and that long-term incentives for reporting are funded.

Yet exactly what knowledge is needed in order to close these gaps between the challenges and proposed outcomes, and facilitate the actions required, are less easy to identify. This chapter introduces the subject, which is expanded upon in this report's accompanying Capacity Development Strategy (forthcoming) and in the forthcoming paper (working title), "An exploration of knowledge-seeking within the low carbon transport arena: findings from key informant interviews in selected African and South-Asian countries". For example, where a primary concern is the existence of other more urgent government priorities, relevant knowledge might involve the quantifiable impact of LC-HVT interventions on these other priorities. To resolve an opaque policy direction, knowledge of policy development in association with all relevant government departments, knowledge of stakeholder engagement and conflict management might offer a way forward. A dearth of sources of sustainable funding for capital investment might be partially resolved through incisive problem assessment, business-planning skills, and alternatives analysis.

Business management skills are essential, for example operating an efficient, profitable and socially just public transport service. Without political insight, legal knowledge and change-management skills, effective, fit-for-purpose bus contracting cannot be attended to successfully. Training in standing firm against vested interests among potential investors, and in evidence-based behavioural change processes, would be welcome. As became evident during primary research, other knowledges required is data collection protocol, implementation and interpretation skills required to quantify outcomes, impacts, and emissions, and to audit social as well as environment benefits.

During primary data collection for this study (refer Chapter 1.3, Data Collection), respondents were presented with a list of possible knowledge needs and gaps plus the option of 'other' (developed as a result of a literature review and corroborated by a peer-review process) and asked to rank these in order of importance. Respondents were also asked how they would prefer to receive access to knowledge, with qualitative interviews complementing the survey work. The findings are presented in Figures 23 to 30. Scoring highly among respondents was the political and social need to make the case for low carbon transport to decision-makers, and to improve alternatives-analysis skills among political decision-makers. It is also important though challenging to make an economic case to support the political case as externalities are not often factored into decision making.[90]

At the same time, however, the literature highlights the increasing implementation of measures based on 'short cuts' (in the form of best-practice), or measures uncritically transferred from elsewhere. Unless these are accompanied by meticulous understanding of the different local contexts (191) (193)(196) and the way in which 'best practice' has been designated (127); interrogation of the vested interests of policy 'entrepreneurs' (197); and the motives of international think tanks, funding agencies and trans-national non-government organisations (NGOs) (197–199); policy success is unlikely. Best practice does not necessarily involve substantive evaluation, and is at times "little more than an exercise in informal polling"(200) (201) and skilled marketing (202).

How decisions are made in the transport sector, however, remains an under-researched field (203). The available research suggests that decisions, policies and strategies are driven as much by ideology and

[90] Under a financial analysis for a (particularly private sector) investor, it is difficult to assign a return on investment (ROI) value to co-benefits that accrue to local society (health, noise, liveability) or global society (climate change) where there is no directly applicable damage function on the balance sheet. Where a benefit cannot be fully assigned to shareholders, it falls into a philanthropic category rather than a financial return on investment.

politics as much technical evidence, and that policy transfer is rarely a rational survey of best practices but "a political process through which policymakers select their sites of learning in accordance with wider aspirations, ideologies and positioning"(129). Recent work within the political economy and policy transfer arena have begun to examine the politics and policy gaps that are the key driving factors influencing the transport sector – see (113)(121)(131), and the literature review in Section 5.

6.2. SPECIFIC NEEDS AND KNOWLEDGE GAPS IDENTIFIED THROUGH PRIMARY DATA COLLECTION

Overall, respondents noted an urgent need to know how to influence decision-makers, how to make the case for low carbon transport, and how to prepare bankable proposals for low carbon transport projects, although individual respondents shared their own gaps in technology expertise, countries require a different layer of knowledge and assistance.

Key findings of the primary data are reported by gaps relating to financial/economic knowledge; political/social knowledge; technical knowledge; and institutional/regulatory knowledge.

6.2.1. MAKING THE CASE FOR LOW CARBON TRANSPORT MEASURES

Low-income countries are faced with poor urban planning, inefficient basic service delivery, poor infrastructure provision, inadequate transport services, unregulated traffic, increasing congestion and pollution, and inadequate technical, institutional and financial capacities (140). Countries are further confronted with the substantial concerns of poverty, public health provision, public and road safety, food security, access to education, and access to housing, among others – all of which have a consequential relationship with transport disadvantage (204). Mobility is time-consuming and expensive, which affects the competitiveness and attractiveness of developing world countries and cities. The externalities of existing mobility include loss of productive lives in road crashes, the loss of time due to hospitalisation and injury, the damage to family and friendship networks, and the harm done to long-term life chances because of curtailed or abandoned healthcare and schooling (120) (165–167).

Ensuring that mobility interventions are also 'low carbon' is rarely a key consideration among decision-makers, as reflected in the survey results in Figure 23Figure 23. It is a major concern among developing countries that climate mitigation actions imposes costs, and quantitative emission reduction targets will adversely affect economic development (2). Hence what has become known as the 'co-benefits' approach, which "finds solutions that can be mainstreamed into existing national and local development policies" (2). For example, emerging urban transport best practices in India have led to local benefits of improved air quality, enhanced mobility and national energy security through reduced dependence on oil (2). Thus, how to make the case for transport measures in general, and how to prioritise low carbon measures, is a key concern among study respondents.

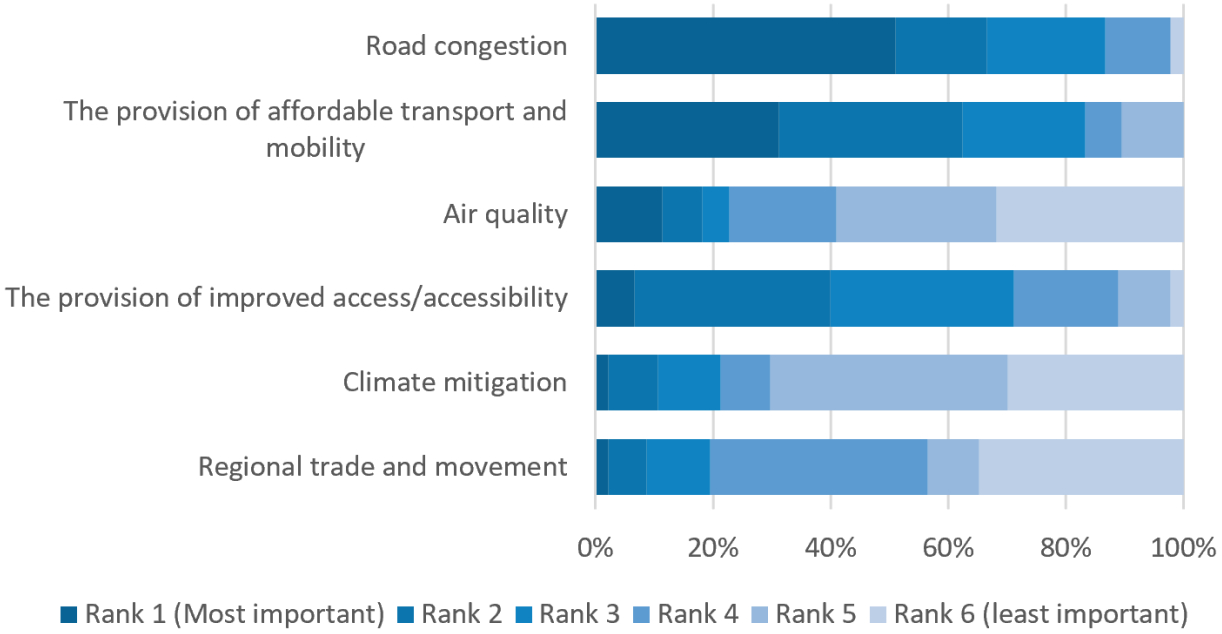

Figure 23: Problems that the project countries' transport interventions intend to solve

During primary data collection for this project, study respondents reflect a desire to make the case for low carbon transport and its related measures to political and other decision-makers, yet also lack relatively basic knowledge that might assist in doing so.

Few respondents (the majority of whom work in the transport sector) know of their country's low carbon transport targets (where they exist), or of the transport-focused details of their country's NDC submission to the Paris Agreement, as shown in Figure 24 below. At least half of the researchers who responded to the survey are not certain whether their country in fact has a climate change policy, or how this relates to the city in which they work.

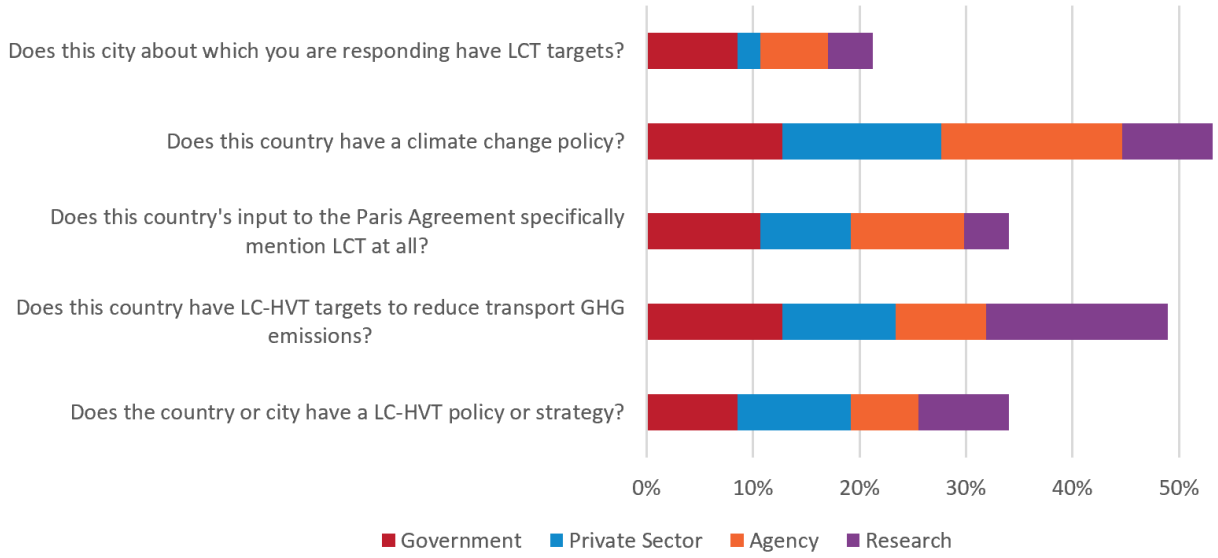

Figure 24: Respondents' knowledge of LC-HVT targets to reduce GHG emissions

Many of these knowledge gaps are related to the data sets to calculate the emissions benefits and cost benefits of low carbon options. As can be seen in Figure 25 below, most of the practitioners surveyed do not have a clearly identified source for finding the transport related GHG emissions data that would be needed for these calculations, and government-provided data sets and sources are referenced by fewer than one quarter of respondents.

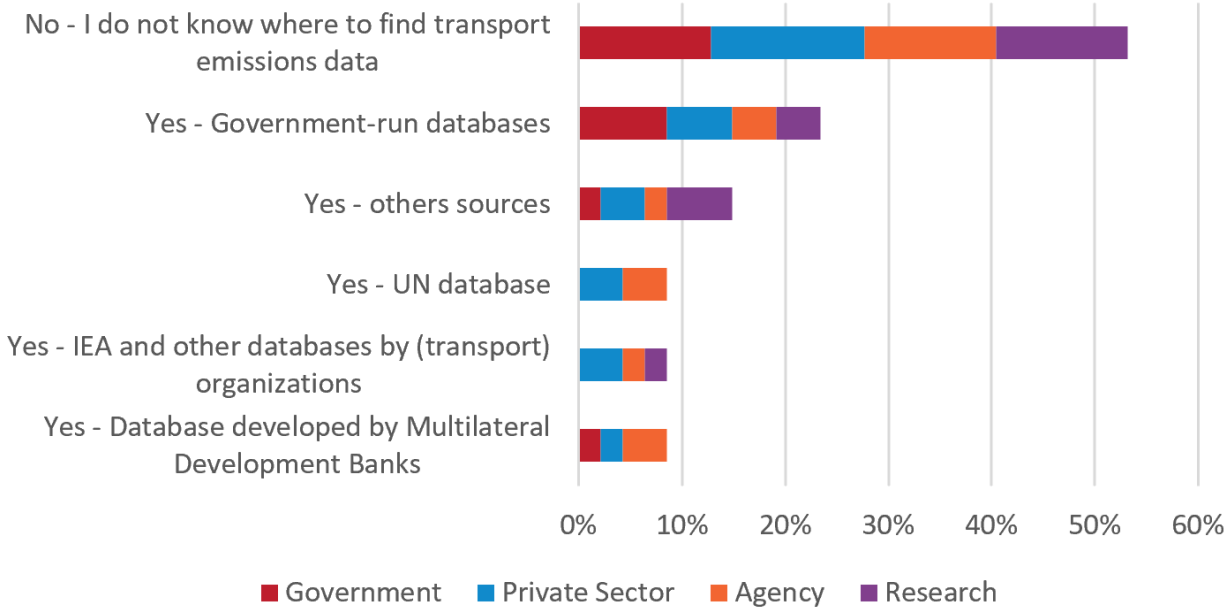

Figure 25: Knowledge about transport-related GHG emissions data

6.2.2. PRIORITISING KNOWLEDGE GAPS TO FILL

Study respondents were asked to rate the five most important areas of knowledge that they believe the country and institutions need with regarding to LC-HVT.

Figure 26 reveals interventions in order of descending importance as perceived by study respondents. A significant observation is that higher priority areas are related to process (i.e. ***how*** to implement LC HVT), and only the last item on this list is related to technology and products (i.e. ***what*** to implement). This matches the findings of SUTP India[91] which focussed its capacity building on how to implement sustainable transport projects (205).

Key findings of the primary data are reported in the sections that follow, in terms of gaps relating to financial/economic knowledge; political/social knowledge; technical knowledge; and institutional/regulatory knowledge.

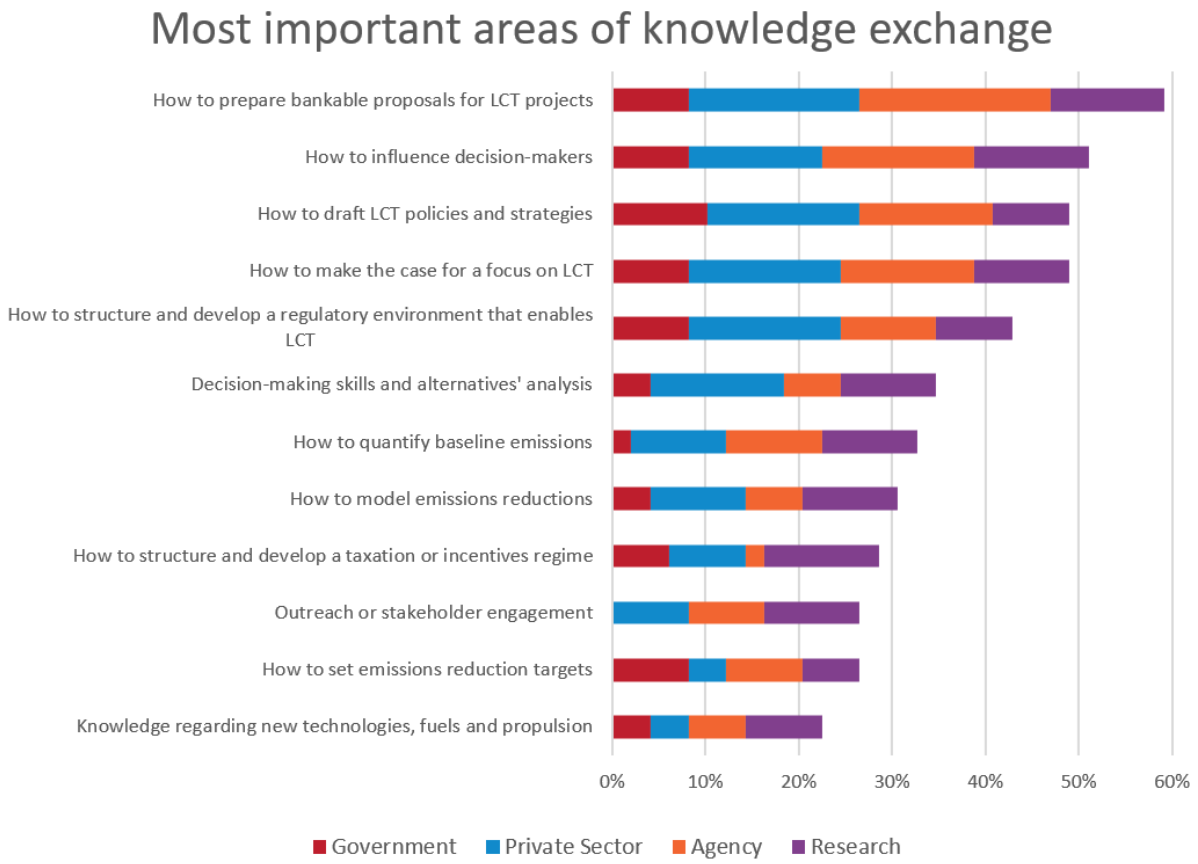

Figure 26: What do respondents believe their country/institution/organisation most need to know regarding LC-HVT

[91] The government of India (GoI) vision for providing a Sustainable Urban Transport System became a primary objective with the adoption of the 2006 National Urban Transport Policy (NUTP). The Ministry of Urban development (MoUD) initiated SUTP with support of GEF and the World Bank to foster a long-term partnership between GoI and state/local governments in the implementation of a greener environment under the ambit of the NUTP. More at: http://www.sutpindia.com

A. POLITICAL KNOWLEDGE

How to make the case for low carbon transport, to decision-makers, is the most cited 'gap' in knowledge among respondents in the primary data collection phase of this work (see above, and Figure 27, below). Climate mitigation remains among the lowest priorities for transport decision-makers in the selected countries, trailing more tangible impacts – being significantly out-distanced by more 'political' imperatives of road congestion, affordability, and access.

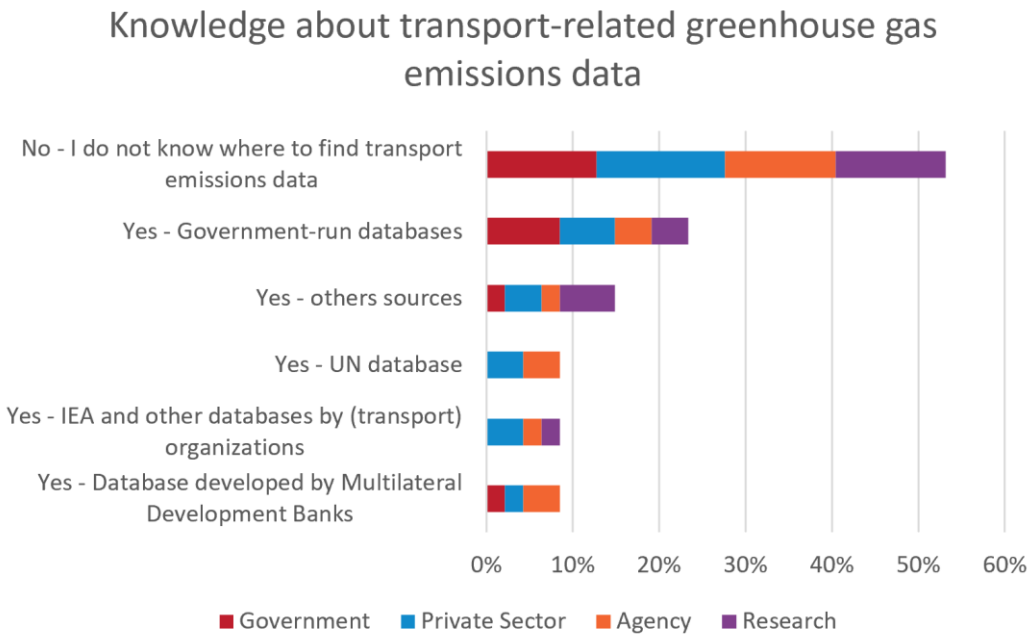

Figure 27: What do respondents' most wish to know regarding low carbon high volume transport

Thus, key to overcoming the political and social barriers identified in Chapter 5 is developing a clear case for low carbon transport measures: a persuasive, evidence-based argument that it will pay to leapfrog carbon-intensive transport systems and move directly to LC-HVT, as illustrated in various Asian examples shown in Box 16. The benefits of LC-HVT include improved health, air quality, balance-of-payments, equity and social justice, and reduced road congestion, poverty and urban deprivation – all of which are central to countries' social goals and the broadly-adopted sustainable development goals (SDGs) and targets.

Box 17: Using evidence and participation to make the case for low carbon transport modes

Respondents in Asia highlighted the urgent need to establish a pragmatic policy plan that moves transport from oil-based to renewable-energy based over an acceptable time period. This approach has two steps: 1) generate strong technical evidence through research, data, solutions; 2) conduct more stakeholder meetings and use social media to explain to the public based on the high-level data, SD benefits, and political decision-making.

Respondents noted a need for political leadership to reduce subsidies for private vehicles, and criticised government weakness in allocating road space to pedestrians or public transport rights-of-way and imposing residential parking charges.

There are, however, many positive examples, which include changing the vehicle registration rules in **Bangladesh** with parliament approving a new Road Transport Act 2018, to allow electric rickshaws to be registered for use in secondary cities. In another example, **Indonesia**'s climate change policy has led to increased political will and momentum to implement transport policies that were developed for various other policy objectives, for example fuel efficiency standards, investments in rail, and BRT. The 5-year strategic plan of the Ministry of Transport also has a CO_2 reduction target.

Big steps are being taken in **India** at the national level. Initially, reducing emissions from transport was driven by air quality and public health concerns with advocacy battles in the Supreme Court. With the benefits from these policies realised, the Indian government has put their projects in place, there is convergence between the Climate Change Action Plan and the National Clean Air Action Plan that include the principles of low carbon actions with public health, air quality, energy security, and road safety. The national urban transport policy, the national habitat standard, and the national transit-oriented development policy have been adopted and the challenge now is how to ensure that these policies and policy principles are translated for implementation. But of course, the political battle is not yet over, as there is strong push-back from private vehicle owners and manufacturers.

A lack of political knowledge and understanding can also threaten efforts to advance low carbon transport measures, as shown in the case of an unsuccessful campaign for a BRT network in Bangkok, Thailand (Box 17).

Box 18: The importance of political knowledge in BRT development in Bangkok, Thailand

Bangkok is a city of eight million with a metropolitan area of 14 million, and rapidly increasing motorisation. In 2005 the city developed a master plan, aiming for a network of 5 BRT routes with a total of 110 km to complement the existing rail- based mass transit system (about 80 km), which, while popular, had failed to relieve congestion.

In May 2010 the first BRT line begun operations, with one 15.9 km corridor serving a low-volume route with 25 standard 12m buses (high-platform) and 12 stations. By June, the system handled 18,000 passengers a day running at an average speed of 30 km/hr. with a 5 min headway during peak hours and 10 min during non-peak hours. Although limited for a large city like Bangkok, the BRT line was of good quality. Start of a successful BRT network? Not quite, the BRT project was curtailed in September 2010, the other planned BRT lines were cancelled.

The creation of a BRT system for Bangkok was a pet project of Apirak Kosayaodhin, the Bangkok Metropolitan Administration (BMA) governor who ruled between 2004 and 2008. He made BRT a cornerstone of his political campaign. But the members of the opposing party, Thai Rak Thai Party, had heavily vested interests in automobile and road businesses and were opposed to all public transport (including BRT) and made sure that the project was subjected to delays and bad publicity.

Governor Apirak who had pushed for the BRT project creation stepped down in 2008. His successor (also from the Democratic Party), made it clear that the BRT was an inherited project for which his administration did not care much. The project lost momentum and was finally implemented in a very partial way and along a route mostly running through a low-demand peripheral location.

In the initial planning stages, Governor Apirak was unable to generate the necessary political pull and popular goodwill to push the project forward under its own inertia within the short time before the novelty effect wore off. Without his top-level political support, the institutional setup was too complex to coordinate and implement this type of project. Local transportation agencies were unable and/or unwilling to change past roles and purposes and adopt/support BRT.

Little was done to promote the BRT system to potential users and stakeholders, and much of the opposition was based on political affiliation rather than concern for the city. After Governor Apirak's departure from office, the project lost momentum. It was implemented in a very partial way and along a lower density route in which it could never break-even or generate sufficient excitement and support to allow the original master plan to move forward.

B. FINANCIAL / ECONOMIC KNOWLEDGE AND MEASURES

The need to understand the **financial / economic** evaluation of lifecycle costs of new technologies is also evident. This becomes important when evaluating schemes that include technologies that have a high initial investment (e.g. electric buses when compared to their diesel counterparts) but much lower operating costs. There is also a gap in how to quantify baseline emissions, to which any new technology alternative will be compared to define the emissions reductions or emissions mitigation that the higher investment in the new technology can generate.

The ability to prepare bankable proposals for low carbon projects (i.e. to make the project attractive to financing options) was a gap highlighted by local government and funding agencies. Potential measures to build on these needs are discussed further in the following sections.

C. TECHNICAL KNOWLEDGE (INCLUDING THE NEED FOR DATA)

While the issues of behavioural change, and paratransit reform were identified as knowledge gaps, individual stakeholders are keen to learn about technology. For example, respondents recognise the benefits of EVs as most of the selected countries have available solar energy that is not harnessed to its full potential (see Chapter 3 for examples of electric bus pilot projects in selected countries). As general technical capacity is low in several of the selected countries, there is an opportunity to provide capacity development. Eastern Africa will soon require capacity building support as the region is in discussions to reduce the age limitation for vehicle imports to five years. This means that those involved in the automotive industry will need training on how to maintain these newer vehicle types.

The selected countries lacked the necessary data to monitor progress in the LC-HVT integration. All respondents noted that is difficult to source information from transport operators, and that the respective institutions are not set up to collect this data on a continual systematic basis. Respondents discussed ad-hoc technical reports generated by international or private organisations that are illustrative, but lack guidance for monitoring, recording and verification.

Box 19: Data collection in Indonesia: the need for coordination and sharing

In Indonesia, data for reporting on GHG emission reductions from transport measures is being collected at the national and the provincial level. There is a willingness to improve environmental performance by the Ministry of Transport, even if GHG reduction is not yet a key performance indicator. However, lack of data is still a key problem (especially for private vehicles), not only for GHG estimation of measures but for policy development in general. It is difficult to secure public funding for data gathering and there is a need to ensure a high-level of quality for the data; in addition, data sharing between government agencies is an imperative. Indonesia is taking steps toward coordinating these efforts through its national climate change framework.

D. KNOWLEDGE RELATING TO INSTITUTIONS / REGULATIONS

Institutional weakness is widely regarded as a key barrier, but offers an opportunity to 'not get distracted by EVs – but take a comprehensive look at getting institutional systems in place... "How do you get the systems in place where the cities make good decisions and invest wisely? That's what we need to learn".[92]

Experience in African and Asian low-income countries reveals that without institutional reform, public transport reform is unlikely or even more challenging. Institutional reform is a complicated process that involves all transport stakeholders to improve their coordination and effectiveness of implementing policies. This may involve an accountable urban transport authority to plan the service network, administer regulation, and guide the development of the sector; an empowered regulatory framework to provide the legal basis to impose an appropriate mix of obligations and incentives, with safety and consumer protection safeguards; a secure source of funding for fleet renovation, for infrastructure improvements, and to finance against business contracts, rather than just the security of assets and other collateral; and a public transport industry amenable to regulatory control, ready to compete for the right to operate specified services, and willing to invest in fleet capacity and quality (206).

[92] Expert interviews, South Africa (see Appendix 1).

Coordinating bodies can play a key role in advancing low carbon transport, as exemplified in several West African countries (Box 19).

Box 20: Institutional reform and financial stability

The Lagos Metropolitan Area Transport Authority (LAMATA), **Lagos**, **Nigeria**, the Executive Council of Urban Transport in **Dakar** (CETUD), **Senegal**, and the Urban Transport Agency in **Abidjan** (AGETU**), Côte d'Ivoire**, are all African examples of coordinating transport bodies, that countries could adapt and learn from.

LAMATA was established in 2003 to create institutional capacity to plan and manage the state's transport system. Its first goal was to execute the Lagos Urban Transport Project (LUTP), and ultimately to promote the coordinated development of all public transport modes in the metropolis. In 2007 a revised LAMATA Law was passed that included the function to: "… regulate rail and other modes of transportation".

CETUD's most important role is public transport planning, and it prepared the Plan de Déplacements Urbains de Dakar (Urban Mobility Plan) 2002-06.

AGETU was created in 2000 as a state body (controlled by the Ministry of Transport), although it has only operated since 2005 when supporting taxation laws were adopted by the Ivoirian Parliament. AGETU deals with both the regulated bus operator and the unregulated paratransit operators, under various franchise or permit schemes.

Key to the sustainability of these bodies to date is financial support from the World Bank and other institutions (206).

Respondents also indicated an urgent interest in learning from others' experiences in reforming or regulating the paratransit industry – an industry that is itself an institution albeit not a government one. Such reform is more likely where there is public transport industry amenable to regulatory control, ready to compete for the right to operate specified services, and willing to invest in fleet capacity and quality; Uganda, Ghana, Nigeria and Rwanda are all looking into more effective regulatory and contracting opportunities; South Africa has a comparatively highly regulated paratransit industry, and is looking at new models of incorporating these services into formal systems. Study respondents expressed interest in understanding the opportunities presented by such hybrid formal/informal systems, and of licencing, concessioning and franchising models.

Respondents call for regulatory frameworks to be enforced, but there is less knowledge regarding how to enforce such frameworks. Where there is a stated need for academics and city, regional or national decision-makers to engage with one another, there is a corresponding need for knowledge in how to do this: what models have worked elsewhere, and what might work here? The wisdom to engage with diverse stakeholders, develop a collective direction and facilitate 'ownership', is something few people can take for granted, but these skills can be taught and improved upon. Learning exchanges (see Box 20, below) are one channel for sharing knowledge across a range of geographies and actors, as illustrated in an exchange held in Cape Town in late 2018.

Box 21: Open Streets Cape Town – the value of Learning Exchanges

From 22-29 October 2018, **Open Streets Cape Town** hosted a group of 19 individuals from 11 African cities as part of learning exchange. The participants were all already involved in initiatives aimed at improving mobility and liveability in their respective places of origin.

The exchange comprised a series of conversations, interactive walks, workshops, bicycle rides, and formal presentations by local city officials, environment professionals, and academics from the Centre for Transport Studies at the University of Cape Town. The idea was to provide a variety of ways of engagement and learning formats. And so, while formal content was shared on issues such as the state of NMT on the African continent, the exchange placed as much importance on informal interactions (e.g. sharing meals and painting on the street together).

6.3. IDENTIFYING CHANNELS FOR KNOWLEDGE FLOW AND EXCHANGE

In investigating channels for knowledge flow and exchange, it is essential to first establish which actors among whom this knowledge must flow for successful broad-scale implementation of LC-HVT. Figure 28 below reveals the most important transport-related organisations or entities that should have access to critical knowledge, as perceived by survey respondents. The national transport ministry was rated highest in this list of needs by all respondents, followed by political decision makers and national environmental ministries, followed closely by local transport authorities. In contrast, local and regional *environmental* authorities were *perceived* as having less need for knowledge of low carbon transport.[93] This revealed the perception of the participants that while national environmental authorities are important participants in the successful implementation of LC-HVT, their local and regional counterparts have less effective involvement, despite that many transport projects are locally implemented.

[93] However, it may be argued that a greater understanding of the scale and nature of current and projected climate impact will enable political and economic decision makers to appreciate the scale and nature of the low carbon transport solutions required to contribute toward achieving the science-based targets of a 1.5DS scenario.

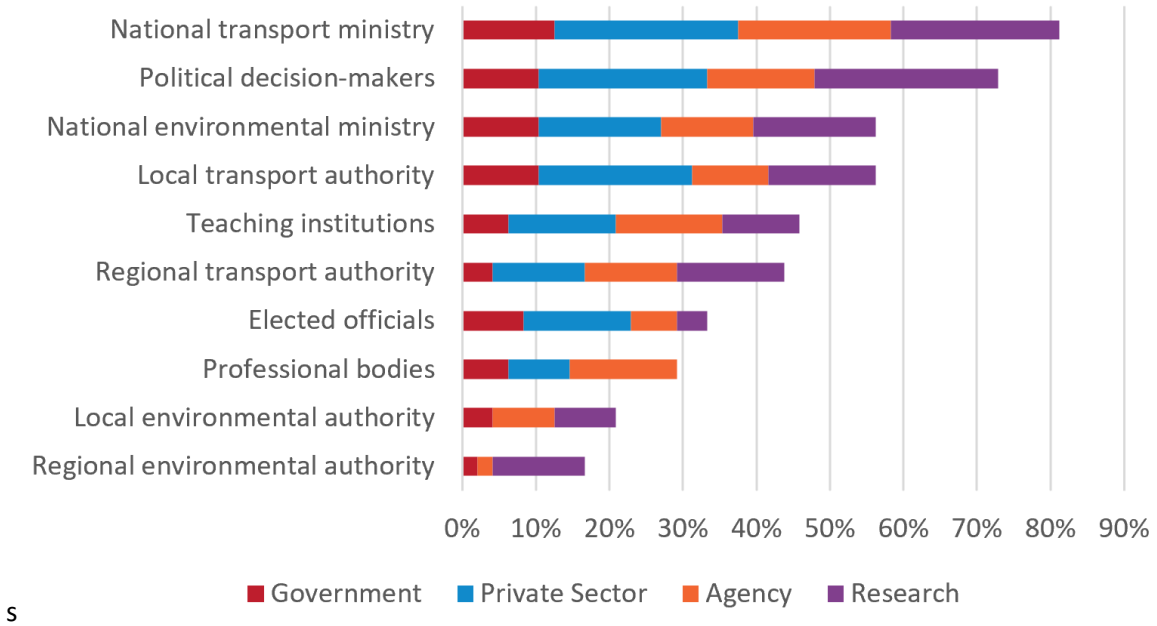

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Figure 28: Respondents' perception of organisations most in need of knowledge

Respondents were also asked to identify the non-transport stakeholders that they believe to be essential to activate the LC-HVT interventions (see Figure 29). Firmly in the first place on this list are the finance ministries, followed by advocacy organisations and trade unions. Commuter organisations and vehicle manufacturing companies received a lower rating, stressing the importance given to prioritising and securing funding streams and mobilising community groups to accelerate low carbon transport measures; the lack of priority given to commuter associations, however, might be because in many LICs, such organisations do not exist.

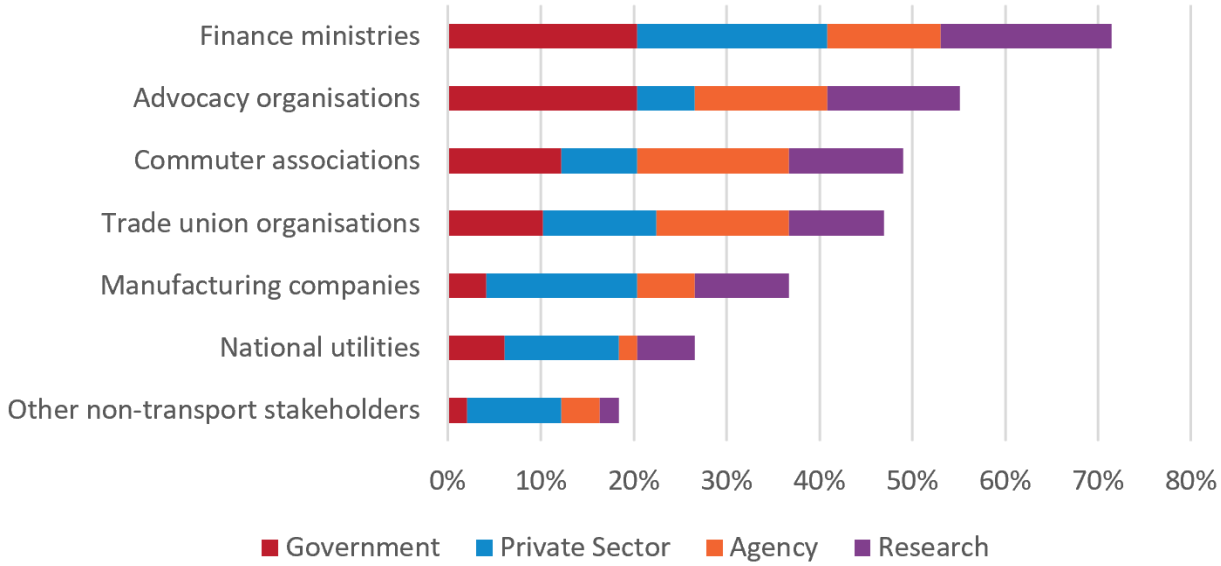


Figure 29: Non-transport stakeholders essential to activating LC-HVT interventions

Figure 30 evaluates the means of transferring the knowledge identified in the knowledge gaps to the cohorts of stakeholders that most need it. Seven means were voted as very suitable or suitable by at least three quarters the participants (i.e. workshops, exchange programmes and study tours,

mentorship programmes, local conferences, regional conferences, internships, and continuing professional education).

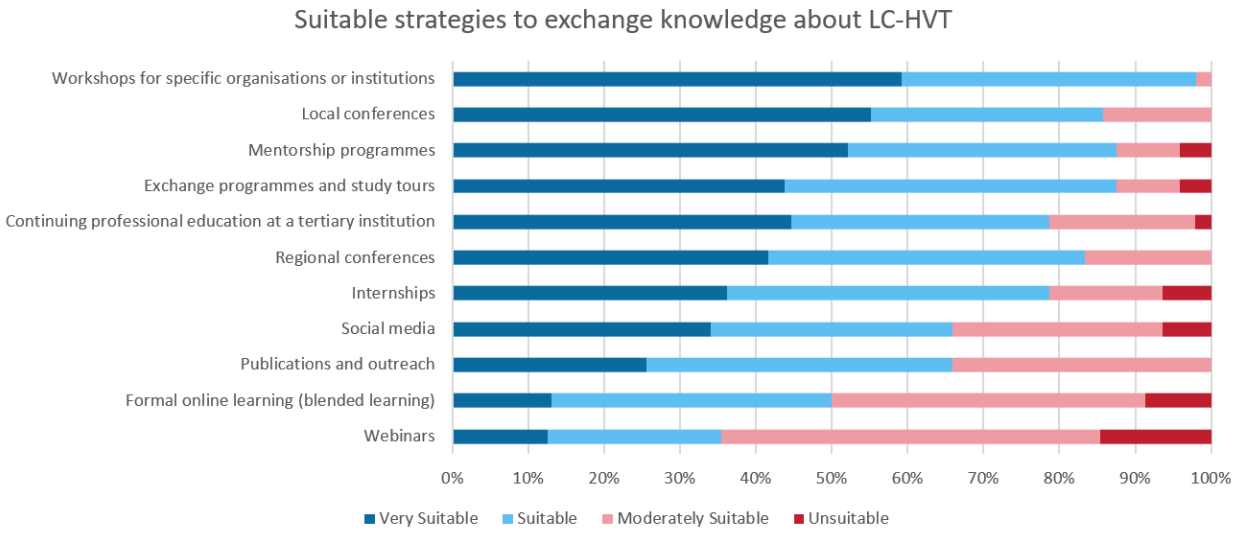


Figure 30: Suitable Strategies to exchange knowledge about LC-HVT

One success exchange and mentorship programme is found between Cape Town institutions and a research and a Sweden-based knowledge centre for sustainable urban development (Box 21). On the other hand, long-distance interactions such as publications, online learning and webinars were found to be only moderately suitable or unsuitable by at least one third of respondents. A number of respondents highlighted the need to develop a model that included some level of 'oversight' over workshop or conference participants, noting the problematic occurrence of attendees simply signing in, collecting a stipend or Continuing Professional Development (CPD) points, but not engaging. 'Getting the right attendees is key'.[94]

[94] Expert interviews Nigeria, South Africa, Ghana (see Appendix 1).

Box 22: Exploring state-university-society partnerships and collaborations: the City of Cape Town, the University of Cape Town, and Mistra Urban Futures, Sweden (207)

The University of Cape Town and the City of Cape Town, together with Mistra Urban Futures, Sweden, are working together on a knowledge programme that explores different state-university-society partnerships and collaborations, to focus on how they function as brokering communities; deepening theoretical understanding of conditions for co-production and collaborative and comparative research in different national and institutional contexts; and developing methods for successful transfer and implementation of good practices in university-society collaboration between two different national contexts, in this case Sweden and South Africa.

To this end, researchers at the University of Cape Town (masters or PhD students) are 'embedded' in the policy processes in relevant departments of the City of Cape Town. An additional value of the South African project is the joint writing processes, where city officials contribute to the academic output as co-authors of scientific articles. The City of Cape Town also takes in postgraduate interns (Honours or Masters level) in order to provide work experience to junior researchers.

The intention is that the PhD students are supported by main supervisors from the universities and co-supervisors from the municipality. A research team will also be a part of the project with aim of developing a theoretical contribution to the research literature on knowledge transfer and co-production

The purpose of the project is to study the concept of municipal PhD-students as a method and a channel for organisational learning in the municipalities. The project will also develop, test and evaluate other kinds and methods of cooperation between research and practice as job rotation through embedded researchers in practice and practitioners in research, joint seminars, joint development and innovation projects, exchange of mentors etc.

6.4. SUMMARY AND DISCUSSION

Regarding **sources** of knowledge for low carbon transport, a significant observation is that higher priority knowledge needs among varied stakeholders are related to **how** to implement LC-HVT measures, far more than knowledge on **what** to implement, suggesting that many practitioners know what they should do to accelerate low carbon transport, but do not know how to go about it. Partly this is due to low carbon not being a principal driver of transport interventions amongst their core constituencies (such as congestion reduction, improving access and mobility) and partly because they have not built the tacit knowledge on how to implement, that comes from experience in multiple prior projects.

While more than half of respondents are aware of a climate change policy in place for their city or country of practice, only about a third are aware of low carbon ***transport*** strategies in their countries' NDCs (or transport emission reductions targets). For some, this is because many developing country NDCs do not define low carbon transport strategies. For others, the problem lies in the lack of communication and consensus that translated national goals to local strategies.

Where the local transport strategy is defined, the policy and project implementors have a need for GHG-related datasets to be able to calculate the mitigation they expect to achieve. Most practitioners surveyed do not have a clearly identified source for finding transport related GHG emissions data needed for these calculations, and government-provided data sets and sources are referenced by less

than one quarter of respondents, suggesting the need to strengthen data compilation, analysis and access at national and local levels.

Regarding **channels** for sharing knowledge on low carbon transport: a key takeaway is the wide range of stakeholders that need access to knowledge sharing about what low carbon transport is, as well as how it can be brought forward, and how this will lead/underpin the wider societal changes to address climate change. Among *transport* stakeholders, national environmental ministries and local transport authorities are seen as being equally in need of knowledge, while national transport ministries and political decision makers are seen as having an even greater need. Among *non-transport* stakeholders, respondents' emphasis on the key role of advocacy organisations, commuter organisations, and trade unions (in addition to funding agencies) reveals the importance of bringing on-board, and building consensus with the wider range of stakeholders; not only those directly impacted by the policy or project but business interests, academic institutions and society at large. Finally, the suitable channels for knowledge perceived as most effective among all respondents stress the perceived need for practical tacit knowledge (through workshops for specific organisations or institutions, mentorship programmes, exchange programmes, study tours, local and regional conferences and internships) as opposed to prolonged opportunities for education and training.

These insights show that the low carbon aspects of transport are not an important driver for transport interventions at the local level and proponents are having a difficult time selling these to policymakers and society. This is partly due to the difficulty of quantifying these co-benefits in local terms, partly due to the lack of local low carbon targets for transport, and partly due to the need for more awareness raising with key stakeholders. Respondents revealed what kinds of knowledge is necessary to fill the gaps and which methods are seen as most efficient in communicating this knowledge to build capacity and translate to more effective action on LC-HVT.

Many of the insights from respondents reflect the disconnect (gap) that exists between *top-down perspectives* of what needs to be done regarding LC-HVT to put the world on a 1.5C-pathway and allow the country to meet its NDC commitments, and *bottom-up perspectives*, on what can be practically achieved on the individual project and policy level to implement and operate low carbon transport systems (Figure 31).

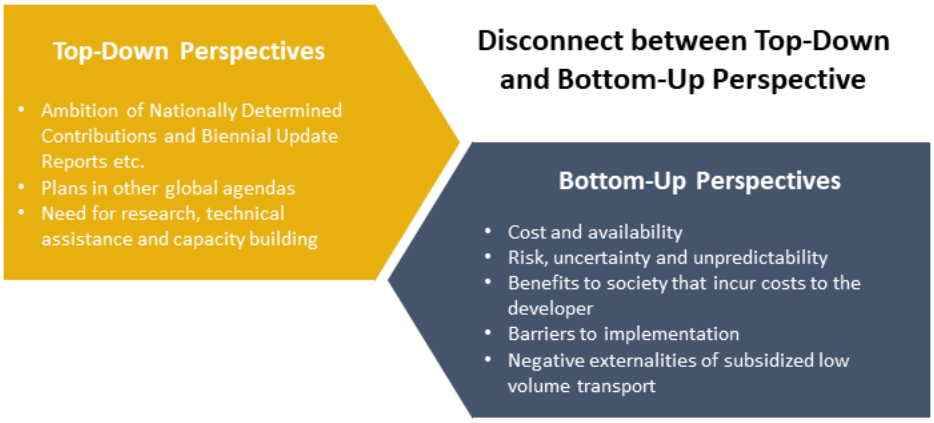


Figure 31: Disconnect between top-down and bottom-up perspectives on LC-HVT

Those top-down entities associated with defining NDCs, biennial update reports (BURs), and other global forums, identify the need to reduce GHG emissions and reduce the overall need for transport, change

what the dominant transport modes are, and make transport lower carbon (avoid: shift: improve). The process of converting this agreed direction into on-the-ground actions requires targeted finance for low carbon interventions to be secured, greater awareness among decision-makers and their core constituents of the imperative need to reduce carbon emissions and tacit knowledge of how to do it among the project and policy implementors. To achieve this and avoid diluted commitments where there is a lack of shared multi-stakeholder vision and public sector leadership, as the bottom-up stakeholders directly involved in making the changes happen tend to be limited to what they can each evaluate and practically commit to.

Additionally, sustainable transport systems have to be both low carbon and climate resilient. Reducing the vulnerability of a transport system is a function of reducing the potential impact of climate change (based on location and thus its exposure and sensitivity to climate change) and increasing its adaptive capacity (its resources for coping with impacts and minimising damage), broadly defined to include both providers and users (208).

Private investors and transport operators that were interviewed were clear that they can adopt low carbon transport measures to the degree that a successful business proposition can be made (which currently is not always the case for low carbon alternatives).[95] The operating profit threshold that the investor requires depends not only on expected operating expenses and income (e.g. the fare structure, shipping prices and complementary income from commercial enhancement of land use) but also on the risks, uncertainties and unpredictability involved in the transport project and the cost and availability of capital. The profit-making imperative contradicts state imperatives to providing sustainable mobility for all[96] as a social good.

Examples of challenges to climate friendly business models for transport services that allow the top-down perspective's goals to be met, as expressed by the participants in the capacity building workshop, include the following:

A. Cost and availability of capital: In many countries, banks do not accept vehicles as collateral to offer credit to transport operators at acceptable rates, which can constrain the provision of public transport infrastructure. This increases the cost and reduces the availability of capital for most operators (except for the largest operators, who can, offer sufficient fixed assets as collateral).

B. Risk, uncertainty and unpredictability: these include any lack in clarity in the way in which possible future changes in regulations, pricing, costs or other political imperative might impact investors. This might, for example, incentivise the investor to recuperate all initial investment over a shorter period to minimise risk exposure to such possible changes in politics, policy and other exogenous factors.

C. Benefits to society that incur costs to the developer: The carbon benefits of low carbon high volume transport are known, but, except in a few isolated cases, cannot be monetised sufficiently (at current USD/tonne CO_2 rates) to pay a developer for the additional up-front investment that low carbon transport often requires. Other sustainable development benefits do not directly benefit a developer but have benefits to the wider local stakeholder community, which are more distributed in nature.

[95] Based on findings of the capacity building workshop (see Appendix 3).
[96] See Sustainable Mobility for All (SuM4All) at http://www.worldbank.org/en/topic/transport/brief/sustainable-mobility-for-all

Benefits from low carbon HVT include improvements in air quality, health, quality of life, and noise reduction – while a focus on improved (i.e. low carbon) high volume transport (such as buses, BRT, metro replacing private motorisation) can relieve road congestion and deliver social justice and accessibility benefits in addition to avoid locking in high (i.e. >1.5DS) climate change trajectory which will lead to dangerous climate change, incurring far greater societal costs and breakdown in the longer term.

D. Barriers to implementation: Potential hurdles to implementation (such as land appropriation, compensation models and bureaucratic procedures) may increase the implementation time, cost, complexity, risk and uncertainty of the project. These, if borne by the project developer, require a higher return on investment to offset their impact in the cost and risk associated with developing and operating the transport service.

E. Negative externalities of subsidised low-volume transport: The subsidised use of public goods (road space, air quality etc) to private, low volume, high carbon transportation make it more difficult for LC-HVT to compete economically in the marketplace with the service it offers.

F. The uncertainties of behavioural change and resistance to moving away from what is the current 'way of doing things'. Low carbon high volume mass transport in order to mitigate emissions requires behavioural changes of people that otherwise would have used a higher carbon transport modes. Getting people out of private transport and on to mass transit alternatives is complex and creates uncertainty in the demand, which requires the project developer to look for higher nominal returns to cover his risk.

These elements can increase the required price for the low carbon transport service to a level that cannot economically compete with the high carbon low volume alternative, and as a result the project does not move ahead. An example from the introduction of renewable wind generation of electricity into the grid supply illustrates how careful policy development and management can unlock private investment and operation by reducing risks and eliminating institutional barriers, instead of increasing prices to offset these risks. This can provide potential lessons for the transport sector (209).

At the same time, many transport services that are private sector-run and profit driven (e.g. paratransit services in Africa) do not necessarily serve the interests of the end-user. Thus, it is critical to acknowledge that unregulated private-sector provision of public transport that is not subsidised will almost always result in inequitable service, focusing on where the money can be made, which often results in infrequent (or peak-only) services, and poor service quality for low-income and marginal groups. Alternatives being explored in African cities include hybrid models, in which paratransit operators are to provide feeder services to BRT.

7. Report Summary and Future Directions

The following sections describe key research findings of the present study and identify ***general*** areas for further research for each of the primary research questions established at the beginning of the report.

Research Question 1: What priority does reducing GHG emissions have in national/ local decisions that affect transport?

- **Research Findings**
  - Although reaching a 1.5-degree Celsius scenario[97] requires global transport emissions to be 80-90% below business-as-usual levels in 2050, the global and project country pathways to reach this target are not clearly established.
  - Low carbon transport is currently a low priority within the countries selected for this research project, yet access and mobility are seen as key to sustainable development.
  - Transport interventions are mostly driven by development priorities, such as the need to reduce congestion, improve air quality, increase accessibility for a growing urban population, increase energy security, and streamline logistics to support an expanding industrial and economic activity.
  - Low carbon transport in LICs is usually seen as a desirable co-benefit but not as a primary driver of transport interventions, even for transport policies which ultimately achieve low carbon outcomes.

- **Areas for Further Research**
  - Are LC-HVT transport options being deployed to *supplement* or *displace* business-as-usual interventions that lead to an increase in both mobility and impacts (i.e. is low carbon mainly being deployed for *impact alleviation* or *paradigm transformation*)?
  - How can the learnings from LC-HVT investments (including quick wins) be scaled from small-scale localised investments into tangible, context sensitive projects that can be successfully implemented and operated in LIC countries to achieve economywide decoupling?
  - Which class of decision-making tools is most effective in changing what overall transport investments progress and which detailed transport solutions are chosen in LICs? (How) has the use of these tools changed decision-making processes in these countries?

Research Question 2: Is it necessary and/or desirable to promote LC-HVT over the coming years? Why is it important (or not) to promote this?

- **Research Findings**
  - In HICs, where transport demands are mostly satisfied, motorisation levels are mostly stable, and population growth rates are low or even declining, the main concerns are levels of pollution and consumption related burdens.

[97] The Paris Agreement has the goal to limit global warming to 2 degree Celsius above pre-industrial levels and pursue efforts to limit the increase to 1.5 degree Celsius. Thus, a 1.5-degree Celsius target implies that transport has to largely decarbonise and reach around 2 Gt by 2050. More details are given in Section 3.1.

- For lower-income countries, both top-down and bottom-up perspectives identify a lack of clear vision, inadequate leadership, investment, and weak governance structures, lack of skilled personnel, plus 'the seductiveness of following the high-mobility option' as challenges to low carbon development.
- Climate change reports submitted to date by the nine project countries include the transport sector, indicating both an emerging link between transport and climate change and a scope for strengthening it.
- Most of the nine countries include a list of mitigation actions for the transport sector shows that there are options for climate change mitigation in the transport sector, which can serve as useful examples even for LICs with low per capita emissions and other key development priorities.
- Current targets and activities on transport by the selected project countries are still incompatible with the 1.5-degree Celsius target of the Paris Agreement. While various countries lack a specific target for mitigation of transport emissions, most of the countries with existing 2030 emission targets will need to increase their level of mitigation ambition to meet these targets.

- **Areas for Further Research**
  - Many of the countries are investing in large road building programmes being funded through loans – how can this study encourage donors to create incentives to mainstream LC-HVT measures in large infrastructure programs?
  - What are the country-specific impacts of future climate change in LICs and what is the cost of adaptation of transport infrastructure and services versus costs of inaction?
  - At present many donors fund 'low carbon' transport in cities and 'climate resilient' national transport, rural transport and inter-city transport. Can a joint focus on transport mitigation and resilience lead to an increase in sustainability benefits?
  - How can low carbon measures be implemented in transport to deliver significant air and climate co-benefits in LICs? Is there evidence of policies that reduce air pollution and carbon emissions at the same time in LICs and LMICs? Is there evidence or potential for more channels to quantify CO2 co-benefits incorporated policies (e.g. expanding on the NDC/BUR processes)?

Research Question 3: What are the principle barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

- **Research Findings**: Barriers to broad implementation of LC-HVT can be organised around four primary categories:

  - *Financial/economic barriers*
    - Targeted finance for low carbon transport is needed to help overcome any addition investment costs, together with training and assistance in preparing project and funding proposals.
    - There is also a perceived need for funding for research and promotion of low carbon transport.
    - Many of the key low carbon transport interventions do not require large-scale public investments (fuel economy policies, electric two/three wheelers, diesel quality standards) yet face other barriers

- *Political/social barriers*
  - In many countries, pushing a low carbon agenda presents a political risk since this is often not what constituents are primarily demanding.
  - The lack of political leadership, clear goals, political momentum and fear of change are key barriers to implementation.
  - The lack of capacity to make a low carbon transport business viable is also a major obstacle.
  - Regarding social barriers, getting people out of private motorisation into lower carbon modes can be a major challenge.

- *Technology/capacity barriers*
  - Low carbon technologies (such as electric buses) are still not widely deployed, as they are costly, not fully understood by all local decision makers, and perceived as needing time to evolve.

- *Regulatory/institutional barriers*
  - Limited or lack of coordination between implementing entities and authorities are shared as barriers to low carbon transport
  - There is a perceived lack of clear reporting-lines or mandates regarding implementation of low carbon considerations in transport systems.

- **Areas for Further Research**
  - Choosing between national production of new cars and importing second-hand cars does not include a low carbon alternative. To what extent do these different political economies constrain a shift from car-dominated transport systems?
  - How can policy support tools help to avoid lock-in into high-carbon transport systems and investments?
  - How can social, economic and technical barriers be overcome to implement low carbon transport projects, plans and programmes in LICs? What are the mechanisms that will bring about the political and economic shifts required to mainstream low carbon interventions?

Research Question 4: What knowledge is needed to remove these barriers (e.g. developing capacity, and sharing knowledge/good practice/tools)?

- **Research Findings:** Knowledge to increase broad implementation of LC-HVT can be organised around four primary categories:
  - *General knowledge*
    - Higher priority knowledge needs among varied stakeholders are related to *how* to implement LC-HVT measures, far more than knowledge on *what* to implement, suggesting that many practitioners know what they should do to accelerate low carbon transport, but do not know how to go about it (e.g. setting reduction targets, drafting low carbon transport policies that promote social equity, preparing bankable proposals).

        - Suitable channels for knowledge perceived as most effective stress the perceived need for practical *tacit* knowledge (e.g. through workshops for specific organisations, mentorship and exchange programmes, study tours, local and regional conferences and internships).

    - *Financial/economic knowledge*
        - The need to understand the financial/economic evaluation of lifecycle costs of new technologies is also evident (e.g. when evaluating schemes that include technologies that have a high initial investment (e.g. electric buses when compared to their diesel counterparts) but much lower operating cost).
        - More knowledge is needed in quantifying baseline emissions, to which any new technology alternative will be compared to define the emissions reductions or emissions mitigation that the higher investment in the new technology can generate.
        - The ability to prepare bankable proposals for low carbon projects (i.e. to make the project attractive to financing options) was a gap highlighted by local government and funding agencies,

    - *Political/social knowledge*
        - Key to overcoming the political and social barriers is developing persuasive, evidence-based arguments that it will pay to leapfrog carbon-intensive transport systems and move directly to LC-HVT.

    - *Technology/capacity knowledge*
        - As general technical capacity is low in several project countries, there is an opportunity to provide capacity development (e.g. Eastern Africa will soon require capacity building support as the region is in discussions to reduce the age limitation for vehicle imports to five years).
        - Project countries require data to monitor progress in the LC-HVT integration (e.g. it is difficult to source information from transport operators, and that respective institutions are not set up to collect this data on a continual systematic basis).

    - *Regulatory/institutional knowledge*
        - Institutional reform is needed to improve coordination and effectiveness of various stakeholders in implementing low carbon transport policies (e.g. accountable urban transport authorities; empowered regulatory frameworks; secure sources of funding for fleet and infrastructure improvements; a public transport industry amenable to regulatory control and fleet investments).
        - Coordinating bodies can play a key role in advancing low carbon transport, as exemplified in several West African countries

- **Areas for Further Research**
    - Is there evidence that use of multi-criteria analysis (MCA) is leading to broader adoption of low carbon transport? If so, does the inclusion of different stakeholders, (or starting with different MCA approaches) lead to improved low carbon transport outcomes?

- How can LCT be mainstreamed in existing policy and planning mechanisms and budgeting cycles? How can domestic financing schemes (e.g. India's FAME) promoting low-carbon technologies be emulated and expanded?
- What are the potential synergies in producing a balanced package of measures to maximise impact in reducing transport emissions, increasing resilience, and improving mobility of passenger and goods to achieve NDC targets in LICs in Africa and South Asia?
- Is there donor interest in financing operation and maintenance as well as infrastructure? What about the choice to fund heavy infrastructure vs. active transport or local solutions (e.g. relative priority of highways, BRT and urban active transport)?
- (How) can donor funding priorities be more closely aligned to climate impacts, ensuring that national climate policies are not outweighed by other economic, social, political priorities? What is the role of multilateral banks and development agencies in furthering LC-HVT in LIC countries in the project countries?

In addition to the research findings and gaps identified above, Table 1110 contains more ***specific*** areas for future research (organised by the four categories of challenges above) assessing relevance for specific application to project countries (by scope, mode and type) based on report analysis and case studies.

Table 1110: Future applied research areas to address barriers to low carbon transport interventions in LICs

Future applied research areas to address barriers to low carbon transport interventions in LICs																							
	Intervention Scope			Intervention Modes		Intervention Type			Enabling conditions				Project countries cited (lit review/case studies, survey/interview responses)									Linkages to existing research		
Primary challenges	Local	National	Regional / Global	Passenger	Freight	Avoid	Shift	Improve	Financial	Political	Technical	Regulatory	Bangladesh	Ghana	India	Indonesia	Kenya	Nigeria	Rwanda	South Africa	Uganda	Report chapter (s)	Case studies / resources	Key References/Notes
A. Financial/economic challenges																								
How can the financial value of carbon reduction strategies (and associated co-benefits) be better quantified? What practices in HICs and MICs can inform estimates of potential financial and economic return?	X	X		X	X				X					X				X		X	X	2.2	Low carbon transport emission assessment tools	Interviewees have noted that in order to make the case for low carbon transport measures, financial savings or other benefits need to be quantifiable - a legacy of traditional CBA and that much transport planning remains situated within engineering departments.
What is the lifecycle savings potential of electric bus (and 2-/3-wheeler) fleets in urban areas, incorporating co-benefits including air quality?	X			X				X	X	X	X	X			X							5.2.1 / 5.2.3 / 4.2	**Box 7**: PPP models for electric buses; **Box 11**: Cape Town transport data	Interviewees in African countries in particular express anxiety regarding electric mobility technology, as there are few (if any) local examples or cases from which to gather data to make a case regarding life cycle costs. There is some level of 'suspicion' that EVs are another possibly inappropriate technology to be 'sold' to the emerging economies.
How can multi-stakeholder cooperation (e.g. national/local policymakers, IFIs, private sector) help to expand the pipeline of bankable LC-HVT projects in LICs?	X	X	X	X	X	X	X		X	X	X			X			X	X	X	X	X	Appendix 6	Matrix of Implemented Projects and Selected Case Studies	Interviewees in each country expressed concerns that that they have insufficient capacity to develop bankable project proposals and projects themselves.
What are the financial and emission reduction benefits of fossil fuel subsidy reforms in LICs?		X		X	X		X	X		X		X		X	X	X						4.3	**Table 7**: SoK on mitigation potential of 'quick wins'	For **India** and **Indonesia**, fuel subsidy reform could lead to between 1 and 9% GHG savings in 2030. For **Ghana**, removal of subsidies could result in negative

Future applied research areas to address barriers to low carbon transport interventions in LICs																							
	Intervention Scope			Intervention Modes		Intervention Type			Enabling conditions				Project countries cited (lit review/case studies, survey/interview responses)									Linkages to existing research		
Primary challenges	Local	National	Regional / Global	Passenger	Freight	Avoid	Shift	Improve	Financial	Political	Technical	Regulatory	Bangladesh	Ghana	India	Indonesia	Kenya	Nigeria	Rwanda	South Africa	Uganda	Report chapter (s)	Case studies / resources	Key References/Notes
																								impact on household welfare (Cooke et al., 2014)
What needs to be done to ensure that private-sector provision of public transport results in more equitable provision, and avoid profit-driven pitfalls (e.g. infrequent services, or peak-services only, poor quality)?	X	X		X			X		X		X	X	X	X	X	X	X	X	X	X	5.2.1	**Box 7**: PPP models for electric buses	This also relates to urgency noted in all selected countries, to provide for mobility within congested but financially constrained cities. For profit public transport services are the major mode, yet this results in profitable routes / profitable hours only.
How can transport service agreements assist operators to obtain low-cost capital to establish low carbon transport services?	X			X			X				X	X						X	X		5.2.1	**Box 2**: Bus contracting time-frames	In Rwanda, for example, short (three-year) contracts disincentive bus operators from investing in fleet recapitalisation and improvement.
B. Political/social challenges																								
How to make paratransit reform and transformation more politically palatable?	X			X			X	X	X	X		X		X			X	X	X	X	X	5.2.1	**Box 1**: SA taxi recapitalisation **Box 8**: Kenya BRT implications	Paratransit replacement models (the way in which BRT systems have been implemented in most African cities) rely on a transformative, 'big bang', political legacy narrative, but are beyond the budgets of most cities in which they have been attempted, and largely unsuccessful.
How can we use emissions reductions potential to attempt to quantify social justice benefits and the redress of transport	X	X		X			X			X		X		X			X	X	X	X	X	2.2	Low carbon transport emission assessment tools	More than 60 GHG tools in this assessment quantify air pollutants such as PM and NOx. A number of tools capture sustainable development benefits including

Future applied research areas to address barriers to low carbon transport interventions in LICs																								
	Intervention Scope			Intervention Modes		Intervention Type			Enabling conditions				Project countries cited (lit review/case studies, survey/interview responses)									Linkages to existing research		
Primary challenges	Local	National	Regional / Global	Passenger	Freight	Avoid	Shift	Improve	Financial	Political	Technical	Regulatory	Bangladesh	Ghana	India	Indonesia	Kenya	Nigeria	Rwanda	South Africa	Uganda	Report chapter (s)	Case studies / resources	Key References/Notes
disadvantage, and thus make the case for the co-benefits of low carbon transport interventions?																								fuel savings, road safety impacts, and travel time savings.
How to make a more persuasive, evidence-based argument for using LC-HVT measures to leapfrog carbon-intensive transport systems?										X			X		X	X						6.2.2	**Box 16**: Using evidence to make case for low carbon transport modes	
C. Technical/capacity challenges																								
How to better understand the relative contribution of the transport sector (vs. other sectors) to GHG emissions in LICs, and how is this projected to change over time?	X	X		X	X	X	X	X	X		X	X				X				X		2.2	Low carbon transport emission assessment tools	A growing number of sketch tools (18%) provide order-of-magnitude emissions estimates where data is scarce.
How can transport data collection and monitoring practices be improved and linked to broader climate change strategies in LICs?	X	X		X	X						X					X						6.2.2	**Box 11:** Cape Town transport data; **Box 18**: Data collection in Indonesia	Indonesia is taking steps toward coordinating efforts on transport data collection and sharing among government agencies through its national climate change framework.
How can existing technologies be quickly implemented in LICs to achieve a rapid reduction	X			X	X			X			X	X	X	X	X	X	X	X	X	X	X	4.3	**Table 7**: SoK on mitigation potential of 'quick wins'	Malins et al. (2016) includes country level market analysis for low-sulphur diesel for all nine project countries. More than 60 GHG tools in Section 2.2 also

Future applied research areas to address barriers to low carbon transport interventions in LICs																							
	Intervention Scope			Intervention Modes		Intervention Type			Enabling conditions				Project countries cited (lit review/case studies, survey/interview responses)									Linkages to existing research		
Primary challenges	Local	National	Regional / Global	Passenger	Freight	Avoid	Shift	Improve	Financial	Political	Technical	Regulatory	Bangladesh	Ghana	India	Indonesia	Kenya	Nigeria	Rwanda	South Africa	Uganda	Report chapter (s)	Case studies / resources	Key References/Notes
in air pollutant and GHG emissions?																								quantify air pollutants such as particulate matter (PM) and nitrous oxides (NOx).
How to scale up preferred means of knowledge transfer on low carbon transport identified by study respondents (e.g. workshops, exchange/mentorship programmes, study tours, local/regional conferences, internships, continuing education)?			X	X	X				X				X	X	X	X	X	X	X	X	X	6.2 / 6.3	**Box 20:** Open Streets Cape Town; **Box 21**: Cape Town and Mistra Urban Futures, Sweden	Although there is an increasing number of webinars, online training and other 'blended' learning opportunities, interviewees almost invariably noted that face-to-face learning is most effective. This is also the most costly and exclusive mechanism for knowledge-sharing.
Can any LC-HVT investments shift from small-scale localised investments to economy-wide decoupling? Can such investments be illustrated with examples in LICs?	X	X																					**Box 21**: Cape Town and Mistra Urban Futures, Sweden	
How can mechanisms for North-South, South-South, and intra-continental transfer of low carbon transport implementation strategies be expanded/improved? (e.g. tech transfer for e-buses, 2/3-wheelers). What is the role of innovative technology, shared-transport and new mobilit	X	X	X	X	X	X	X	X					X		X			X		X		5.2.3	**Box 10**: Tech transfer on electric buses in Bangladesh and India	

Future applied research areas to address barriers to low carbon transport interventions in LICs																								
	Intervention Scope			Intervention Modes		Intervention Type			Enabling conditions				Project countries cited (lit review/case studies, survey/interview responses)									Linkages to existing research		
Primary challenges	Local	National	Regional / Global	Passenger	Freight	Avoid	Shift	Improve	Financial	Political	Technical	Regulatory	Bangladesh	Ghana	India	Indonesia	Kenya	Nigeria	Rwanda	South Africa	Uganda	Report chapter (s)	Case studies / resources	Key References/Notes
y services in LICs in encouraging a shift to low carbon high volume transport?																								
D. Regulatory/institutional challenges																								
What are the most effective/just models for regulating import of second-hand vehicles into LICs (with and without vehicle industries)? How can retrofitting existing vehicle fleets be used as an intermediate step to achieving emissions reductions on an accelerated scale?	X	X	X	X	X			X		X		X					X			X	X	5.2.4 / 4.3	**Box 14**: Regulating used-car imports in African cities	**Uganda** Traffic and Road Safety (Amendment) Act 2018 bans the import of all vehicles older than 15 years. In 2018, **Kenya** stopped importing vehicles older than eight years, and a new draft policy intends to restrict imports of cars to vehicles that are three years old or newer by 2021
What are the most effective strategies to integrate transport and land- use planning to optimise trips in the face of rapid economic growth in LICs? How best can countries institutionalise complete street planning to span political legacies and election cycles, and depend less on champions and more on regulations and planning requirements? Where can	X			X	X	X	X			X	X	X		X				X		X		5.2.4	**Box 13**: Johannesburg bicycle promotion	This has relevance to all low carbon transport measures.

Future applied research areas to address barriers to low carbon transport interventions in LICs																								
	Intervention Scope			Intervention Modes		Intervention Type			Enabling conditions				Project countries cited (lit review/case studies, survey/interview responses)									Linkages to existing research		
Primary challenges	Local	National	Regional / Global	Passenger	Freight	Avoid	Shift	Improve	Financial	Political	Technical	Regulatory	Bangladesh	Ghana	India	Indonesia	Kenya	Nigeria	Rwanda	South Africa	Uganda	Report chapter (s)	Case studies / resources	Key References/Notes
best, appropriate practices be found?																								
How can the climate change reporting mechanisms be used and improved to enhance inter-agency coordination and help overcoming political barriers to LCT interventions?	X	X		X	X	X	X	X								X							**Box 15:** Indonesia's climate change framework	
What business models have the most potential to facilitate reform and relative formalisation within the paratransit sector, and from which pilots or projects can paratransit associations and unions learn?	X	X		X				X	X	X		X		X			X	X	X	X	X	5.2.1	**Box 1**: SA taxi recapitalisation **Box 8:** Kenya BRT implications	See also B, political challenges.
How to achieve more proportional policy attention to both passenger and freight transport improvements (relative to emission share)?				X	X					X	X		X				X		X			4.3	**Table 7**: SoK on mitigation potential of 'quick wins'	Green freight programme for Northern Corridor (incl. **Kenya**, **Rwanda**) with measures, in context of mitigation and air pollution (target 10% reduction in CO2 per ton-km). Green freight **Bangladesh** study includes fuel efficiency scenario.

APPENDIX 1: EXPERT INTERVIEWS

A total of 23 interviews were conducted with experts from research institutions, government departments, and implementing agencies in the project countries from October to November 2018 to gain more detailed insight into the state of knowledge on low carbon transport and capacity needs. Additionally, seven experts were contacted for input via email exchange and short in-person meetings.

Expert interviewees were by and large university educated with over 70% having a Masters or PhD (engineers, political scientists, or urban planners, with a research as well as a practitioner focus. Many had experience working in multiple countries, not only the country for which they were responding, and contribute regularly to training programmes, workshops or conference proceedings.

List of Interviewees:

Geo Scope	Interviewee Name	Designation & Organisation	Date of Interview
India	Anumita Roychowdury	Executive Director, Research and Advocacy, Centre For Science and Environment	15-Oct-18
India	Thennarasan Malaiyappan	Municipal Commissioner, Surat Municipal Corporation	4-Oct-18
Indonesia	Dr. Siti Mainumah	Head, Department of Research & Development, Ministry of Transport	10 and 17 October 2018
Indonesia	Dr. Elly Sinaga	Greater Jakarta Transport Authority, Indonesia/ Senior lecturer for the Sekolah Tinggi Transportasi Darat (Land Transport School)	8 October and 3 November 2018
Bangladesh	Mr. Noor-e-Alam	Project Director, Ministry of Road Transport and Bridges	4-Oct-18
Bangladesh	Mir Tanweer Husain	Senior Assistant Engineer, Ministry of Local Government, Rural Development & Cooperatives	4-Oct-18
South Africa	Rahul Jobanputra	University of Cape Town / Cty of Cape Town (head of transport planning)	11-Oct-18
South Africa	Maletlabo Handel or Ashanti Mbanga	UNIDO's Low Carbon Transport programme in SA	1-Oct-18
South Africa	Hiten Parmar	uYilo / EVIA	9-Oct-18
Nigeria	Pablo Salazar-Ferro	CODATU/SSATP	12-Oct-18
Ghana	Simon Saddier	SSATP/World Bank	12-Oct-18
Ghana	Magnus Quarshie	Committee: Ghana Environment Protection Agency	17-Oct-18
Nigeria	Seyi Osiyemi	Transportation Executive	10-Oct-18
Rwanda	Nico McLachlan	Transport Consultant, change management, low carbon transport	8-Oct-18
Uganda	Leonard Mwesigwa	Kampala Capital City Authority, Uganda	15-Oct-18
Kenya	Henry Kamau	Director, Sustainable Transport Africa	12-Oct-18
Kenya	Jacqueline Klopp	Center for Sustainable Urban Development, Earth Institute, Colombia University, NYC	15-Oct-18
India	Sarath Guttikunda		15-Oct-18

Geo Scope	Interviewee Name	Designation & Organisation	Date of Interview
SSA	Mark Zuidgeest	University of Cape Town	28-Nov-18
SSA	Herrie Schalekamp	University of Cape Town	28-Nov-18
South Africa	Abdool Kamdar	Sustainable Freight Association	23-Nov-18
South Africa	Anthony Dane	SANEDI / MacroEconomic Study of impact of low carbon transport in SA	23-Nov-18
Global	Arthur Ardila Gomez	World Bank - Global Lead Urban Mobility & Lead Transport Economist	29-Nov-18
Africa	Rebecca Campbell	Open Streets learning exchange, South Africa	24 October 2018
Africa	Marcela Guerrero Casas	Open Streets learning exchange, South Africa	24 October 2018
Africa	Constant Cap	Open Streets learning exchange, Nairobi, Kenya	19 December 2018
Africa	Richard Hamba	Training, Education & Empowerment for Neighborhood Sustainability (TEENS), Uganda	14 December 2018
Africa	Lerato Dladla	Open streets learning exchange, Johannesburg, South Africa	19 December 2018
Africa	Temesgen Tigistu	Open Streets Learning Exchange, Ethiopia	10 December 2018
Africa	Neels Basson	South African national department of transport, Open Streets Learning Exchange	10 December 2018

Interview Script:

A. Introductory questions [5 min]

1. How would you define low carbon transport (LCT)?
2. How or where did you develop your knowledge or interest in LCT?
3. *Have you attended any conferences or workshops in your country/city where LCT is discussed?*

Workstream A: Develop knowledge base of low carbon transport measures/appropriate best practices [45 min total]

B. Historic and projected LCT Trends [10 min]

1. What changes are starting to happen in LCT in your country/city?
2. Who/what entities are driving LCT trends? Are any entities trying to prevent these changes?
3. What needs to happen over the coming [10 years]? What will be required to make this happen?

C. Implemented projects and policies A3] [10 min]

1. What low carbon transport projects have been implemented in your region/country/city so far?
2. How successful have these projects been based on these measures (on a 1-5 scale, low to high)?
    a. Increasing transport efficiency (and shifting to more efficient modes)
    b. Increasing access and equity
    c. Maintaining financial sustainability
    d. GHG emission reductions
3. Are you aware of any implemented LC-HVT projects that have proved to be financially/operationally unsustainable over time [despite successes elsewhere]?

D. Needed/Appropriate projects and policies [A3] [10 min]

1. What are the most appropriate interventions (including transport 'quick wins') are of particular relevance for your region/country/community?

2. Which strategies have the highest feasibility to be transferred from other [developed or developing] countries to your region/country/city?
3. *Which low carbon measures have the greatest potential to shift from pilot studies to mainstream approaches in your region/country/city?*

E. Major opportunities and constraints to implementing LCT [A] [15 min]

1. What are the strengths [and gaps] in national, sub-national, and multi-national policy priorities and ambition for low carbon transport measures?
2. Which are the main actors that are blocking development and implementation of low carbon transport plans and targets? Which key barriers exists? e.g.
    a. Limited understanding of local contexts by international advisors
    b. Conflicts of interest (e.g. decision-makers, industries)
    c. Poor governance/corruption
3. What trade-offs are made between low carbon transport measures and other urgent and competing policy imperatives in LICs (e.g. economic growth, road safety)?

***Workstream B: Assess stakeholder capacity and define capacity building strategy** [40 min total]*

F. Current capacity for planning/implementing LCT [10 min]

1. Who are the key low carbon transport stakeholders [national/provincial/regional or local] government ministries, transport agencies, researchers the following measures?
    a. Avoid and shift measures (local/national, transport agencies); often related to infrastructure
    b. Vehicle energy efficiency and low carbon fuels (national mostly, energy, industry, finance, environment)
    c. Freight (private sector, national/local policy)
2. Who are the 'non-traditional' stakeholders that contribute to low carbon transport measures in your [region/country/city] (e.g. trade unions, community organisations)?
3. [In each sector], which organizations are reporting on activities and progress related to LCT on a regular basis?

G. Capacity building needs for LCT [B] [15 min]

1. Where is institutional capacity needed to assess, refine and integrate research recommendations to accelerate prioritised low carbon transport measures [for three categories noted under Question F1]?
    a. National policy making agencies
    b. Provincial /local operating agencies
    c. Non-governmental actors
2. In each sector, what are the gaps and constraints in monitoring, reporting and verification (MRV) to evaluate success of low carbon programmes and projects?
3. Is there a need for appropriate performance indicators within transport authorities (including management, communication, governance skills)? [B.3.2]

H. Capacity development opportunities for LCT [15 min]

1. What are the most appropriate capacity building opportunities in LICs to accelerate and streamline the adoption and implementation of research recommendations?, e.g.
    a. Local and national peer-to-peer exchanges (and/or exchange programmes among institutions)

    b. Online/blended learning programmes (or short courses)
    c. Developing publication-quality research for inter-country sharing
2. (How) could cooperation with global [bilateral and multilateral] donors help to accelerate and streamline the adoption and implementation of research recommendations?
3. (How) could improved capacity change the way in which low carbon transport measures are financed, implemented, and evaluated?

I. Closing Questions [5 min]

1. What do you believe your country/institution/organisation most needs to know regarding LCT?
2. What do you feel would be the best way in which to share knowledge about LCT?
3. What would you, personally, like to know more about in terms of LCT?

APPENDIX 2: STAKEHOLDER SURVEY

A survey on LC-HVT knowledge and capacity in Africa and South Asia was designed and administered to SLoCaT's expert stakeholder network (from which the expert interviewers were also drawn) from September to October 2018 with qualitative and quantitative questions exploring how low carbon transport knowledge is gained, how capacity is achieved, and how transport users and other affected parties are engaged. The State of Knowledge papers will build on this data and provide greater analysis and reporting where relevant.

List of survey respondents:

Name	Organisation	Location
Michael Linke	Independent/Bicycling Empowerment Network Namibia	Brazil
Irene Namuyiga	Kampala Capital City Authority	Uganda
Anthony Dane	Change Pathways	South Africa
Jide Oduyoye	LAMATA	Nigeria
Roger Behrens	University of Cape Town	South Africa
Marcela Guerrero Casas	Open Streets	South Africa
Louise Scholtz	WWF SA	South Africa
Paul Mukwaya	Makerere University	Uganda
Yohnny Raich	WhereIsMyTransport	South Africa
Neluheni Ndivhuho	Department of Transport	South Africa
Neluheni Ndivhuho	Department of Transport	South Africa
George A. Makajuma	African Development Bank	Kenya
Hubrecht Ribbens	Ribbens Consultancy	South Africa
Manu Sasidharan	University of Birmingham	United Kingdom
Kazeem Sanusi	Kazeem Sanusi Group	Nigeria
Samuel Abejide	Walter Sisulu University	South Africa
Florence	Innovative Transport Solutions	South Africa
Christopher de Saxe	CSIR Built Environment	South Africa
Babatunde Obadina	Lagos Bus Service Limited	Nigeria
Sivuyile	City of Cape Town	South Africa
Joseph Anochie-Boateng	CSIR	South Africa
Mavis Mhlanga-Mochadibane	Tshwane Women in Transport	South Africa
Nwabisa Beba	City of Cape Town	South Africa
Helvi Ndilimeke Petrus	Stellenbosch University	South Africa
Constant Cap	Naipolitans	Kenya
Blake Robinson	ICLEI Africa	South Africa
Blake Robinson	ICLEI Africa	South Africa
Emmanuel Joen	Ochenuel Mobility	Nigeria
Kazeem Sanusi	Kazeem Sanusi Group	Nigeria
Victor de Abreu	SMEC SA	South Africa
Pablo Salazar Ferro	CODATU	Senegal
Michael kKhato	Nat Treasury SA	South Africa

Name	Organisation	Location
Lize Jennings-Boom	Western Cape Government	South Africa
Carel Snyman	People | Energy | Mobility	South Africa
H M Shivananda Swamy	Centre of Excellence in Urban Transport, CEPT University	India
Innocentia Modau	WWFSA	South Africa
Nicky Sasman	City of Cape Town	South Africa
Andre Rautenbach	Mangaung Metro Municipality	South Africa
Helvi Petrus	Stellenbosch University	South Africa
Janneke Snijder	ITS Engineers	South Africa
Bob Stanway	none	South Africa
Jai Kumar Gaurav	GIZ	India
Lize Jennings	Western Cape government	South Africa
Manu Sasidharan	University of Birmingham	United Kingdom
John Mark Mwanika	Amalgamated Transport and General Workers Union	Uganda
Ranjith	GFA	India
Justin Coetzee	GoMetro	South Africa
Gerhard Hitge	Self-employed	South Africa
Noor E Alam	Roads and Highways Department	Bangladesh
Ntimba Michael	Gauff Consultants (U) Ltd	Uganda
Mark Rountree	City of Cape Town	South Africa
Shambhu KC	Ministry of Urban Development, Nepal	Nepal
Constant	Naipolitans	Kenya
Herrie Schalekamp	University of Cape Town	South Africa
Andrew Dawson	University of Nottingham	United Kingdom
Melusile Ndlovu	Chemonics International	South Africa
Paul Vorster	ITS South Africa	South Africa
Aliasgher Janmohammed	Childsafe	South Africa
ROB DE JONG	UNEP	Kenya
Mbulelo Singapi	TS Traffic Safety (Pty) Ltd	South Africa
Priscilla Muchibwa	UN Habitat	Kenya
Shola Oni	Lagos Bus Services Limited	Nigeria
Chris Plano	University of Cape Town	South Africa
Sean Cooke	University of Cape Town	South Africa
Mandy Westwood	SMEC	South Africa
Carlos Esteves	Independent professional engineer	South Africa
Oluseyi Osiyemi	Transport Services Limited	Nigeria

APPENDIX 3: WORKSHOP ON CAPACITY BUILDING STRATEGY FOR THE IMPLEMENTATION OF LOW CARBON, HIGH VOLUME TRANSPORT IN SOUTH ASIA

The Workshop on Capacity Building Strategy for the Implementation of Low Carbon High Volume Transport in South Asia was organised by the Partnership on Sustainable, Low Carbon Transport (SLoCaT), under the framework of the Applied Research Programme in High Volume Transport (HVT) by the Department for International Development of the United Kingdom (DFID) on 2 October 2018. The workshop was a pre-event to the Eleventh Intergovernmental Regional Environmentally Sustainable Transport (EST) Forum in Asia,[98] hosted by the United Nations Centre for Regional Development (UNCRD) from 2 – 5 October 2018 in Ulaanbaatar, Mongolia.

The workshop was attended by more than 30 participants representing 11 EST countries (Afghanistan, Bangladesh, Bhutan, Cambodia, India, Malaysia, Maldives, Mongolia, Pakistan, Thailand, Vietnam) and 11 different transport organisations, research institutes, and non-government organisations.

A summary report of the workshop can be downloaded here.

List of Registered Participants:

Total No. of Participants Attended (registered)	35	
Country Rep Attended:	19	
Countries represented:	11	(Afghanistan, Bangladesh, Bhutan, Cambodia, India, Malaysia, Maldives, Mongolia, Pakistan, Thailand, Vietnam)
Country Breakdown:	Afghanistan	1
	Bangladesh	2
	Bhutan	1
	Cambodia	2
	India	1
	Malaysia	2
	Maldives	1
	Mongolia	6
	Pakistan	1
	Thailand	1

[98] Eleventh Intergovernmental Regional Environmentally Sustainable Transport (EST) Forum in Asia. http://www.uncrd.or.jp/?page=view&nr=1125&type=13&menu=198

	Vietnam	1
NGO Rep Attended:	16	
Types of NGO represented:	5	
NGO Breakdown:	Transport Organisation	2
	MDB	2
	Research	8
	Independent	2
	UN Organisation	2

No	Country/ Organisation	Title	Name	Surname	Organisation
1	Afghanistan	Mr.	Javid Ahmad	Shirzad	Ministry of Rural Rehabilitation Development
2	Bangladesh	Mr.	Noor-e-	Alam	Ministry of Road Transport and Bridges
3	Bangladesh	Mr.	Mir Tanweer	Husain	Ministry of Local Government, Rural Development & Cooperatives
4	Bhutan	Mr.	Wangchuck	Pemba	
5	Cambodia	Mr.	Sophal	Kong	Ministry of Public Works and Transport
6	Cambodia	Mr.	Ouk	Ourk	Ministry of Public Works and Transport
7	India	Dr.	Subhamay	Gangopadhyay	National Highway Authority
8	Malaysia	Mr.	Abd Hamid bin	Surip	
9	Malaysia	Mr.	Amran	Abdullah	KL City Hall
10	Maldives	Ms.	Nafha	Aujaaz	
11	Mongolia	Mr.	S.	Batbold	
12	Mongolia	Ms.	Nyamdavaa	Shagdar	National Agency for meteorology and environment of Mongolia
13	Mongolia	Ms.	Sarantsetseg	Khasaa	GASI
14	Mongolia	Ms.	Naraa	Narmanclah	GI
15	Mongolia	Ms.	Myagmarjgal	Mendloayou	ALAGAC
16	Mongolia	Mr.	Myagmarsureu	Turbai	MRTD
17	Pakistan	Mr.	Muhammad Maswood	Alam	Karachi Metropolitan Corporation
18	Thailand	Ms.	Manwipa	Koson	
19	Viet Nam	Mr.	Anh Duong	Tran	Ministry of Transport
20	Independent	Mr.	Holger	Dalkmann	Self-employed
21	Independent	Mr.	Peter	O'Neill	Independent
22	MDB	Mr.	Jamie	Leather	Asian Development Bank
23	MDB	Mr.	Arturo	Ardila-Gomez	The World Bank
24	Research	Dr.	Annabel	Bradbury	Cardno
25	Research	Dr.	Karlson James (Charlie)	Hargroves	Curtin University Sustainability Policy (CUSP) Institute
26	Research	Ms.	Catharina	Visser Bartel	Research for Community Access Partnership (ReCAP)
27	Research	Mr.	Robert James	Earley	Sino-Canadian Commodities Consulting Co. Ltd.
28	Research	Prof.	Tran	Thi Kim Dang	The University of Transport & Communication
29	Research	Dr.	Surya Raj	Acharya	Tribhuvan University
30	Research	Mr.	Daniel	Conley	University of Adelaide
31	Research	Ms.	Lauren	Gallina	University of Adelaide (Entrepreneurship Commercialization and Innovation Centre)
32	Transport Organisation	Mr.	Giok Seng	Lee	Asia Pacific Natural Gas Vehicles Association (ANGVA)
33	Transport Organisation	Ms.	Deliani Poetriayu	Siregar	Institute for Transportation & Development Policy

No	Country/ Organisation	Title	Name	Surname	Organisation
34	UN Organisation	Dr.	Madan B.	Regmi	United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)
35	UN Organisation	Mr.	C.R.C.	Mohanty	United Nations Centre for Regional Development

APPENDIX 4: MATRIX ON LOW CARBON TRANSPORT GOOD PRACTICES

This matrix compiles current knowledge of appropriate and context-specific best practices in low carbon transport. The leading question of the first database is: What are relevant good practices on low carbon transport? The scope of the matrix is global, covering examples from project countries, other developing countries and developed economies. The project team conducted desk research and gathered results from latest studies and analyses their relevance for priority countries.

The matrix can be downloaded here: http://slocat.net/sites/default/files/HVT_Annex_4-Matrix-Low-Carbon-Transport-Good-Practices.xlsx

Method:

A desk research was carried out to investigate low carbon transport good practices worldwide. Of relevance are implemented projects, policies and programs that have a positive impact on low carbon high volume transport. The good practices do not have to be solely on transport but they require to have clear impacts on transport. Keywords such as 'best practices'/'good practices' in combination with '(low carbon) transport' have been used to identify relevant material through an online search. Further, projects that received international recognition through awards (for example, ITDP's Sustainable Transport Awards) or best practice literature have been taken into consideration.

The items were collected in a database describing their main characteristics, such as the relevant modes, sub-sectors and mitigation measures, Aoivd-Shift-Improve-focus and (if available) emission savings. The covered good practices were assessed on their relevance to the main DFID study themes, which are:

- Transport and climate change: Projects and plans that aim to primarily reduce emissions
- Low carbon technologies: Projects aiming to introduce new technologies and improve existing technologies
- (Urban) Freight transport: Projects focusing on freight
- Walking/ cycling / urban transport: Projects focusing on urban passenger transport by sustainable modes
- Decision support tools: Projects providing decision support tools

The database also captures which transport sectors (freight and passenger transport) and which subsectors (urban transport, rural transport, heavy rail, high speed rail, inland waterways/shipping, aviation) are covered. It gives a representative share of how low carbon transport measures in the project countries have to be balanced and it can be used for comparisons in later tasks.

The measures of low carbon transport in the database are based on previous work conducted by SLoCaT on NDCs and other climate-related reporting mechanisms. The typology gives a comprehensive picture of emission mitigation measures and categorizing the good practices allows comparability. The good practices are analysed to what area of Avoid, Shift and Improve they belong to. In the last step of data collection, co-benefits are being identified. Here, co-benefits that are particularly mentioned in the good practice are marked.

The analysis can indicate the status quo of low carbon transport good practices. The database shows what kind of measures are being implemented around the world and it can be compared to activities in the project countries.

Summary table:

Country/ Countries	Title of Good Practice	Rationale for Selection as Good Practice	Transport Measures Included
United Republic of Tanzania	Dar es Salaam BRT	Winner of Sustainable Transport Award 2018	Construction of BRT system
Philippines	Public Utility Vehicle Modernisation Program	Regional good practice for Southeast Asia; relevant to DFID priority countries; including both PT reform as well as electric jeepneys (paratransit)	The programme calls for the phasing-out jeepneys, buses and other Public Utility Vehicles (PUVs) that are at least 15 years old and replacing them with safer, more comfortable and more environmentally-friendly alternatives by 2020
India	Vehicle emission standards in India		In 2016, India adopted Euro 6/VI equivalent standards that will go into effect in 2020
Norway	Electric Mobility Plans as part of National Transport Plan 2018-2029	Highest share of EV sales in EU	E-Mobility
China	Mobike - Bike-sharing and the City, 2017 White Paper	Reports showing CO2 benefits	Free-Floating bikesharing
Global	ofo - Our 2017 Ride	Reports showing CO2 benefits	Free-Floating bikesharing
Romania	SUMP Of Turda	Winner of SUMP Award 2018	SUMP plan development with measures on: bikesharing, carpooling, parking policy, carsharing, bicycles for vendors
United Kingdom	London's Low Emission Zone	Often quoted example	Implemented in 2008, low emission zone to reduce air pollution
Colombia	Case Study: Colombia's Bus Rapid Transit (BRT) Development and Expansion	Often quoted example	Development of BRT in Bogota
Colombia	Colombia's National Plan	Often quoted example	National Urban Transport Program (NUTP) offers funding and support to large cities to develop Integrated Mass Transit Systems and medium-sized cities to develop Strategic Public Transportation Systems
Brazil	Curitiba	Often quoted example	
China	Yichang	Often mentioned as best-practice	BRT, parking reform, bicycle infrastructure, and NMT reform
China	Shenzhen	Often quoted example of electrification, 100% electric bus fleet	Electrification of bus fleet

Country/ Countries	Title of Good Practice	Rationale for Selection as Good Practice	Transport Measures Included
Germany	Climate Action Plan 2050	One of few long-term climate plans with details on transport	increase funding for electric mobility, provide financial incentives for use of low carbon mobility options, increase modal shift to public transport, rail freight, and inland shipping, promote walking and cycling, and expand the use of electricity-based fuels in national and international air and maritime transport.
United Kingdom	London Freight Plan	Quoted in Report as Best Practice on Freight	Four key projects were identified in the Freight Plan: ▪ The Fleet Operator Recognition Scheme, ▪ A freight information web portal, ▪ Delivery and Servicing Plans, and ▪ Construction Logistics Plans
United States of America	New York Urban Freight Measures	Quoted in Report as Best Practice on Freight	
India	Raahgiri: car-free day		
Europe	FREVUE	Recent large-scale project on freight	City logistics, electrification
Germany	Bremen - Car-Sharing System	Often quoted best practice	Car-sharing
Germany	Munich	Often quoted best practice	Bike-sharing, car-sharing (electric vehicles), public transport improvements in a holistic approach
Netherlands	Electrifying Amsterdam Schiphol Airport	Emissions avoided	E-mobility (taxis, buses)
China	Low carbon transportation pilots in Tianjin, Chongqing, and Guangzhou, among others		Public transport, NMT, new energy vehicles, and intelligent transport
Chile	Santiago	Winner of Sustainable Transport Award 2017	improvements to its cycling, walking, and public transportation infrastructure
Brazil	Fortaleza	Winner of Sustainable Transport Award 2019	complete streets, or equitable division of road space; reducing CO2, and increasing road safety by prioritising public transport, cycling, and walking
China	Electric two-wheelers	Emissions avoided	Uptake of electric two-wheelers
United Kingdom	Ultra-low emission bus scheme (formerly Green bus fund)	Well working policy growing in scale	

Country/ Countries	Title of Good Practice	Rationale for Selection as Good Practice	Transport Measures Included
Thailand	CO2-based vehicle taxation	Example of developing country tackling CO2 vehicle emissions	Taxation of vehicles based on CO2-emissions
Spain	Sevilla's Cycling Strategy		Bike Masterplan, which defined a cycle network of 120 km, as well as other measures for promoting cycling and bike-sharing system
United Kingdom	Policy pathways towards achieving a zero-carbon transport sector in the UK in 2050	Good example of how to transition to emission-free transport	Spatial planning, fiscal measures, behavioural changes, technology for road, aviation and shipping
United Kingdom	Evaluating the impact of a workplace parking levy on local traffic congestion: The case of Nottingham UK	Implemented measure with positive impact	Parking management through a workplace parking levy
N/A	Key research themes on regulation, pricing, and sustainable urban mobility	Key research on sustainable transport	road pricing, public transport pricing and regulation, car parking policies, home and low-emissions zones, and regulation and subsidies to bring about cleaner vehicles
India	E-rickshaws	good practice for electric mobility	electric rickshaws in India, supporting their implementation
United Kingdom	The Bristol Twenty Miles Per Hour Limit Evaluation (BRITE) Study Analysis of the 20mph Rollout Project	showing positive benefits	20mph limits across the city
Germany	Freiburg - Vauban	global well-known best practice for car-free urban development	car-free planning, urban planning, land use, fiscal policies
United Kingdom	Smarter choices: changing the way we travel	illustrating impacts of soft measures	workplace and school travel plans personalised travel planning, travel awareness campaigns, and public transport information and marketing car clubs and car sharing schemes teleworking, teleconferencing and home shopping

APPENDIX 5: MATRIX ON LOW CARBON TRANSPORT MEASURES IN NATIONAL POLICIES, PROGRAMMES AND TARGETS

SLoCaT developed a matrix to catalogue Low carbon transport measures in project countries. It includes NDCs, national communications and biennial update reports in project countries, noting transport-specific emissions targets and/or any transport sector related mitigation policies identified within these communications.

The matrix catalogues relevant sub-national measures and commitments on low carbon transport in project countries (e.g. targets to phase-in electric vehicles or phase-out internal combustion engines), to identify approaches with political and/or corporate support that are primed for accelerated implementation.

The matrix can be downloaded here: http://slocat.net/sites/default/files/HVT_Annex_5-Matrix-Low carbon-Transport-Measures.xlsx

Methodology:

Leading Question: What targets and policies on low carbon transport have been developed in main climate change plans by the project countries?

Objective: This specific database aims to give an illustrative picture of low carbon transport plans and policies in project countries. It shows what activities are intended to be pursued on the national and subnational level, how well balanced they are and help to outline low carbon transport activities in the priority countries.

Scope: Project Countries

This activity was conducted through desk research. Material about low carbon transport in project countries were examined on references to content that fits the criteria, scope and timeframe of the database.

The main data sources for the database on low carbon transport measures were nationally determined contributions (NDCs), national communications (NCs) and biennial update reports (BURs) submitted to the UNFCCC, national plans and local mobility plans. To give an indicative picture of activities on the subnational level, at least one local plan (preferrable the capital city) was included. In addition, relevant items identified through the surveys and interviews were added to the database.

The plans were examined by a similar approach as the database on good practices.

APPENDIX 6: MATRIX ON IMPLEMENTED PROJECTS AND SELECTED CASE STUDIES

SLoCaT collected implemented low carbon transport projects in project countries, and building upon the SLoCaT Transport Knowledge Base (TrakB) and progress reports/data published by Multilateral Development Bank (MDB) Working Group on Sustainable Transport and other sources.

The matrix can be downloaded here: http://slocat.net/sites/default/files/HVT_Annex_6-Matrix-Implemented-Projects.xlsx

Methodology:

Leading Question: What projects and policy measures on low carbon transport have been implemented in project countries in recent years?
Scope: Project Countries

The matrix was developed through desktop research, based on global data sources on sustainable transport projects and additional sources. The focus was on projects that have been implemented in recent years (from 2008 or after). The information were collected in the developed matrix and analysed for their transport modes, relevant sub-sectors and mitigation measures. Some of the identified major data sources were the MDB Working Group on Sustainable Transport (WGST), climate finance instruments and the global BRT database.

The MDB WGST actively supports projects in developing countries. In their annual progress report, all sustainable transport projects by the MDBs were listed. Relevant high volume, low carbon transport projects from their portfolios were included in the database. The pipelines of climate finance instruments deliver insights of supported low carbon transport projects. Their pipelines cover activities from 1992 up to recent. Recent projects that have been supported were included in the matrix.

APPENDIX 7: COUNTRY PROFILES

The country profiles examine each of the nine project countries in terms of their basic characteristics, transport emissions (current and future scenarios) and low carbon transport. The implementation status of quick wins is highlighted for each country as well as the main barriers, priorities and activities are described in brief paragraphs:

Country Profile of Bangladesh

Income Level Group:	Middle-income	Population Size (million):	164.67
GDP per Capita:	1018.84	Share of Urban Population:	35.68%
Motorization Rate (Vehicles per 1,000 ppl):	3.85	HDI:	0.579
		Petroleum Consumption (Barrels Oil/Day):	107

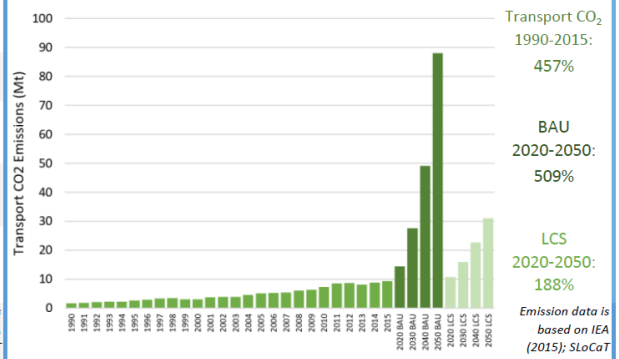
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	9.3			
Share of Transport in Total Economy-Wide CO_2 Emissions:	13.15%	Global Avg:	29.85%	
Share of Road Transport in Transport CO_2 Emissions:	76.34%	Global Avg:	93.64%	
Transport CO_2 Emissions per Capita (t CO_2/person):	0.1	Global Avg:	1.24	
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	0.6	Global Avg:	1.3	
Projected Transport CO_2 Emissions for BAU Projections (Mt):	27.6	for 2030		
	88.1	for 2050		
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	15.9	for 2030	*Emission data is based on IEA (2015); SLoCaT (2015)*	
	31.0	for 2050		

Development of Transport CO2 Emissions from 1990 to 2050 (BAU and LCS)



Transport CO_2 1990-2015: 457%

BAU 2020-2050: 509%

LCS 2020-2050: 188%

Emission data is based on IEA (2015); SLoCaT (2015)

Low Carbon High Volume Transport

Size of Rail Network (km):	2,835	*World Bank (2015)*
Railway Passenger Activity (million pkm):	7,305	*World Bank (2015)*
BRT System Length (km):	No Data	*BRT Data (2016)*
BRT System Passengerper Day:	No Data	*BRT Data (2016)*
Urban Rail System Length (km):	No Data	*Various Sources*
Fuel Emission Standards:	Euro 1	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys

None	Being discussed or small pilot projects	Some implementation or pilot projects	Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

The introduction of transport GHG mitigation is not a priority in Bangladesh, however it is seen as a valuable co-benefit. The development of a transport system dominates transport planning and even some of the suggested transport measures among their climate actions just highlight congestion and the flow of traffic. The efficiency of all modes is regarded as a major national priority and national plans put a strong emphasis on road infrastructure. Issues of air quality have a higher priority than GHG emissions. The capital Dhaka is under a huge stress with a large population size and rapid increase of vehicles. Road safety is another urgent issue that requires a lot of attention (as seen in the protests in 2018).

Bangladesh has the target to reduce transport CO2 emissions by 24% below BAU by 2030 by introducing metro and bus rapid transit systems and expansion of freeways. A 15% improvement in vehicle efficiency and a mode shift of 20% from road to rail by 2030 is included in their NDC.

Part of this mitigation is coming from the push to use more CNG as an automotive fuel for private vehicles. There are a lot of areas that they can work to reduce more CO2, like the bus sector. Passenger cars are mainly imported second hand from Japan (there is a maximum age of 5 years for car imports) and are converted on arrival to CNG because it significantly reduces fuel costs.

It is illegal to use CNG on trucks and buses because there is not enough CNG available for all vehicles however many local city corporation are allowing this as a means to save operating costs.

What are the principal barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

The institutional framework in Bangladesh needs to be reformed to better respond to the dynamics and to implement LC-HVT. Challenges are a lack of effective coordination, strong fragmentation of responsibilities and low capacity as well as knowledge in this field. The environmental assessment for projects is also missing and thus, the advantages of sustainable transport aren't included in transport planning. Projects are being rather planned individually instead of being part of a larger comprehensive approach. The majority of fiscal resources are allocated towards road transport and investments for rail and water transport are on decline.

There is a strong need for capacity building. There is a huge shortage of institutional capacity. Part of the problem lies in the contracting process for government employees. It's a different type of selection process. If you are good enough in writing in Bengali and geography, history and there are some questions of multiple choice, and good at writing--It's not necessary that you have a very good transport knowledge or environmental knowledge to join the Roads Finance Department. When a person is joining the department, after that he also needs more knowledge and he needs a personal level of capacity-building.

Local -level politicians find it politically risky to propose investments that they have not seen successfully operating in Bangladesh. In most cases they need to personally experience a working pilot. If the project proponent tells them that "I've seen work in Bangkok", some mayors will say, "That's a good idea, we'll do that", but many will reply, "No that's Bangkok, show me something that's working in Bangladesh".

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

Urban: Bangladesh has in recent years added nearly 1,000 buses to the Bangladesh Road Transport Corporation and plans to expand the fleet with 600 more buses. Dhaka is in the process of developing a mass rapid transit system with 6 lines and a BRT corridor Gazipur-Airport is in development.

National transport ministry and the environment ministry require to work together on scaling up LCT interventions.

Road: Beijing has provided more than $3bn for the bridge across the Padma, as the Ganges is known in Bangladesh as part of a wider plan to spend $30bn on Bangladeshi infrastructure schemes as part of their new Silk Road initiative of global trade routes.

Rail: Bangladesh Railway has got a total network of 2,877.10 route kilometres (broad gauge 659.33 km, dual gauge 374.83 km and metre gauge-1,842.94 km) but has been losing market share held back by lack of investment and aging and unreliable rolling stock . Under its Seventh Five-Year Plan (2016-2020), the government has placed special emphasis on railway development, setting targets to increase the market share to 15% in freight transport and 10% in passenger movements by 2020.

Inland Waterways: Bangladesh has about 14,000 kms of waterways (rivers/canals) of which about 5,968 kms. remain navigable during monsoon and 3865 kms of rivers/canals are navigable during the dry season. Currently, most of these waterways suffer from navigational hazards like shallow water and narrow width of channel during dry weather, siltation, bank erosion, absence of infrastructure constrained by the absence of proper surface road links to facilitate the smooth transit of cargo. Investment is now deing made to improve the navigability of waterways along the Chittagong-Dhaka-Ashuganj corridor, connecting routes to help reduce travel time, cut cargo costs and boost both national and regional trade. The country will also get a new general cargo terminal at Pangaon and the Ashuganj cargo terminal will get an upgrade. New terminals will be built, as well as improvements made to existing facilities in Sadarghat, Narayanganj, Chandpur and Barisal.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
Mobility Management	Public Transport (Bus and Urban Rail), Green Freight Measures	Energy Efficiency Standards, Vehicle Emission Standards, Road Infrastructure Development, Railway Infrastructure Development

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

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ADB Provides $360 Million for Rolling Stock to Boost Bangladesh Railway; 21 Feb 2018; https://www.adb.org/news/adb-provides-360-million-rolling-stock-boost-bangladesh-railway

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Country Profile of Ghana

Income Level Group:	Middle-income	Population Size (million):	28.83
GDP per Capita:	1671.63	Share of Urban Population:	53.87%
Motorization Rate (Cars per 1,000 ppl):	32.27	HDI:	0.579
		Petroleum Consumption (Barrels Oil/Day):	79

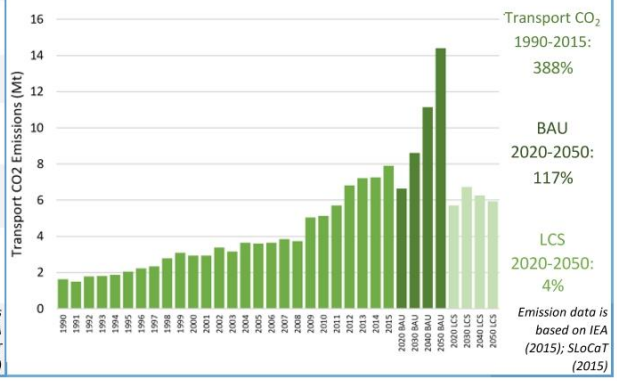
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	7.9		
Share of Transport in Total Economy-Wide CO_2 Emissions:	53.69%	Global Avg:	29.85%
Share of Road Transport in Transport CO_2 Emissions:	92.41%	Global Avg:	93.64%
Transport CO_2 Emissions per Capita (t CO_2/person):	0.3	Global Avg:	1.24
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	1.7	Global Avg:	1.3
Projected Transport CO_2 Emissions for BAU Projections (Mt):	8.6	for 2030	
	14.4	for 2050	
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	6.7	for 2030	*Emission data is based on IEA (2015); SLoCaT (2015)*
	5.9	for 2050	

Development of Transport CO2 Emissions from 1990 to 2050 (BAU and LCS)



Emission data is based on IEA (2015); SLoCaT (2015)

Low Carbon High Volume Transport

Size of Rail Network (km):	No Data	*World Bank (2015)*
Railway Passenger Activity (million pkm):	No Data	*World Bank (2015)*
BRT System Length (km):	No Data	*BRT Data (2016)*
BRT System Passengerper Day:	No Data	*BRT Data (2016)*
Urban Rail System Length (km):	No Data	*Various Sources*
Fuel Emission Standards:	No Data	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys

None	Being discussed or small pilot projects	Some implementation or pilot projects	Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

Low-carbon transport as such is not yet a policy aim, although under a UNEP/EPA program policies and programs are being drafted to develop a bill for cabinet approval. In 2008, the Ministry of Transport was divided into two ministries: Ministry of Transport, and Ministry of Roads and Highways. The Department of Urban Roads which is responsible for the mobility improvement, in Accra is now located in the Ministry of Roads and Highways (SSATP 2015).

What are the principal barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

As a developing country, Ghana's primary concern is economic growth and poverty alleviation (EPS, 2015); this means that the country largely prioritises adaptation and sustainable development over climate change mitigation. Rising debt, and an IMF bailout in 2015, mean that funding is a significant barrier to implementing low-carbon measures. There are also fears that lower-carbon measures could lead to job losses and displacement, such as with the BRT development in Accra (with job losses among tro tro operators, and the displacement of hawkers)- including increased public transport fares resulting from the BRT project (CEPS, 2015).

CEPS (2015) notes that 'addressing climate change requires a long-term approach, which is made challenging by the shifting political priorities and lack of long-term vision.' Capacity, in both technical and institutional aspects, is a substantial barrier to broader implementation of LCT – whether within the Environmental Protection Agency itself or within national policy making agencies, local operation agencies, and non-governmental actors (expert interview). There is a lack of network, collaboration and shared experience between the agencies, a lack of understanding of the local context by foreign investors, and a lack of adequate resources to equip most of the agencies.

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

Although climate change mitigation, and energy security are drivers for low carbon development, financial savings (by government), poverty alleviation and economic growth are of significant importance. Public health (in particular the adverse effects on health caused by air pollution) are key to Ghana's programme for 'soot-free buses'. (EPA, 2017). Ghana is part of the Central and Western African Regional Framework Agreement on Air Pollution (Abidjan Agreement) (2009) which calls for improvement in fuel quality and the development/implementation of vehicle standards under the transport sector. The country is developing policies to tighten fuel economy standards for passenger vehicles, coupled with labelling schemes and fiscal incentives such as CO2 based vehicle taxation.

The driving force behind the BRT corridor in Accra is largely to overcome what has become a dominant feature of urban Ghana: excessive congestion brought about by a failing public transport system and a rapid growth in private vehicles and paratransit operations in the form of tro tros (minibus taxis) (SSATP, 2015). BRT projects intend to overcome current poor quality public transport services, a poor road safety record and low operating speeds (expert interviews)

The expansion of inter and intra city mass transportation modes (Rail and bus transit system) in four cities has resulted in the number of trips by public transportation increased by 10% in those cities. The number of walking and cycling trips has increased by 5% in these areas, while there has also been a reduction in travel time by at least 8 minutes per trip by public transport. Transport congestion levels have decreased (expert interviews). However, tro tros remain the dominant public transport mode (although private vehicles account for 70% of passenger trips in Accra – SSATP, 2015), and BRT has had limited implementation. A new pilot called Ayalolo, operated by the Greater Accra Passenger Transport Executive (GAPTE), has scheduled services from the CBD of Accra to Adenta. A process of formalising tro tro operations has been underway Underpinning the para-transit reform model is a process of formalization of an operating license or permit since at least 2013.

A number of measures such as proposals for vehicle emissions standards, penalties on imported vehicles over ten years old, and annual road-worthy certification for all vehicles after inspections, are also in the pipeline.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
Vehicle Import Restrictions	Public Transport (Bus and Urban Rail), Walking, Cycling	Fuel Quality Improvements, Inspections, E-Mobility, Rail Infrastructure Development

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

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Centre for European Policy Studies (CEPS) (2015) Country case study – Ghana Climate for Sustainable Growth (2015) Centre for European Policy Studies, Brussels. Andrei Marcu, Project Leader David Belis, Wijnand Stoefs Katja Tuok

Country Profile of India

Income Level Group:	Middle-income	Population Size (million):	1339.18
GDP per Capita:	1841.56	Share of Urban Population:	32.84%
Motorization Rate (Vehicles per 1,000 ppl):	22	HDI:	0.624
		Petroleum Consumption (Barrels Oil/Day):	4142

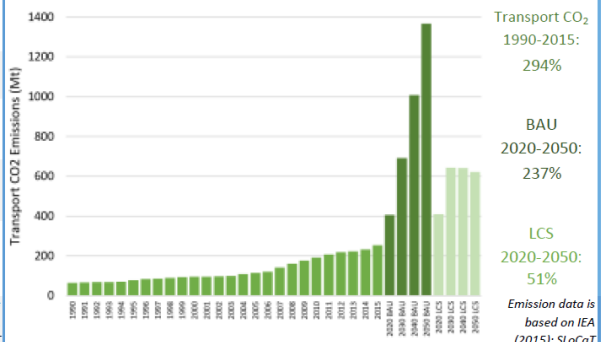
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	254.4		
Share of Transport in Total Economy-Wide CO_2 Emissions:	11.79%	Global Avg:	29.85%
Share of Road Transport in Transport CO_2 Emissions:	92.96%	Global Avg:	93.64%
Transport CO_2 Emissions per Capita (t CO_2/person):	0.2	Global Avg:	1.24
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	1.1	Global Avg:	1.3
Projected Transport CO_2 Emissions for BAU Projections (Mt):	691.0	for 2030	
	1366.2	for 2050	
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	643.2	for 2030	*Emission data is based on IEA (2015); SLoCaT (2015)*
	621.2	for 2050	

Development of Transport CO2 Emissions from 1990 to 2050 (BAU and LCS)



Low Carbon High Volume Transport

Size of Rail Network (km):	66,030	*World Bank (2015)*
Railway Passenger Activity (million pkm):	1,147,190	*World Bank (2015)*
BRT System Length (km):	174	*BRT Data (2016)*
BRT System Passengerper Day:	340,122	*BRT Data (2016)*
Urban Rail System Length (km):	344	*Various Sources*
Fuel Emission Standards:	Euro 5	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys

None	Being discussed or small pilot projects	Some implementation or pilot projects	Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

The transport sector accounts for nearly 18 per cent of the total energy consumed in India. At the national ministry level, GHG mitigation from transport is recognized as a need—and is detailed in their NDC—but is seen as a useful co-benefit of a sustainable transport policy rather than a priority that should guide transport interventions. Nevertheless, the national transport policy refers to GHG emissions as one of the urgent needs.

Air quality however (particularly PM and more recently NOx) is seen as a pressing concern that demands direct attention. Studies in 2014 to 2017 showed that more than 75% of Indian cities continue to report PM concentrations above the National Ambient Air Quality Standard. The matter is grave as air pollution reportedly causes about 1.1 million premature deaths each year.

Transport interventions are focused on solving severe transport problems in the country.
congestion, reducing air pollution and improving accessibility. India's NDC expresses a strong focus on a "safe, smart and sustainable green transportation network" through outlining activities around railway transport (freight and passenger), inland water transport, people-centred urban transport systems, metro systems, road development, electric vehicles, fuel efficiency programs and biofuels.

Rail: The Total Transport System Study in 2007-08 calculated that railways' share in total inter-regional freight traffic came down from 89 per cent in 1951 to 30 per cent in 2007-08. India is targeting to increase this share of railways in total land transport from 36% to 45% with a goal of 50% in 2031-2032 with a corresponding reduction in the modal share of road transport.
The share of rail in total passenger traffic carried by rail and roads together has also declined from 68 percent in 19521 to 10 percent in 2011-2012.

Dedicated Freight Corridors (DFCs), are envisaged to augment rail freight transportation capacity, particularly on the eastern and western Corridors and free up the existing network for the kind of capacity expansion needed for passenger movement. The DFCs are being introduced with the potential to reduce CO2 emissions by 457 Mt over 30 years.

Road: Vehicle ownership has soared in India over the last two decades. In 1991, according to the Ministry of Road Transport and Highways (MoRTH), the number of vehicles registered in the country was just over 21 million. By 2011, the number had increased to 142 million. Over this period, India lagged behind international best practices in terms of fuel quality and vehicle emission standards.
Vehicle fuel efficiency standards, first introduced in 2016, reduce transport emissions by 50 Mt CO2 per year. India has adopted Euro 6/VI equivalent standards that will go into effect in 2020. And it put into place restrictions of importing used vehicles which is rather motivated by supporting the local automobile industry but will have positive impacts on the average emissions levels of vehicles.

Urban: India is working on the need to enhanced public transport and NMT systems and disincentivise private vehicle use. Over 10 cities have metro systems. Delhi Metro can reduce around 0.57 Mt CO_2 per year. In Delhi, the BRT has been removed after pressure from constituents and strong oppositions from politics and the public.

The second phase of India's successful Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) is being implemented, supporting all types of electric vehicles. FAME supported the purchase of over 2.6 million electric or hybrid vehicles (cars, rickshaws etc.). India has around 1.5 million electric rickshaws.

Inland waterways in India are underdeveloped as a mode of transportation, despite their inherent advantages of fuel efficiency, environment friendliness, hinterland connectivity to less developed rural regions, and its capacity to shift large volumes of cargo from congested roads.

What are the principal barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

The major gaps for LC-HVT uptake in India is making the case for low-carbon transport to decision-makers and the understanding of lifecycle costs of new technologies: There are no clear emission reduction targets for the transport sector despite various measures and policies being introduced. An anxiety around new technologies and the higher costs (e.g. electric vehicles being currently more expensive) was also identified in the stakeholder interviews.
The major issues that need to be addressed include:

Lack of interconnected, hierarchical transport network: India needs a holistic approach in designing integrated transport networks. hierarchical connectivity, intermodal access.

Rebalancing and Causality: India's transport networks are severely constrained for capacity however new infrastructure needs to be programmed in anticipation of future demand to reduce investment costs, improve system integration and facilitate LC-HVT.

Governance and institutions: India's unique and dated system of institutional governance has resulted in a transport system that favours silo decisions, with the result that there is little intermodal coordination, and a system that is beset by unclear responsibilities, politicisation of investment, and weak accountability.

Skills and human resources: Despite programs such as SUTP-India, the country urgently requires more people skilled in all phases of infrastructure development, procurement, and administration.

Funding: different characteristics of the various transport modes warrant different funding models and innovative solutions are needed for LC-HVT implementation.

Pricing: A complex web of subsidies, tariffs and taxation policies still apply to transport in India. This results in distorted pricing that hinders LC-HVT choices.

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

To improve urban transport, India has over 1,000 km of metro rail in construction or under consideration. Light rail systems are also being constructed around India. The nationwide rail network continues to be electrified and more cities roll out electric buses (Himachal Pradesh, Mumbai, Pune, Kerala and Telangana among others). The Indian city Surat is considering procuring about 50 electric buses through a PPP model or the complete capital investment model. The recently launched National Clean Air Programme aims to promote public transport.
To enhance the inland waterways transport, Government has announced the implementation of Jal Marg Vikas for capacity increase. It is also proposed to establish integrated waterways transportation grid with a view to connecting all existing and proposed national waterways with road, rail and ports connectivity. Another initiative is the Sagarmala Project with the objective to increase port-led development.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
Land Use, Fuel Subsidy Removal, Parking Policies, Congestion Charging, Mobility Management	Public Metro, Walking Measures, Cycling Measures, Green Freight Measures	Energy Efficiency Standards, Feebate, Ecodriving Fuel Quality and Vehicle Emission Standards Improvement, Biofuels, E-Mobility, Road Infrastructure Development, Rail Infrastructure Development

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

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Country Profile of Indonesia

Income Level Group:	**Middle-income**	Population Size (million):	**263.99**
GDP per Capita:	**3931.43**	Share of Urban Population:	**54.62%**
Motorization Rate (Vehicles per 1,000 ppl):	**87.20**	HDI:	**0.689**
		Petroleum Consumption (Barrels Oil/Day):	**1648**

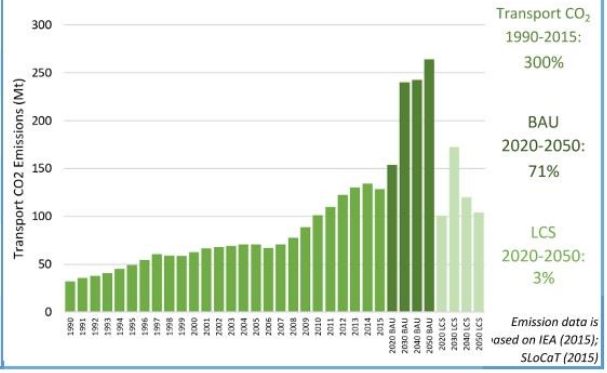
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	**128.6**		
Share of Transport in Total Economy-Wide CO_2 Emissions:	**26.92%**	Global Avg:	29.85%
Share of Road Transport in Transport CO_2 Emissions:	**87.95%**	Global Avg:	93.64%
Transport CO_2 Emissions per Capita (t CO_2/person):	**0.5**	Global Avg:	1.24
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	**1.3**	Global Avg:	1.3
Projected Transport CO_2 Emissions for BAU Projections (Mt):	**240.1**	for 2030	
	263.9	for 2050	
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	**172.5**	for 2030	*Emission data is based on IEA (2015); SLoCaT (2015)*
	104.0	for 2050	

Development of Transport CO2 Emissions from 1990 to 2050 (BAU and LCS)



Low Carbon High Volume Transport

Size of Rail Network (km):	**4,684**	*World Bank (2015)*
Railway Passenger Activity (million pkm):	**20,283**	*World Bank (2015)*
BRT System Length (km):	**207**	*BRT Data (2016)*
BRT System Passengerper Day:	**370,000**	*BRT Data (2016)*
Urban Rail System Length (km):	No Data	*Various Sources*
Fuel Emission Standards:	**Euro 2**	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys: None | Being discussed or small pilot projects | Some implementation or pilot projects | Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

Compared to other objectives such as accessibility, GHG reduction is not a major priority for transport policy, however some impact in decisions on policies has been observed, e.g. in fuel efficiency policy discussions and local mobility plans (Bakker et al., 2017). Indonesia's climate change policy has led to increased political will and momentum to implement transport policies that were developed for various other policy objectives, for example fuel efficiency standards, investments in rail, and BRT. The 5-year strategic plan of the Ministry of Transport also has a CO2 reduction target. In Indonesia, the Ministry of Energy is more active in transport regulations when it comes to fuel efficiency policy and biofuels (including in domestic aviation). The strong push for biofuel production and use is mainly to reduce oil consumption and promote rural development. Biofuel blending up to 20% (B20) is a key measure in achieving the climate change mitigation contribution from the transport sector.

What are the principal barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

Inter-ministerial coordination (transport, energy, finance, environment) is still lacking and sometimes there are conflicting policy aims. For example, Indonesia incentivised the production of smaller and more fuel efficient 'Low Cost Green Cars' to support the domestic vehicle industry. The objective may have been to reduce emissions; however, because the policies were not harmonised the result has been a fast growing car population that is leading to increased congestion. Capacity constraints and lack of knowledge of sustainable transport solutions are barriers as well. Data and monitoring is another gap. There is a willingness to improve environmental performance by the Ministry of Transport, even if GHG reduction is not yet a key performance indicator. Lack of data is still a key problem (especially for private vehicles), not only for GHG estimation of measures but for policy development in general. It is difficult to secure public funding for data gathering and there is a need to ensure a high-level of quality for the data; in addition, data sharing between government agencies is an imperative. Indonesia is taking steps toward coordinating these efforts through its national climate change framework

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

The Jakarta BRT is considered relatively successful, with good integration in the broader public transport, GHG impact and financial sustainability with operational subsidies (like nearly every bus system in world). However in smaller cities in Indonesia, BRT systems have not proven successful. Additionally, there have been large investments in rail and waterway freight; however, modal shift is not yet taking place. Indonesia is planning to develop a national urban mobility plan under the Indonesia Sustainable Urban Transport Program Indonesia (SUTRI-NAMA), which has been initiated by international organisations together with the Ministry of Transport. Fuel economy policy discussions are also taking place, supported by international organisations. Euro IV compliant fuel is available since December 2017 from some suppliers, however such standard is not in place yet due to pushback from refineries. Fossil fuel subsidy reduction is being pursued by the government, mainly to reduce state budget expenditures but also to save fuel.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
Land Use, Parking Policies, Congestion Charging, Mobility Management	Public Transport (Bus and Urban Rail), Walking Measures, Cycling Measures	Ecodriving, Fuel Quality and Vehicle Emission Standards Improvement, Biofuels, Railway Infrastructure Development, Improvement of Data

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

Country Profile of Kenya

Income Level Group:	Middle-income	Population Size (million):	49.70
GDP per Capita:	1114.88	Share of Urban Population:	26.22%
Motorization Rate (Vehicles per 1,000 ppl):	29.25	HDI:	0.555
		Petroleum Consumption (Barrels Oil/Day):	93

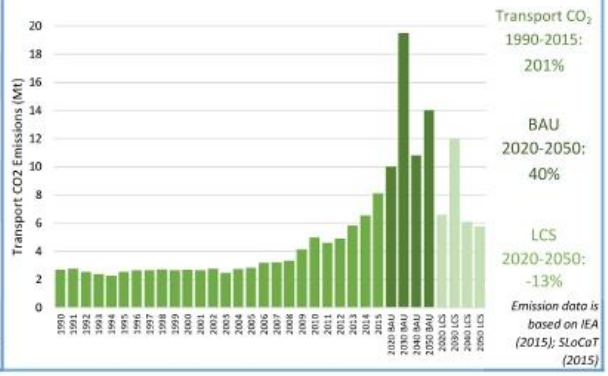
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	8.1		
Share of Transport in Total Economy-Wide CO_2 Emissions:	53.53%	Global Avg:	29.85%
Share of Road Transport in Transport CO_2 Emissions:	97.53%	Global Avg:	93.64%
Transport CO_2 Emissions per Capita (t CO_2/person):	0.2	Global Avg:	1.24
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	1.5	Global Avg:	1.3
Projected Transport CO_2 Emissions for BAU Projections (Mt):	19.5	for 2030	
	14.0	for 2050	
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	12.0	for 2030	*Emission data is based on IEA (2015); SLoCaT (2015)*
	5.8	for 2050	

Development of Transport CO2 Emissions from 1990 to 2050 (BAU and LCS)



Transport CO_2 1990-2015: 201%

BAU 2020-2050: 40%

LCS 2020-2050: -13%

Emission data is based on IEA (2015); SLoCaT (2015)

Low Carbon High Volume Transport

Size of Rail Network (km):	1,917	*World Bank (2006)*
Railway Passenger Activity (million pkm):	226	*World Bank (2006)*
BRT System Length (km):	No Data	*BRT Data (2016)*
BRT System Passengerper Day:	No Data	*BRT Data (2016)*
Urban Rail System Length (km):	No Data	*Various Sources*
Fuel Emission Standards:	No Data	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys

None | Being discussed or small pilot projects | Some implementation or pilot projects | Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

Like most African countries, Kenya faces what Klopp (2012) describes as a 'fairly typical plethora of inter-related urban malaises': high levels of poverty, social segregation, oil dependency, road crashes, 'extremely poor air quality, serious traffic congestion, limited transport choices, little to no planning for pedestrians and cyclists, and a historical failure to invest in and plan for formal bus and train services (Klopp, 2016). Reducing greenhouse gas emissions is therefore not necessarily the highest priority when it comes to transport decision-making. Congestion and air quality do nevertheless lead to major concerns regarding efficiency, productivity, fuel-consumption and urban health (Klopp, 2012). Thus road building, and air quality, take perhaps the highest priority, and 'actors with strong interests and focus on rapid road construction and large-scale infrastructure development are at the core of decision making about transportation policy' (Klopp, 2012).

The World Health Organisation measurements of Nairobi air quality has shown it to be one of the worst in the world during peak hours, caused mainly by the import into Kenya of second-hand vehicles.

What are the principal barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

In Kenya, transportation decision-making has been influenced by the way in which power and institutions operate, both formally and informally, with bus services shifting even in relation to elections (Klopp, 2016).

Barriers include what Klopp (2012) describes as the large and distorting role of external actors; fragmentation in institutions, policymaking and projects; closed and top-down planning processes; the absence of mobilisation for policies and projects that serve the majority of city residents, especially the poorer segments.

Overall, these have their origins in a broader political context which includes a historical legacy of planning as a form of exclusion, authoritarian politics, and institutional configurations and practices that favour patronage and rent-seeking (Klopp, 2012).

These are challenges not necessarily at play in Kenya alone, nor are they peculiar to the implementation of low-carbon transport measures but to progressive and inclusive public policies overall.

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

Kenya has developed a National Climate Change Response Strategy (NCCRS 2010), a National Climate Change Action Plan (NCCAP 2013), a National Adaption Plan (NAP) and a Climate Change Act (2016) to curb the increased emissions in the country (Lah et al, 2017). The country's Vision 2030 intends to promote mass transit systems to cater for the large numbers of people who currently walk as their main mode. Shifting road freight to rail, water and non-motorised transportation can reduce up to 4.1 MtCO2 a year until 2030 (Kenya´s National Climate Change Action Plan, 2013). UNEP is working with the Kenyan government to implement a tax incentive scheme, increasing the share of cleaner vehicles, prohibiting old, emissions-intensive vehicles from using Kenya's roads (Lah et al, 2017).
Kenya, in its 2nd NC, indicated that the sustainable transport option with the largest mitigation potential is the development of an extensive mass transit system for greater Nairobi in the form of BRT corridors, complemented by Light Rail in high thoroughfare corridors. This public transport system has an abatement potential of approximately 2.8 Mt CO2eq a year by 2030 (Government of Kenya, 2015).

Kenya has analysed seven low carbon development options for the transport sector in its 2nd NC. Among those, the option with the second largest mitigation potential is the introduction of biodiesel, with a 10 % blend requirement having a potential of approximately 1.2 Mt CO2eq a year in 2030. The abatement potentials for the other low carbon development options vary between 0.5 and 0.8 Mt CO2eq a year in 2030 (Government of Kenya, 2015).

Kenya's Integrated National Transport Policy (Moving a Working Nation) (2009) in particular recognises non-motorised modes, and notes that 'no action has been taken to integrate them into the national transport network so that they can effectively play a complementary role to road and other transport modes for both passengers and goods.' (Jennings et al, 2016). Nairobi City has an NMT Policy, titled 'Toward NMT as a mode of choice'.

Since the end of the 1990s virtually all 'public' transport in Nairobi for example is privately owned and run (unscheduled 'matatu' services) (SSATP, 2015). The city therefore intends to develop commuter rail and BRT infrastructure on main corridors through a World Bank project. In addition, the World Bank is providing support for the establishment of the Nairobi Metropolitan Transport Authority, which will address transport issues in Nairobi. The Authority is mandated by the Integrated National Transport Policy.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
Vehicle Restrictions	Public Transport (Bus and Urban Rail), Green Freight Measures	Fuel Economy/ Energy Efficiency Standards, Biofuels, Railway Infrastructure Development

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

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Country Profile of Nigeria

Income Level Group:	Middle-income	Population Size (million):	190.89
GDP per Capita:	2392.92	Share of Urban Population:	50.17%
Motorization Rate (Vehicles per 1,000 ppl):	20.70	HDI:	0.527
		Petroleum Consumption (Barrels Oil/Day):	316

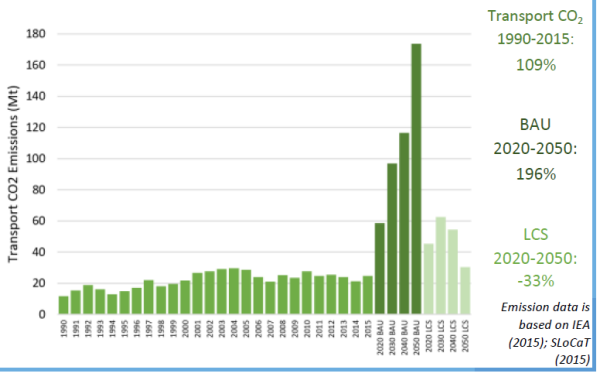
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	24.6		
Share of Transport in Total Economy-Wide CO_2 Emissions:	27.44%	Global Avg:	29.85%
Share of Road Transport in Transport CO_2 Emissions:	99.59%	Global Avg:	93.64%
Transport CO_2 Emissions per Capita (t CO_2/person):	0.1	Global Avg:	1.24
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	0.5	Global Avg:	1.3
Projected Transport CO_2 Emissions for BAU Projections (Mt):	96.8	for 2030	
	173.7	for 2050	
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	62.6	for 2030	*Emission data is based on IEA (2015); SLoCaT (2015)*
	30.4	for 2050	

Development of Transport CO2 Emissions from 1990 to 2050 (BAU and LCS)



Transport CO_2 1990-2015: 109%

BAU 2020-2050: 196%

LCS 2020-2050: -33%

Emission data is based on IEA (2015); SLoCaT (2015)

Low Carbon High Volume Transport

Size of Rail Network (km):	3,528	*World Bank (2007)*
Railway Passenger Activity (million pkm):	174	*World Bank (2007)*
BRT System Length (km):	22	*BRT Data (2016)*
BRT System Passengerper Day:	200,000	*BRT Data (2016)*
Urban Rail System Length (km):	No Data	*Various Sources*
Fuel Emission Standards:	No Data	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys

None	Being discussed or small pilot projects	Some implementation or pilot projects	Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

Nigeria's transport mitigation actions reported in its NC and NDC focus on the expansion of its BRT system, and the modal shift from car to bus and expansion of the high speed rail network. 'The overriding principles are about providing mobility and access.. Everyone else is secondary (expert interview)/

Regarding Lagos in particular (the capital of Nigeria and one of the largest cities in the world), transport decisions are based on the urgent need to improve urban mobility. Traffic in the city is frequently stationary and long commutes, often of over two hours, are a common experience for residents (Mason-Jones et al, 2012).

Although the Lagos Urban Transport programme will eventually lead to improvement in the reduction in GHG Gas emissions, there are no institutional structures and attempts to monitor and plan towards it. One cannot identify a specific institution or documents that suggest the measures or indicators that have been developed towards achieving reduction in air and noise pollution (SSATP, 2015).

In 2012 the Lagos transport authority, LAMATA, claimed that the BRT-Lite system had resulted in a 13% reduction in CO2 emissions along the operating corridor, the literature or sources have not identified any independent assessments of this assertion. Most passengers were previously using other forms of public transport, with only a small proportion having been attracted out of private cars. However, the use of newer, larger buses on the BRT corridor suggests that there would have been some level of efficiency gain from the implementation (Mason-Jones et al, 2012).

What are the principal barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

Unlike most African cities, Nigeria as a whole, Lagos State, and LAMATA are able to attract significant investments from both international development partners and local sources (SSATP, 2015). Infrastructure and facilities for the initial BRT Lite line were financed directly from Lagos State, and LAMATA also has a dedicated source of funds (road use taxes) which will be used to partially finance future lines (Kumar et al, n.d.).

The Lagos BRT also benefited from 'strong, forceful support from a politically astute champion' and was backed by 'a solid organization with superior administrative and technical skills and public transport experience' (Kumar et al, n.d.).

This is not to say that challenges and barriers do not exist. The absence of policies on land use and economic development have led to urban sprawl, increased travel distances, and increased the price of public transport (SSATP, 2015). Most developments in Lagos are unplanned, and public transport costs to users constitute over 20% of disposable income (SSATP, 2015).

There are no public operating subsidies, and operating profit allowed the loans used to purchase the buses from Tata have been paid back early (Kumar et al, n.d.); while this has been hailed as a success story, there are real concerns that this renders public transport ultimately not financially viable, and that it leads to high costs for users and operators (expert interviews).

There are cultural challenges too, where people see the use of private cars as a status symbol. Much personal investment goes into car ownership, thus attempts to persuade people to stop using them is an uphill battle (expert interviews); likewise, for two-wheelers and bicycles.

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

Nigeria's National Policy on Transportation (2015) aims to develop an 'adequate, safe, environmentally sound, efficient, affordable, preferred and integrated transport system within the framework of a progressive and competitive market economy. Its purpose is to establish a framework that can guide the planning and development of transport activities in a systematic and sustainable manner for the social and economic development of Nigeria.' A National Cycling Policy and Strategy and a pedestrian manual do exist in draft form (Jennings et al, 2016), and Lagos state is developing an NMT policy.

The key low-carbon transport measure in Nigeria is the Lagos BRT-Lite, which was launched in 2008, operating along a 22 km corridor running radially out of the CBD. The BRT infrastructure consists of physically segregated lanes along 65% of the corridor length, exclusive BRT lanes marked by paint along a further 20%, and buses travelling with the mixed traffic for 15% of the route.

Nigeria is part of the Central and Western African Regional Framework Agreement on Air Pollution (Abidjan Agreement, 2009), which calls for improvement in fuel quality and the development/implementation of vehicle standards under the transport sector. Nigeria is also working to blend 10% by volume of Fuel-Ethanol with Gasoline (E10) and 20% by volume of Biodiesel with Petroleum Diesel (B20) for transport fuels, and plans to introduce efficiency standards and the use of LPG / CNG for buses and taxis.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
Land Use, Fuel Subsidy Removal, Congestion Charging/ Low Emission Zones, Pricing	Public Bus Transport, Walking Measures, Cycling Measures, Green Freight Measures	Fuel Economy/ Energy Efficiency Standards, Biofuels, LPG/CNG, Road Infrastructure Development, Rail Infrastructure Development

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

References

Expert interviews

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Country Profile of Rwanda

Income Level Group:	Low-income	Population Size (million):	12.21
GDP per Capita:	721.23	Share of Urban Population:	32.96%
Motorization Rate (Cars per 1,000 ppl):	No Data	HDI:	0.498
		Petroleum Consumption (Barrels Oil/Day):	6

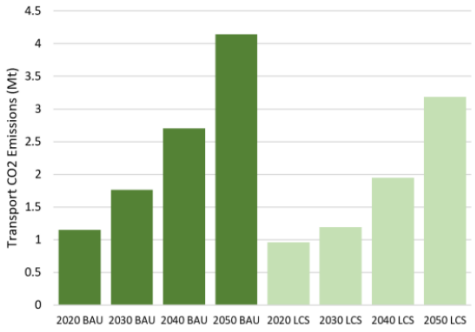
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	No Data		
Share of Transport in Total Economy-Wide CO_2 Emissions:	No Data	Global Avg:	29.85%
Share of Road Transport in Transport CO_2 Emissions:	No Data	Global Avg:	93.64%
Transport CO_2 Emissions per Capita (t CO_2/person):	No Data	Global Avg:	1.24
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	No Data	Global Avg:	1.3
Projected Transport CO_2 Emissions for BAU Projections (Mt):	1.8	for 2030	
	4.1	for 2050	
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	1.2	for 2030	*Emission data is based on IEA (2015); SLoCaT (2015)*
	3.2	for 2050	

Development of Transport CO2 Emissions from 2020 to 2050 (BAU and LCS)



Transport CO_2 1990-2015: N/A

BAU 2020-2050: 261%

LCS 2020-2050: 232%

Emission data is based on IEA (2015); SLoCaT (2015)

Low Carbon High Volume Transport

Size of Rail Network (km):	No Data	*World Bank (2015)*
Railway Passenger Activity (million pkm):	No Data	*World Bank (2015)*
BRT System Length (km):	No Data	*BRT Data (2016)*
BRT System Passengerper Day:	No Data	*BRT Data (2016)*
Urban Rail System Length (km):	no	*Various Sources*
Fuel Emission Standards:	No Data	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys

None	Being discussed or small pilot projects	Some implementation or pilot projects	Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

Rwanda has set an ambitious conditional target to reduce 64% of GHG emissions in the transport sector by 2030 compared to BAU. Rwanda has one of the lowest emissions per capita in the world, estimated at 0.65 tons CO2/person (National Strategy on Climate Change and Low Carbon Development, 2011). At the same time, however, there has been a substantial increase in motorisation in recent years, almost half of which are motorcycles. Rwanda's transport sector is entirely dependent on imported fuel and consumes approximately 75 % of all the country's imported petroleum products. The limited choice of routes means that Rwanda is dependent on the political stability of the neighbouring regions and is particularly vulnerable to interruptions of supply.

Air pollution is an increasing challenge, and transport is the main contributor (particulate matter has exceeded the WHO limits since at least 2014).

What are the principal barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

Rwanda is particularly capacitated in terms of transport-relevant skills and training, although there is a lack of knowledge regarding the technicalities of electric mobility. There has been very little empirical work in developing countries on how or if low-carbon resilient development approaches work in practice, and so Rwanda's activities will be important in contributing to an evidence base to support policymaking and the practical application of low-carbon resilient development in the least developed countries. Effective monitoring and evaluation are needed.
Talking about low-carbon is to some extent a 'western luxury thing' (expert interview)- but value has been seen in the low-carbon route in order to decrease dependency on fuel imports.

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

Key drivers are the need to improve public transport, as well as fuel security and balance of payment (trade and foreign currency), congestion, motorisation, and global climate treaty imperatives.

Transport policy in Rwanda (excluding aviation) is coordinated by the Ministry of Infrastructure (MININFRA) and the Rwandan Transport Development Authority (RTDA), a semi-autonomous body under the Ministry of Infrastructure. There is good inter-governmental cooperation in terms of mobility planning in Rwanda. The Regulator (RURA) is responsible for bus contracting. Key policies of the transport sector are outlined in the National Transport Policy 2008, the National Transport Sector Investment Strategy 2002 and the Integrated National Transport Strategy 2011– 2015. These policies have been developed to achieve Rwanda's Vision 2020 goals by reducing constraints to transport in order to promote sustainable economic growth and contribute to poverty reduction. Specific policies being implemented in Kigali include the rollout of a smart fare collection system, re-negotiation of bus contracts, and a detailed feasibility study for a BRT system. In 2016, the City of Kigali began the implementation of a car-free zone policy. At present only one street has been converted, but the City aims in coming years to ban all cars from the CBD to create a pedestrian-friendly city core. Rwanda is also introducing regulation of the quality of imported vehicles, taking into account the year of manufacturing, the mileage and other technical characteristics required.

After four years of unsuccessful attempts to get biofuel production off the ground, the government is abandoning its $35 million biodiesel project. Poor science behind the feasibility studies that expected jatropha to be a key feedstock, but later was determined to not be viable in the country's climate, is blamed for the project's failure. The government has tried to auction off equipment such as a biodiesel-fuelled bus but no buyers have been found. Potential use of the facility as an R&D site have also been floated but not yet decided upon.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
Land Use, Vehicle Restrictions (Import), Mobility Management	Public Transport (Bus and Urban Rail), Walking Measures, Cycling Measures	Fuel Quality and Vehicle Emission Standards Improvement, CNG, Other Measures to Improve Energy Efficiency (Feebate, Ecodriving), Road Infrastructure Development, Railway Infrastructure Development

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

Country Profile of South Africa

Income Level Group:	Middle-income	Population Size (million):	56.72
GDP per Capita:	7426.48	Share of Urban Population:	62.83%
Motorization Rate (Vehicles per 1,000 ppl):	173.63	HDI:	0.666
		Petroleum Consumption (Barrels Oil/Day):	660

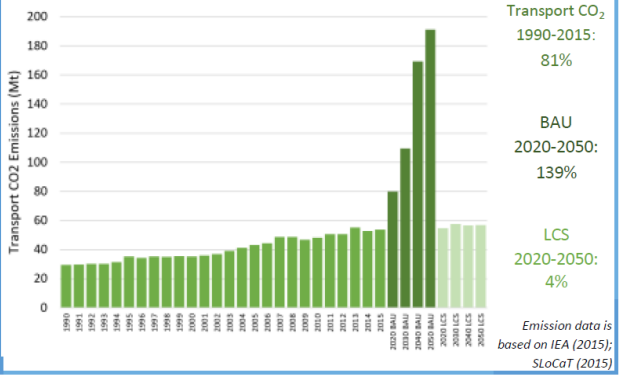
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	53.6			
Share of Transport in Total Economy-Wide CO_2 Emissions:	12.09%	Global Avg:	29.85%	
Share of Road Transport in Transport CO_2 Emissions:	93.10%	Global Avg:	93.64%	
Transport CO_2 Emissions per Capita (t CO_2/person):	1.0	Global Avg:	1.24	
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	1.3	Global Avg:	1.3	
Projected Transport CO_2 Emissions for BAU Projections (Mt):	109.5	for 2030		
	191.2	for 2050		
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	57.6	for 2030	*Emission data is based on IEA (2015); SLoCaT (2015)*	
	56.8	for 2050		

Development of Transport CO2 Emissions from 1990 to 2050 (BAU and LCS)



Emission data is based on IEA (2015); SLoCaT (2015)

Low Carbon High Volume Transport

Size of Rail Network (km):	20,500	*World Bank (2015)*
Railway Passenger Activity (million pkm):	14,689	*World Bank (2015)*
BRT System Length (km):	74	*BRT Data (2016)*
BRT System Passengerper Day:	108,178	*BRT Data (2016)*
Urban Rail System Length (km):	No Data	*Various Sources*
Fuel Emission Standards:	No Data	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys

None	Being discussed or small pilot projects	Some implementation or pilot projects	Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

Congestion relief, reduced motorisation, improved public transport quality, and improved access are the key stated transport priorities in South Africa. Subsequent to country's first democratic elections in April 1994, transport needs in the country were identified variously as safety, shorter travel times, affordable fares, less overcrowding, reduced walking distances, and improved access to facilities (Jennings et al, 2018). The 1994 Reconstruction and Development Programme stated in its key programme, Meeting Basic Needs, that 'a future transport policy must promote coordinated, safe, affordable transport as a social service' (Jennings et al, 2018). By 2007, South Africa's Public Transport Strategy makes it clear that 'mass motorisation of the South African population [is not] possible, [but is also not] desirable, nor equitable'; the Strategy conceptualises transport in terms of quality mobility. National government proposed Bus Rapid Transit (BRT) services as 'the mobility wave of the future, and the only viable option that can ensure sustainable, equitable and uncongested mobility in liveable cities and districts' (Jennings et al, 2018). Both the National Development Plan (2012) and the National Transport Master Plan (NATMAP) (2015) see a need to maintain and expand transport infrastructure to support South Africa's economic growth and social development goals.

Decisions regarding the provision of transport are to be 'consistent with national interests, such as meeting basic needs, growing the economy, developing human resources, and democratising the state and society, while also being environmentally and economically sustainable as well as financially viable (Jennings, 2018, in press). The narrative of 'low-carbon', low-emissions transport that mitigates climate change is a relative recent one.

What are the principal barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

In line with policy statements above, study respondents indicate that 'low carbon is definitely not a priority in terms of South African government thinking'. 'This is a vast country, and government simply cannot make this a priority. Poverty imperatives, and the provision of mobility, are more important. And eventually, it will be about climate adaptation not mitigation.'

Further, there is rarely a direct link made between low-carbon transport and air quality, poverty, ill health, and ultimately access and transport justice – and 'the staggering extent of corruption, theft, and ineptitude can seem like insurmountable barriers' (expert interviews).

Like with other African countries, South Africa has to contend with two parallel transport challenges: high-carbon, private-car-dependency among the middle-classes, and poor quality mobility and transport disadvantage among the poor.

While some measure pf Bus Rapid Transit (BRT) services have been rolled out in 12 cities and large towns in the country, these services have largely been intended to provide better quality mobility to those already using public transport (in the form of unscheduled paratransit services). It is not easy to finance public transport operations in South African cities, where the urban form generates low passenger volumes and high peak/off-peak ratios (Salazar-Ferro, 2017). During the course of 2017, South Africa's National Department of Transport and the National Treasury raised the alarm that the country's BRTs were making losses 'significantly higher than anticipated'. These systems were, at best, recovering 40% of their operating costs through fares (NDoT, 2016). Even the most-used BRT system (by daily ridership) in South Africa, MyCiTi in Cape Town, required a 75% operating subsidy in the 2016/17 financial year (Schalekamp et al, 2017).

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

As part of the Copenhagen Accord (December 2009), under the UNFCCC, South Africa is obliged to report on its greenhouse gas (GHG) emissions via the National Atmospheric Emission Inventory System. South Africa pledged a GHG emissions reduction target of 34% by 2020 and 42% by 2025 below the business as usual trend. In line with this pledge and the Paris Agreement (2015), South Africa's Nationally Determined Contribution (NDC) commits the country to limiting its GHG emissions to peak at a range between 398 and 614 Mt CO2e over the period 2025-2030 (NDoT, 2017), and makes specific mention of adding electric and hybrid electric vehicles.

The National Climate Change Response Policy (2011) is South Africa's comprehensive response to climate change. It presents a vision for the long-term transition to what it describes as a climate-resilient, equitable, and internationally competitive lower-carbon economy and society (NCCRP, 2011). The Climate Change Response Policy (2011) had mandated the DoT to lead a Transport Flagship Programme: "As part of the Transport Flagship Programme, the Department of Transport will facilitate the development of an enhanced public transport programme to promote lower-carbon mobility … and create an Efficient Vehicles Programme with interventions that result in measurable improvements in the average efficiency of the South African vehicle fleet by 2020."

In order to develop the transport mitigation approaches set out in the Climate Response Policy, the Department of Environmental Affairs (DEA) established a Transport Technical Working Group. The group considered mitigation in the air, road and rail transport sectors. In 2014, the DEA (2014) published a Mitigation Report, which analysed the potential for South Africa's GHG mitigation in multiple sectors. The analysis therefore identified a range of road-transport measures that could deliver emissions reductions by 2050. These included modal shifts, demand reduction measures, more efficient vehicle technologies, more efficient operations, and alternative low carbon fuels (particularly 'switching to vehicles recharged by electricity, powered by gas, or hydrogen fuel cells). The analysis showed that, if all technically available mitigation potential in the transport sector were implemented (the With Additional Measures, or WAM, scenario), GHG emissions could be reduced by 11 869 ktCO2e by 2020, 39 525 ktCO2e by 2030, and 117 151 ktCO2e by 2050 (DEA, 2014).
One of the outcomes of the Mitigation report was the Department of Transport (DoT)-led Green Transport Strategy 2017-2050 (NDoT, 2018). The Strategy aims to substantially reduce the GHG emissions and other environmental impacts from the transport sector by 5% by 2050. Actions are mainly focusing on the development of 1) green roads (shifting private passenger cars to public transport (rail), shifting freight transport from road to rail); 2) rail (extending rail network to provide high-speed transport while switching to renewable energy trains); 3) green transport technologies (use of CNG, LNG and EV); 4) green fuel economy standards (norms, standards and regulations that promote green fuel economy in vehicles and improve emission standards of fuel in South Africa).

South Africa has had a National Biofuels Strategy since 2007. The regulatory framework provides financial support to biofuel manufacturers via a general fuel levy, but this has not been enough to encourage production. In August 2015 the South African government announced that the biofuel funding incentive would be revamped over concerns that it was unaffordable after the drop in global crude oil prices.

Several targets have been set by South Africa to improve vehicle efficiency, increase the use of cleaner fuels, and the uptake of electric vehicles (EVs). In its BUR submitted in 2017, South Africa set a target to achieve a 20% improvement in average vehicle energy intensity (MJ/km). The country also focused on the integration of EVs and targeted that 20% of its fleet be hybrid-EVs by 2030. In 2014, South Africa focused on a Compressed Natural Gas (CNG) industry fuel switch and CNG vehicle fuel switch, which led to a GHG reduction of 0.0027 Mt CO2eq over 10 months (Mar-Dec 2014). The pilot pointed to an estimated GHG reduction of 165,896 Mt CO2eq over a 10-year period, which assumes a 23-27% emission reduction per vehicle in South Africa from 2014 to 2024.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
Land Use	Public Transport (Bus and Urban Rail), Walking Measures, Cycling Measures, Green Freight Measures	Measures to Improve Efficiency, Biofuels, CNG, E-Mobility, Intelligent Transport System, Rail Infrastructure Development

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

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Expert interviews
SSATP (2015) Policies for Sustainable Accessibility and Mobility in Urban Areas of Africa Cities, TRANSITEC Consulting Engineers Ltd (M. Stucki), in collaboration with ODA, CODATU and Urbaplan
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Jennings, Gail (2018, in press). "Why should we build cycling lanes? For what?" Building a socially just bicycle programme in an unequal city: the case of Johannesburg. For GCRO (Gauteng City-Region Observatory
Salazar-Ferro, P (2017) Paratransit – formal service relationships in urban public transport systems: Case studies of hybridity and operational complementarity (submitted for the degree of Doctor of Philosophy, Department of Civil Engineering, University of Cape Town)
Schalekamp, H, Mclaren M & Behrens, R (2017) "Exploring cashless fare collection in the contact of urban public transport reform in South Africa", Southern African Transport Conference (SATC) 2017
National Department of Transport (NDoT) 2016) Terms of Reference for the Development of a Public Transport Subsidy Policy

Country Profile of Uganda

Income Level Group:	Low-income	Population Size (million):	42.86
GDP per Capita:	641.18	Share of Urban Population:	16.78%
Motorization Rate (Vehicles per 1,000 ppl):	12.21	HDI:	0.493
		Petroleum Consumption (Barrels Oil/Day):	27

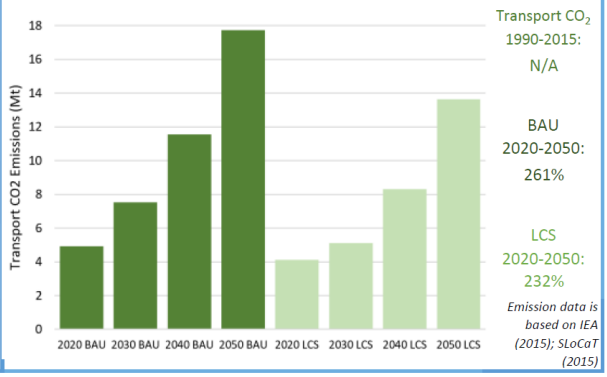
Partnership on Sustainable Low Carbon Transport

HIGH VOLUME TRANSPORT APPLIED RESEARCH

Overview of Transport CO_2 Emissions

Transport CO_2 Emissions (Mt):	No Data			
Share of Transport in Total Economy-Wide CO_2 Emissions:	No Data	Global Avg:	29.85%	
Share of Road Transport in Transport CO_2 Emissions:	No Data	Global Avg:	93.64%	
Transport CO_2 Emissions per Capita (t CO_2/person):	No Data	Global Avg:	1.24	
Transport CO_2 Emissions per GDP (t CO_2/10,000 USD):	No Data	Global Avg:	1.3	
Projected Transport CO_2 Emissions for BAU Projections (Mt):	7.5	for 2030		
	17.7	for 2050		
Projected Transport CO_2 Emissions for Low Carbon Scenario (LCS) (Mt):	5.1	for 2030		*Emission data is based on IEA (2015); SLoCaT (2015)*
	13.6	for 2050		

Development of Transport CO2 Emissions from 2020 to 2050 (BAU and LCS)



Transport CO_2 1990-2015: N/A

BAU 2020-2050: 261%

LCS 2020-2050: 232%

Emission data is based on IEA (2015); SLoCaT (2015)

Low Carbon High Volume Transport

Size of Rail Network (km):	No Data	*World Bank (2015)*
Railway Passenger Activity (million pkm):	No Data	*World Bank (2015)*
BRT System Length (km):	No Data	*BRT Data (2016)*
BRT System Passengerper Day:	No Data	*BRT Data (2016)*
Urban Rail System Length (km):	No Data	*Various Sources*
Fuel Emission Standards:	No Data	*UNEP (n.d.)*

Quick Win Low Carbon Transport Measures

Accelerate tighter diesel fuel quality standards to reduce Black Carbon and other SLCP	Accelerate phase-out of fossil fuel subsidies.	Introduce and scale up pricing for car-related travel options	Limit import of inefficient and polluting second hand trucks
Formulate Sustainable Urban Mobility Plans, supported by a National Urban Mobility Policy	Implement (ultra-) low emission zones, incl. car-free zones in city centers	Provide and improve walking and cycling infrastructure	Promote electric two- and three wheelers, incl. e-vehicle sharing
Improve freight efficiency	Tighten fuel economy standards		

Legend Keys

None | Being discussed or small pilot projects | Some implementation or pilot projects | Full-scale or large projects

What priority does reducing greenhouse gas (GHG) emissions have in national/ local decisions that affect transport?

Uganda's primary commitments in terms of its NDC is adaptation to climate change and the reduction of vulnerability (Enriquez, et al, 2018) – key areas for adaptation in the transport sector include promoting fuel and vehicle efficiency, as, like other countries in the region, Uganda is dependent on vehicle and fuel imports, and is focused on economic development and poverty alleviation. The country's Vision 2040 focuses on implementation of transport infrastructure, rather than on transport service, in order to strategically enable key economic opportunities in Uganda (Enriquez, et al, 2018).

At the same time, Uganda's 2015 National Climate Change Policy and its Nationally Determined Contribution (NDC) recognise the need to mitigate emissions from vehicles and ensure that transport infrastructure is climate resilient. The climate priorities for Uganda's transport sector are to: develop and ensure integrated planning and management of transport and other physical infrastructure that build on insights from climate predictions, promote the development, approval, and effective implementation of a long-term national transport policy and plan that will take greenhouse gas mitigation concerns into account (Enriquez, et al, 2018).

What are the principle barriers/obstacles that could make broader implementation of LC-HVT difficult to achieve?

The competitiveness, attractiveness and productivity of Uganda's capital, Kampala are severely impacted by its poor road network, its water and sewer systems, poor rail access and unreliable supply of energy. Road congestion is a way of life. Commuters from suburbs less than 20 km from the city centre can take an hour or so to travel each way, and incur high transportation costs. (SSATP, 2015). Thus where public transport and roadway improvements are sought, this is largely underpinned by a desire to improve mobility and productivity.

Respondents cite lack of funding, poor political will, and corruption, and key barriers to achieving substantial low-carbon developments. There is a difficulty in understanding the link between transport and sustainable development goals (expert interviews) and politicians find it easier to 'buy' votes with promises of road-building (responding to the country's rapid rate of motorisation) rather than sustainable development. By and large, politicians – the ultimate decision-makers – regard technical advice as interference.

What is being done to implement low carbon transport? What have been the core influencers of the proposed/current LCT interventions?

Parking and congestion in the inner city are rated pressing issues in Kampala, with the lack of formal, scheduled public transport supply one of the biggest challenges. The lack of and quality of road infrastructure is another challenge, and high air pollution levels and crash rates are a direct consequence of the poor public transport supply and related congestion. Travel time and the negative impacts of congestion are major issues (SSATP, 2015). Thus where public transport and roadway improvements are sought, this is largely underpinned by a desire to improve mobility and productivity.

Uganda has a National Transport Master Plan (2008) which sets a 15-year scenario for future development and management of the transport sector, including a transport sector investment plan, and an outline of the required institutional and regulatory framework and its implementation (Jennings et al, 2016). In 2012 the Uganda Ministry of Works and Transport published a standalone NMT policy. The National Transport Master Plan, along with all other transport policies and strategies, is deliberately positioned within Uganda's overall national development framework, supporting and aligning with the nation's development targets. The aim of the Master Plan is to provide an agenda that could be integrated into a larger framework of development, and to provide an implementation pathway for Uganda's vision for the transport sector to have "a full-developed and sustainable national transport system for all by 2050 (Enriquez, et al, 2018).

Since its adoption, two further plans have been published. Futher, t National Transport Master Plan is integrated with the Comprehensive National Development Planning Framework and the Uganda Vision 2040 to have "a transformed Ugandan society from a peasant to a modern and prosperous country within 30 years" (Enriquez, et al, 2018).

In terms of current low-carbon transport measures, Uganda's 2nd NC highlighted the provision of incentives for low carbon and low-cost public transport such as BRT and other means of mass transport (e.g. trams).

The country also aims to blend gasoline with ethanol and achieve the use of 100% ethanol vehicles as well as use of 100% biodiesel or blending.

For fuel efficiency, Uganda has launched the Fuel Efficiency Initiative National Appropriate Mitigation Action which includes policies and regulations to promote cleaner fuels and more fuel efficient vehicle technology with approximate investment cost of USD 5.8 million over 6 years. This measure can help to avoid approximately 2 Mt CO2eq per year in 2030, which equals between 24% and 34% below BAU projections for road transport.

Other interventions include the completion of a Multi-Modal Urban Transport Master Plan, and statutory instrument has been drafted to restrict CBD access by HGV during the day (expert interviews). The country is now limiting the importation of second hard vehicles older than 15 years old. Walkways are being expanded in the city, and there is ongoing construction of the first formal NMT Corridor in Kampala (Luwum Street to Namirembe road, about 1.7 km) (expert interviews).

There are processes in place to reorganise the existing public transport system characterised by Boda bodas and 14-seater taxis, implement boda boda and car-free zones in Kampala, increase street parking fees, and extend the one-metre gauge passenger train service to other areas around the city. Further, Uganda plans to accelerate the deployment of tighter diesel fuel quality standards to reduce emissions of black carbon and other short-lived climate pollutants, and implement a pilot BRT service.

Existing Avoid Strategies	Existing Shift Strategies	Existing Improve Strategies
	Public Transport, Green Freight Measures,	Other Measures to Improve Energy Efficiency (Fuel Efficiency), Maintenance and Inspection

Based on NDCs, NCs and BURs

This factsheet was generated by The Partnership on Sustainable, Low Carbon Transport (SLoCaT). Data is based on TraKB Version 0.2.

References

Expert interviews

SSATP (2015) Policies for Sustainable Accessibility and Mobility in Urban Areas of Africa Cities, TRANSITEC Consulting Engineers Ltd (M. Stucki), in collaboration with ODA, CODATU and Urbaplan

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APPENDIX 8: ABSTRACT OF STATE OF KNOWLEDGE PAPER (A)

An exploration of knowledge-seeking within the low carbon transport arena: findings from key informant interviews in selected African and South-Asian countries

This paper reports on a commissioned study of knowledge-seeking among low carbon transport researchers and practitioners in a cohort of African and South Asian countries. A literature review considers policy transfer, sustainability transitions, and best practices as factors in knowledge-seeking. Key-informant interviews further investigate these factors, and ask questions regarding the way in which individuals develop their knowledge or interest in low carbon transport; the drivers of transport improvements and interventions, and how these can be harnessed for accelerated commitment to transport decarbonisation; the knowledges needed to overcome these challenges and accelerate the decarbonisation of the transport sector; specific policies or programmes elsewhere, from which key informants believed they could learn; and the most appropriate opportunities and mechanisms by which to share knowledge about low carbon transport.

This paper contributes to the limited body of work regarding knowledge-seeking in developing countries, and reveals that motivations and transfer mechanisms among key informants do not differ substantially from those surfaced in the developed world literature. Challenges to low carbon transport implementation differ significantly, however, and the best practices and policy ideals sought by key informants are more likely to be found within a similar country cohort.

This small-scale qualitative series of interviews does not attempt to make universal or quantitative claims. Instead, this work serves as an early step in exploring the topic, to generate recommendations, and to frame issues before proposing a substantive research intervention. Overall, there is little research that tracks and evaluates policy transfer pathways, impacts, and successes and failures in the project country cohort. This paper recommends that a systematic evidence-base be developed in this latter regard, following the framework drafted by key scholars cited in this paper.

APPENDIX 9: ABSTRACT OF STATE OF KNOWLEDGE PAPER (B)

Integrating short-term low carbon transport options in long-term climate policy in low-income countries (LICs)

Per capita GHG emissions from transport in low- [and middle-] income countries are at a relatively low level currently. However, a substantial deviation from projected increases is required to bring emissions in line with long-term global climate objectives. There is relatively little literature on how LICs can integrate climate change mitigation and sustainable transport strategies. Key drivers of transport policy include accessibility, congestion, air quality, energy security, with GHG emissions being of lower priority.

This state of knowledge paper therefore aims to assess the feasibility and potential of selected low carbon transport measures with high sustainable development benefits that can be implemented in the short to medium term, so called 'quick wins', and how these can be integrated with climate change strategies, in nine LICs/MICs in Africa and South(east) Asia. The research methodology comprises key informant interviews, an online survey among experts and policymakers in the countries, and literature review.

Results indicate that sustainable urban transport policies and measure are considered of highest priority, with vehicle-related measures such as fuel quality and fuel economy standards, and electric two and three-wheelers being of key relevance as well. In existing national climate change strategies, these are integrated to a certain extent, however with better coordination between transport and energy/environment agencies such strategies can be improved. A knowledge gap exists as to the mitigation potential and sustainable benefits of these quick wins in the local context of LICs.

APPENDIX 10: ABSTRACT OF CAPACITY BUILDING PROGRAMME

Capacity Building Needs Assessment and Strategy to promote low carbon development in high volume transport for selected low-income and lower middle-income priority countries in Africa and South Asia

This study assesses reasons why low carbon high volume transport solutions are not being actively implemented in the selected priority low income countries in Africa and South Asia and looks at what could be done to strengthen their capacity to accelerate the implementation of such solutions.

It is based on primary research with active outreach to key experts in research institutions, government departments, the private sector, and implementing agencies in the group of project countries. In addition, peer-reviewed and grey-literature reviews were conducted.

The principal findings show that the respondents in general are highly focussed in their priorities for transport interventions on the mechanics of improving transport services for their core constituents. The research showed that in general, highest priority was given to the reduction of road congestion (67% of respondents cited this as high priority), the provision of affordable transport and mobility (cited this as high priority by 62%) and the provision of improved access/accessibility (cited by 40%). Of lower priority were air quality (18% of respondents) and climate change mitigation—mentioned by only 11%.

The responses tell a story of how, because low carbon is not a main priority for transport interventions, funding is lacking, regulations and applicable legislation are not in place and there is often no clear policy that promotes low carbon transport.

The study analyses specific barriers to low carbon transport and proposes a capacity building strategy to fill this gap with a very practical focus on accelerating low carbon transport implementation.

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