



Country scoping of research priorities on low carbon transport in Nepal

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Acronyms

AASGI	Accessible, Affordable, Safe, Green and Inclusive
APEC	Alternative Energy Promotion Centre
DFID	Department for International Development
DOLI	Department for Local Infrastructure
DOR	Department for Roads
DoTM	Department of Transport Management
EV	Electric Vehicles
EEG	Energy & Economic Growth Applied Research Programme
GGGI	Global Green Growth Institute
GHG	Greenhouse Gases
GoN	Government of Nepal
HVT	High Volume Transport Applied Research Programme
LIC	Low-Income Country
LRN	Local Road Network
MEWRI	Ministry of Energy, Water Resources and Irrigation
MIC	Middle Income Country
MW	Megawatt
MOE	Ministry of Environment
MOF	Ministry of Finance
MOFAGA	Ministry of Federal Affairs and Government Administration
MOPIT	Ministry of Public Infrastructure and Transport



NDC	Nationally Determined Contribution
NGO	Non-Governmental Organisation
RBN	Road Board of Nepal
SRN	Strategic Road Network
UNFCCC	United Nations Framework Convention on Climate Change



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Abstract	
<p>The UK Department for International Development initiated under its Energy and Economic Growth and High Volume Transport applied research programmes scoping studies to determine research priorities in low-carbon transport in low- and middle-income countries in Asia and Sub-Saharan Africa, including Nepal.</p> <p>The overall objective of these scoping studies was to identify priority research projects that could help advance the transition to a low-carbon transport system in low-and middle-income countries, including Nepal. The studies identified key challenges in transport and energy and research gaps in the target countries and determined a prioritised research agenda that can facilitate the transition to low-carbon transport.</p>	
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EXECUTIVE SUMMARY

A scoping study has been conducted on the research priorities around low-carbon transport for Nepal. This has involved both a literature review and a scoping mission to engage with stakeholders in Nepal.

The scoping mission was conducted to Kathmandu between 9th and 13th December 2019. The mission followed a methodological approach that was common to a series of parallel scoping missions conducted to assess the potential low-carbon transport research priorities across five countries in Asia and Africa at the same time. In-depth interviews were conducted with a small number of key stakeholders and experts and a stakeholder workshop was held at the end of the mission.

The mission identified a series of opportunities and challenges to the development of low carbon transport in Nepal. These are set out below:

Fostering markets for electric transport (Theme 1)

Insufficient infrastructure and underdeveloped markets for electric vehicles deter customers and hinder innovation and entrepreneurship in the private sector. Lack of investment in charging stations serves as a major barrier to increased electric vehicle adoption by reducing the convenience of ownership of electric vehicles. Also, the demand for electric vehicles is underdeveloped: customers are unaware of the advantages of electric vehicles; certain types of vehicles are hard to buy; average vehicle prices remain prohibitively high; spare parts are expensive; and electricity supply is uncertain. Although government has provided tax relief initiatives and increased the ratio of loan-to-value for electric vehicles, a lack of subsidy and other government incentives limit electric vehicle use. In fact, electric vehicle start-ups have insufficient financial support, which weakens entrepreneurship.

Research Questions:

- What are viable approaches to stimulating demand for electric mobility within Nepal?
- How can consumers and transport operators be encouraged and incentivised to invest in electric mobility?

Quantifying the social and economic costs and benefits of a low-carbon transport sector (Theme 2)

As a land-locked country that, in the last few years, suffered a nine-month blockade on petroleum products, Nepal's political environment is keen on import substitution, energy security and reliability of energy supply. There is a policy imperative to move away from imported petroleum products towards a domestic supply of renewable energy. This provides an opportunity for promoting low-carbon approaches in the transport sector. Co-benefits from low carbon transport are available in these areas. Revenue generated from tax on importation of petroleum products give government significant revenue, but conversely, benefits could accrue from reduced foreign exchange if fuel demand was reduced.

However, the current system provides mobility and employment for many parts of the Nepalese society. The current system also has its own institutional and social organisation. Any changes in the transport system must be understood in the context of the social and economic costs and benefits of existing and future systems.

Research Questions:

- What are the social and economic costs and benefits of a move to a low-carbon transport sector?
- What are the implications for government revenues of a reduction in petroleum based tax revenues or reduction in foreign exchange outflows for petroleum product purchase?



- What are the co-benefits around a low-carbon transport sector and how can their awareness be raised?

Emissions data and modelling (Theme 3)

Whilst national emission inventories are being created, data on emission characteristics of transport sector are limited. There is also a lack of robust and effective tools to inform decision-makers and support the use of effective action. This makes evaluating change and planning pathways for effective reductions in greenhouse gases and improvements in local air pollution difficult.

Research Questions:

- What are the characteristics of greenhouse gas emissions in the transport sector?
- What tools can be developed that are calibrated and validated with local primary data to assess the impact on greenhouse gases of low-carbon transport policies?

Delivery of quality, low-carbon, public transport offering (Theme 4)

Public transport in Nepal is delivered by a wide range of private operators. Often these private operators are unionised and politically powerful. As such, they will need to be incorporated into any plans towards formal, low-carbon public mass transport. There exists a significant viability gap for major mass transit system investment, limited freight demand for viable long-distance rail investment, substantial challenges to public private partnership in these areas and a lack of political priority to resolve them.

Research Questions:

- What are the viable approaches to the incorporation of a complex private ownership structure of public transport into the development of a quality, mass transit system?
- What are the viable financing approaches to delivering affordable urban mass transit?

Building the technical capacity to deliver a low-carbon transport sector (Theme 5)

Institutions across the transport sector responsible for the promotion, regulation, planning and management of a move towards a low-carbon transport sector face challenges with retaining technical knowledge and institutional memory when turnover of technical staff can be high. Technically capable professionals are being trained but there are constraints and challenges to their effective utilisation and retention within sector institutions. The lack of technical capacity can also restrict the potential for manufacturing low-carbon transport locally in Nepal.

Research Questions:

What are the viable and strategic approaches to develop capacity in a low-carbon transport sector at the institutional, planning, technical and vocational levels?



1. Introduction

1.1 Background

The United Kingdom's Department for International Development (DFID)'s High Volume Transport (HVT) and Energy and Economic Growth (EEG) applied research programmes share common elements regarding transport and energy. IMC Worldwide (IMC) leads the HVT programme, while Oxford Policy Management (OPM) leads the EEG programme.

The EEG research programme examines links between energy and economic growth, working closely with policy makers in Sub-Saharan Africa and South Asia to build more sustainable, efficient, reliable and equitable energy systems. EEG research areas cover efficient and productive energy use, reliability, renewable energy and grid access.

In contrast, the HVT research programme aims to make transport safer, greener, more affordable, accessible and inclusive in low-income countries (LIC). The HVT research priority areas include climate mitigation and adaptation, inclusion, gender and road safety, policy and regulation, technology and innovation, fragile and conflict-affected states and research uptake and capacity building.

The two programmes have joined forces to undertake a scoping exercise to examine low carbon transport (LCT) and energy research priorities in the low- and middle-income (LIC/MIC) countries of Bangladesh, Nepal, Pakistan, Uganda and Zambia. This joint IMC/OPM scoping exercise will maximise commonalities between the HVT and EEG programmes.

1.2 Objectives

The overall objective of the transport scoping exercise is to contribute to the transition to LCT in LIC/MIC in Asia and Sub-Saharan Africa by meeting research needs and enhancing knowledge and capacity in the areas of transport.

The transport scoping exercise will identify key challenges in transport and energy, research gaps in the target country and determine a prioritised research agenda that can facilitate the transition to LCT.

The following key questions will guide the scoping exercise in each country.

1. What are the key challenges to LCT in each country?
2. What type of research activities are being undertaken to assist address these challenges?
3. Which actors/organisations/research institutes are best placed to undertake this research?
4. Who are the main beneficiaries of such knowledge/research?

1.3 Research needs matrix

Sustainable mobility can be defined as **Accessible, Affordable, Safe, Green and Inclusive (AASGI)**. The HVT Programme developed a matrix based on these key elements of sustainable mobility which lists the main actions or 'enablers' that allow these key elements to be achieved in practice.

The AASGI matrix (see Table 1) is used in this scoping exercise to categorise transport knowledge gaps and prioritise transport research needs in the five countries. It identifies which key elements of sustainable mobility require further research and capacity building.



Table 1: AASGI Matrix

Key Enablers	Accessible	Affordable efficient	Safe	Green	Inclusive
Policy, planning and regulations <i>Evidence based policy formulation and promulgation. Proactive, equitable and informed planning, and regulation of transport services.</i>					
Finance and economics <i>Access to infrastructure finance including private finance through Public-Private Partnerships (PPP) and similar structures. Understanding of economics around specific transport challenges</i>					
Governance and Institutions <i>Institutional changes that lead to improved capacity and efficiency, understanding and improving governance structures, and influencing behavioural change e.g. through the anthropology perspective.</i>					
Technology <i>Access to innovation and technology, and their impact on transport.</i>					
Data <i>Application, sources, and importance of big data in providing evidence for improved transport services.</i>					
Operations, service and management <i>Including day to day activities in public transport provision excluding construction of capital infrastructure.</i>					
Infrastructure <i>Including provision of physical assets, construction and engineering.</i>					

1.4 Country focus

The HVT/EEG collaboration will focus on Bangladesh, Nepal, Pakistan, Uganda and Zambia. In addition, work will be undertaken in China and India that will complement this study.

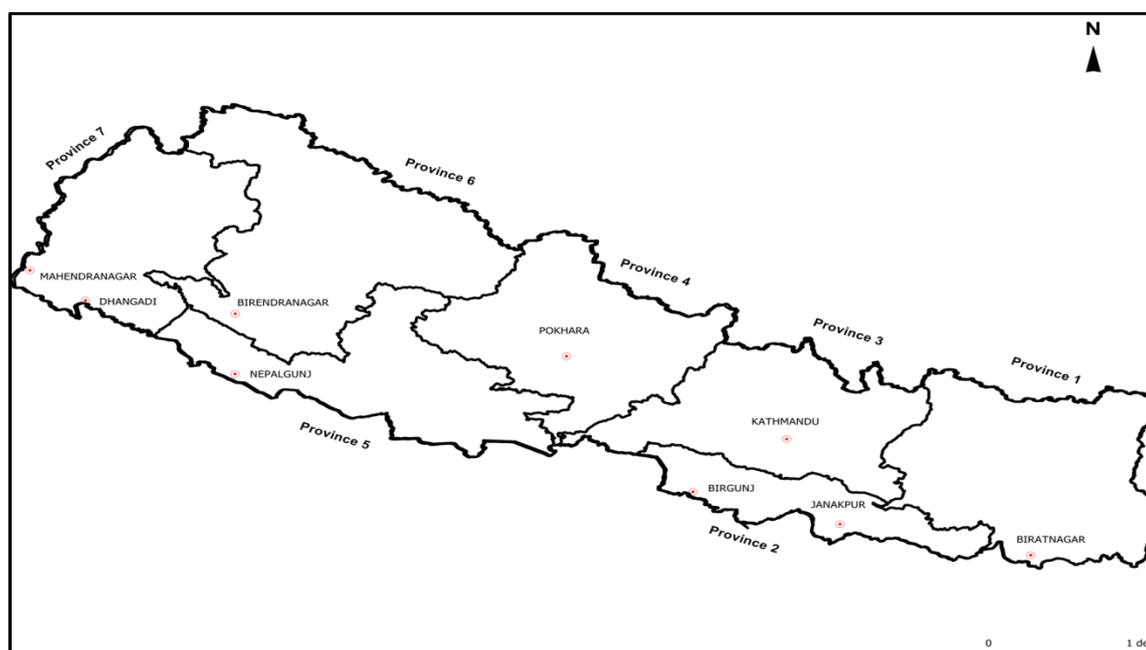
The current report relates to the scoping carried out in Nepal in December 2019.



2. Transport Sector Context

Nepal is a small, stable, landlocked South-Asian country. It is bounded by its large neighbours India and China and the Himalayan mountain range. It has a population of 29 million people and has a significant level of poverty at approximately 25%. However, the World Bank expects the economy to grow by over 6% in 2020 as it has done over the last three years (1). Nepal is one of the few countries in the world that is almost entirely dependent on renewable hydro-electric power for its electricity. It has substantial potential to generate even more hydro-electric power than is currently being exploited. It is entirely dependent on imports from India for its petroleum products. The unofficial blockade of fuel supplies from India for nine months in 2015 has heightened awareness at policy level of the need for renewable energy development to increase energy security.

Figure 1: Map of Nepal with major cities and provinces shown



2.1 Key trends

In 2016, Sadavarte et al (2) reports that the transport sector consumed 45 petajoules (PJ) of energy or 6.6% of national energy consumption – an amount 4.5 times higher than in 2001. This rise in fuel use is due to the total number of motor vehicles, which, Sadavarte et al (2) estimated, grew from 0.27 million (2001) to 2.23 million (2016), though official figures for the total number of vehicles are not available¹. As a result of this increasing energy consumption, Sadavarte et al estimated that in 2016 the transport sector made up 15% of the 8.9 tetragrammes (Tg) of CO₂ emitted by Nepal (2).

There has also been a substantial increase in local air pollution, especially in particulate matter pollution, particularly in Nepal's metropolitan cities. A Global Green Growth Institute (GGGI) study reported in 2018 that PM_{2.5}, which includes dust from construction and carbon particles released from the burning of fossil fuels and operation of vehicles, has risen in Kathmandu to an average annual

¹ However the absence of accurate official figures means that in the work by Sadavarte et al (2) the total national vehicle fleet is estimated, using the annual vehicle registration data from the Dept. of Transport Management and an estimation of how many vehicles are scrapped each year, for each category of vehicle.



30.40 $\mu\text{g}/\text{m}^3$. This is three times higher than the WHO standard. Approximately 9,000 premature deaths occur annually in Nepal as a result of ambient air pollution (3).

In addition to $\text{PM}_{2.5}$, PM_{10} is a growing problem. It highlights that in 2013 air pollution caused more than 22,000 deaths in Nepal. In the same year, welfare loss caused by air pollution was reported at US \$2.8 billion, equal to almost 5% of the country's GDP. This is equal to around 40% of the losses and damages caused by the 2015 earthquake, valued at US \$7 billion. There are also direct annual economic losses due to air pollution. The projected rise of $\text{PM}_{2.5}$ will have a major effect on the economy, i.e. healthcare costs will increase, labour productivity will be affected by reduced working days, and crop yields will decrease.

Increasing vehicle numbers in Nepal, compounded by inadequate planning and management, have led to a number of environmental challenges, including air and noise pollution, and increased traffic congestion. A 2015 report published by the Government of Nepal and the United Nations Centre for Regional Development on Nepal's National Sustainable Transport Strategy (NSTS), emphasised that rapid motorisation undermines energy security and social equity, increases emissions of GHG and other air pollutants, and has a negative environmental impact (4).

A previous scoping study undertaken by the DFID-funded Energy and Economic Growth Programme (5), focusing on Nepal's low-carbon energy sector, highlighted that the country is almost entirely reliant on hydro-electric for its electricity generation. The large majority (95%) of the country's 1073 MW of generating capacity is hydro-electric, most of which is 'run of river' (i.e. no storage). This leaves the system vulnerable to any future long-term changes in rainfall patterns resulting from climate change, and the impact of that on river flows. This is both a low-carbon opportunity and a threat. The same scoping study highlights that installed generation capacity has not kept up with the growing electricity demand (1,450 MW). The economic loss from load shedding could be as high as US \$1.6 billion per year. The World Bank 2019 Nepal Infrastructure Assessment (6) estimates that investments must increase four-fold to meet the growing demand. However, according to several stakeholders interviewed as part of this study, there is a significant amount of hydropower due to come on stream in the short term.

2.2 Key Sector entities

Due to the devolution process, the legal and institutional setup for roads is currently in flux. For roads and the transport sector under the purview of the federal government, the Ministry of Physical Infrastructure and Transport (MOPIT) is the apex body for the preparation of plans, policies, and programmes.

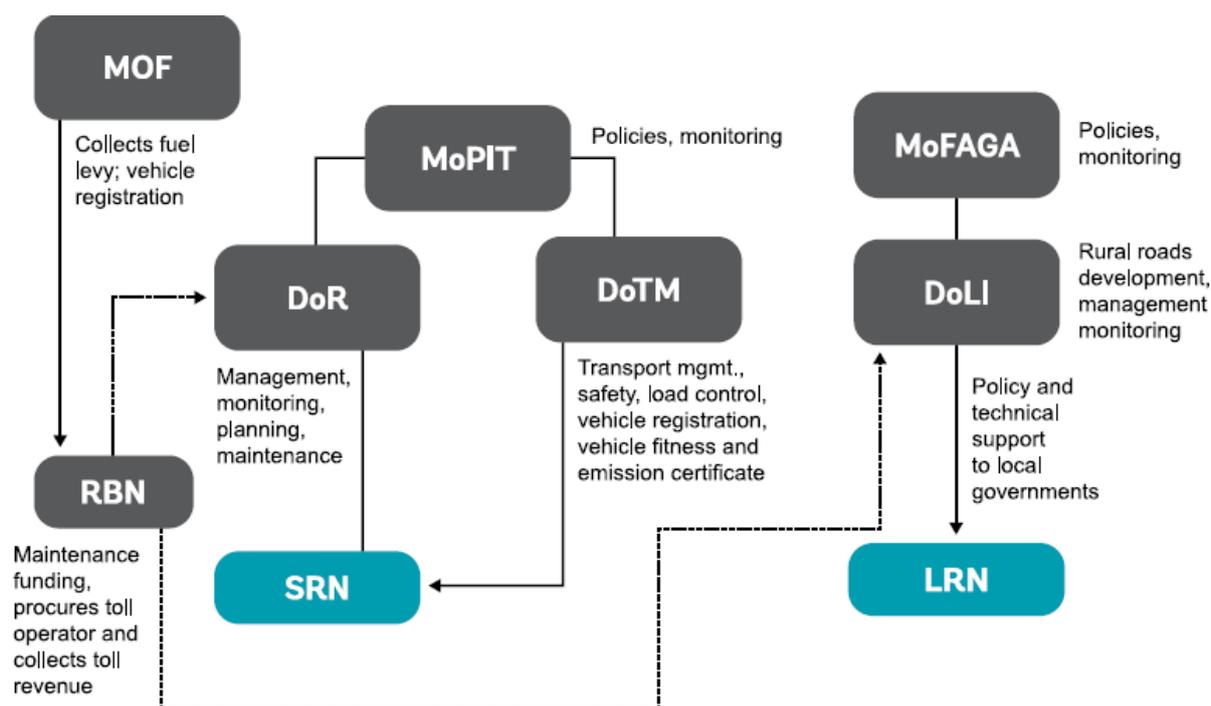
Under its aegis, the Department of Roads (DOR) oversees the development, maintenance, and management of the SRN. The new Constitution and federalisation may make a reclassification of some roads necessary. The Road Board of Nepal, also under MOPIT, manages funding for the operation and maintenance (O&M) of the SRN and local road network. The Department for Transport Management (DOTM), under MOPIT, manages activities around transport management, road safety, registration and vehicle standards compliance and emissions control.

Some national highways and feeder roads that are currently part of the SRN would fall under the jurisdiction of provincial or local-level governments. Provincial and local governments are overseen by the Ministry of Federal Affairs and General Administration (MoFAGA). Within this ministry, work on policy development and technical support for roads and other infrastructure under local and provincial governments is the responsibility of the Department of Local Infrastructure (DOLI)

The relationship of these ministries and agencies is shown in Figure 2.



Figure 2: Institutional Framework for Roads



Source: World Bank, 2019 (6)

The Ministry of Finance (MOF) collects fuel levies and vehicle registration charges and allocates funding to the DOR for construction, improvement, upgrading, and rehabilitation of the SRN. The MOF is also responsible for donor coordination.

In terms of overall environmental policy, environmental standards, pollution monitoring and national climate change policy, the Ministry of Environment (MoE) is the responsible ministry. Energy production and demand management is the responsibility of the Ministry of Energy, Water Resources and Irrigation (MEWRI). Within this ministry, the Alternative Energy Promotion Centre (AEPC), implements policy around encouragement of energy demand using renewable and alternative energy resources for residential, commercial, agricultural and transport sector uses.

2.3 Policy context

The **National Transport Policy** was published in 2001. The Department of Roads is the principle implementation agency. The core policy goal was to develop a reliable, cost-effective, safe and sustainable transport system that promotes and sustains economic, social, cultural and tourism development in Nepal.

The **Environmentally Friendly Transport Policy** was published in 2014. The policy goal is to promote environmentally friendly transport. The policy adopts the 'Avoid, Shift and Improve Approach' (ASI Approach), encouraging that unnecessary travel is avoided, and that trip distance is reduced. It promotes a wider shift towards more sustainable transport modes, especially within the public transport system, and also calls for the improvement of transport practices and technologies to support this. The policy calls for:

- Increasing the share of what the policy terms "environment friendly vehicles" to a minimum of 20% of the total vehicle fleet by 2020.
- Encouraging manufacturing of environment friendly vehicles, which include electric vehicles.
- Encouraging private sector to invest in construction and management of electric vehicle parking stations and service centres.



- Facilitating land for the construction of ten charging stations in Kathmandu, under a pilot initiative. Installing charging stations in retail outlets such as shopping malls, hotels and large parking areas.
- Improving the possibility of local assembly by improving access to required vehicle parts, including batteries.

The National Sustainable Transport Strategy [Draft] (4) was prepared in 2015 but still awaits final approval. This Strategy sought to promoting electric vehicles across all systems. The Strategy contains a series of actions that should be implemented including:

- Undertaking feasibility studies for alternative, electric transport initiatives.
- Encouraging the development of a high-priority, national electric rail system.
- Developing required institutional structures and support for electric mobility.
- Introducing electric bus public transportation in urban areas.
- Providing electric vehicle options in priority tourist destinations.
- Aligning and integrating the development of hydropower with the development of electric mobility (vehicles).
- Introducing electric rickshaws in small and medium-sized cities.

More broadly, Nepal's submission of its Nationally Determined Contribution (NDC) to the United Nations Framework Convention for Climate Change (UNFCCC) (7) has further supported an overall policy shift towards electric mobility. The NDC targets that address the transport sector, as set out in the NDC submission, include:

- NDC Target 9: By 2020, Nepal aims to increase the share of electric vehicle up to 20% from 2010 level.
- NDC Target 10: By 2050, Nepal will decrease its dependency on fossils in the transport sector by 50% through effective mass public transport means while promoting energy efficient and electrical vehicles.
- NDC Target 11: Nepal will develop its electrical (hydro-powered) rail network by 2040 to support mass transportation of goods and public commuting.
- NDC Target 14: By 2025, Nepal will strive to decrease the rate of air pollution through proper monitoring of sources of air pollutants like wastes, old and unmaintained vehicles, and industries.

In addition, as set out by Ghimire (8), the Nepal Rastra Bank and the Ministry of Finance have developed regulations to support electric vehicle consumption through significantly reduced import tax and other duties on electric vehicles, especially for public transport usage.

Furthermore, Ghimire (8) highlights that the Ministry of Energy, Water Resources and Irrigation of Nepal are proposing that at least two charging stations will be constructed in each municipality within four years. In addition, 2019's budget speech of GoN also highlighted the construction of necessary charging stations for EVs and mentioned the necessary budget is allocated.

As identified by the World Bank in 2019 (6), local government capacity to plan and execute projects and use available funds judiciously, at least in the short term, appears to be a major constraint. Intergovernmental transfers to local government resources account for around 90 percent of local government revenue and may even be higher in some years. Although overall urban infrastructure funding needs more resources over the long term, fiscal flows in the short term seem to be greater than local government absorption capacity.

In terms of public transport policy environment and institutions, the Kathmandu Sustainable Urban Transport Project (10) argued that syndicates inhibit competition between operators. Public transport in Nepal's urban areas is almost entirely managed by private operators. Operators' associations have created a syndicate system, abandoning free competition. The syndicate system is further strengthened by weak monitoring by regulatory authorities. This has led to deteriorating quality of service for customers.



3. Transport supply

Nepal's road network consists of highways and feeder roads, constituting the Strategic Road Network including Asian Highways, as well as feeder roads and a few urban roads of national importance; and local, agricultural and minor roads, constituting the Local Road Network. In 2016/17, according to the World Bank (6), the total road network comprised of 29,157 km. Out of this, 12,305 km has been paved, 6,865 is gravelled and 9,987 km is in earthen condition. Road network density was reported as low, at 14 km per 100 square km and 0.9 km per 1,000 people.

Due to a hilly and mountainous terrain, especially in the north, road projects tend to be expensive, and require frequent maintenance. The southern lowland *terai* area is flatter, and as result holds over 60% of the country's road network.

The Department of Roads is responsible for the Strategic Road Network, and the Department of Local Infrastructure and Agriculture Roads is responsible for the local network. Investment by the government in roads is significant and ongoing, though work remains.

In terms of urban transport, the existing public transport system in Kathmandu Valley (the main urban conurbation), according to the Kathmandu Sustainable Urban Transport Study (9), is complex and provides a low level of service to users. It is comprised of seven bus routes, 93 minibus routes, 73 microbus routes, and 20 tempo routes, totalling approximately 200 routes.

The public transport network suffers from an oversupply of vehicles on some routes as well as a duplication of routes with multiple uncoordinated operators. The complex and inefficient routes require a multitude of terminals and loading areas, most of which are inadequate for passengers or in poor condition and contribute to ever-growing traffic congestion. The congestion is exacerbated by low-capacity vehicles operating on high-volume routes, leading to poor air quality and environmental degradation.

Almost all public transport is provided by the private sector with only one notable publicly-controlled Company (SajhaYatayat). Many operators are self-employed, and it was estimated by the Kathmandu Sustainable Urban Transport Project (10) that, in 2016, there were at least 100 public transport unions/associations that are stakeholders in the public transport network. This means that regulation, enforcement and improvement is challenging.

Finally, weak regulation and execution allows old, poorly maintained vehicles to operate and contribute to poor quality of service for users. Stakeholders interviewed highlighted the fact that the Department of Transport Management does not robustly monitor or check the state of these vehicles or whether they are fit for purpose. Typically, public transport is viewed as unsafe or unreliable. This has become the primary incentive for more urban residents to purchase their own private vehicles, particularly two-wheelers (there are almost one million in Kathmandu alone). The increasing number of private vehicles contributes to traffic congestion and poor air quality.



4. Transport demand

As Nepal develops, the demand for vehicles is growing, fuelled by urbanisation and higher incomes. As reported by the GGGI (10) during 1990-2015, the number of total vehicles registered by the Department of Transport Management grew by 14% each year. During the period 1990-2014, the number of registered personal cars grew at 11% and the number of two-wheelers grew at 12%. By 2016, there were a total of 2,339,169 vehicles registered in Nepal. A major share of these vehicles is concentrated in and around Kathmandu. The wider Bagmati Zone, which contains the linked cities of Kathmandu, Lalitpur and Bhaktapur, accounts for 43% of total vehicles registered in Nepal

Overall growth in motorisation masks shifts in modal share. The majority of registered vehicles are two-wheelers. Modal share for two-wheelers has risen from 55% in 1991, to over 80% (2014). Affordability and the capacity of two-wheelers to cut through congested city streets are primary factors driving this dominance. The number of buses rose from 4,000 units in 1990, to more than 35,000 units (2015). This category includes full-size buses, minibuses, microbuses and three-wheeler microbuses, called tempos. However, figures from the GGGI (10) show that as a share of the total vehicle fleet, buses have declined from 11% of the total in 1990, to only 3% in 2015. As the GGGI report highlights (10), with such highly concentrated motorisation, insufficient investment in road and highway networks, and weak public transport systems, traffic congestion is common in Nepal's larger cities. Additional challenges linked to poorly managed road transport include low urban air quality and associated public health costs.

It is useful to note that, according to Sadavarte et al (2), 80% of vehicles are imported into Nepal from India. For this reason, estimated emission inventories, such as the one developed for Nepal by Sadavarte et al (2) assume that all imported Nepalese vehicles comply with official Indian emission standards. This current reliance on the Indian vehicle market may be important for how the electric vehicle market develops in Nepal.



5. Key international development programmes

There are a number of multilateral bi-lateral development programmes. These include:

Global Green Growth Institute - Support to the development of the Electric Mobility Action Plan and the Feasibility and Financing of Electric Public Transport. These produced an Action Plan and a Feasibility Study in 2018.

Asian Development Bank - The ADB focuses its support on the Strategic Road Network and airports. Support has included the Kathmandu Sustainable Transport Project (\$22.5 million, 2010-2019), the still ongoing South Asia Tourism Infrastructure Development Project (\$105 million, 2009-2019) and the recently approved South Asia Sub-regional Economic Cooperation Road Improvement Project (\$186.8 million, 2016-2021).

World Bank - The Bank's strategic engagement focuses on strategic roads, airports and urban transport. Current projects include: Nepal Road sector Development Project (\$65 million, 2016-2021) and Nepal-India Regional Trade and Transport Project (\$99 million, 2013-2021).

UK Department for International Development – The current engagement around the transport centres on rural access and focuses on the latest, third stage of the Rural Access Programme (RAP) (£72 million, 2013-2021).



6. Challenge and opportunities

This National Electric Mobility Action Plan (3) explores obstacles to the achievement of electric mobility and sets out actions and initiatives to overcome them.

Although comprehensive policies and fiscal incentives are in place, a number of barriers currently hinder increased electrical mobility adoption

Gaps in the electric vehicle policy and governance inhibits practical intervention and on the ground development. To accept a switch to electric vehicles, high-level policy needs to be converted into concrete guidelines, plans and regulations. It is essential to enhance the management of public vehicle operators and companies and the management of vehicle distributors. In addition, greater political support and leadership for electric mobility would help to encourage customer and private sector buy-in and investment in such products.

Insufficient infrastructure and underdeveloped markets for electric vehicles deter customers and hinder innovation and entrepreneurship in the private sector. Lack of investment in charging stations serves as a major barrier to increased electric vehicle adoption by reducing the convenience of ownership of electric vehicles. Investment in electric mass transport networks such as electric rail and electric bus systems has also been minimal. Also, the demand for electric vehicles is underdeveloped: customers are unaware of the advantages of electric vehicles; certain types of vehicles are hard to buy; average vehicle prices remain prohibitively high; spare parts are expensive; and electricity supply is uncertain.

Insufficient financing, limited technical and human resources and limited availability of data, restrict electrical mobility investment and business activity and undermine decision-making. Although government has provided tax relief initiatives and increased the ratio of loan-to-value for electric vehicles, a lack of subsidy and other government incentives limit electric vehicle use. In fact, electric vehicle start-ups have insufficient financial support, which weakens entrepreneurship. It is also possible to improve human and technical resources for vehicle service and testing. Data on electric vehicles, the current stock of vehicles, air quality and emission levels are underdeveloped, leading to policy and regulatory decision-making issues. Moreover, the lack of access to data hampers research to determine the country's choices for electric mobility.

Interviews conducted as part of this scoping mission and the subsequent stakeholder workshop also highlighted a range of similar challenges and opportunities that included:

6.1 Challenges

Financing of low-carbon investment on infrastructure, services and capacity. Stakeholders recognise that there is a significant viability gap for major mass transit system investment. This results from high construction costs and a low-income ridership limiting the opportunity to recover financing costs without significant government subsidy, limited freight demand on which to recover costs for long-distance rail investment to be viable, substantial legal and policy challenges to public private partnerships in infrastructure and transport services, and a lack of political priority to resolve all of these financing issues.

Lack of clear institutional structures and capacity for the development of a low-carbon transport sector. Stakeholders highlight the lack of institutional structures and under-utilisation of existing technical expertise to plan for the decarbonisation of the transport sector. Related challenges exist around the more general lack of an integrated national or urban transport master plan or planning function and capacity. Support is provided through the Asian Development Bank and the Global Green Growth Institute but there is limited sustainable capacity transfer.



Complexity of commercially-owned public transport. Public transport is delivered by a wide range of private operators often with political influence who will need to be incorporated into any move towards formal, low-carbon public mass transport.

Impact of Indian vehicle market and regulatory environment. Given that new vehicles in Nepal are overwhelmingly imported from India and that the size of Nepal's vehicle market is dwarfed by the size of the huge Indian market next door, Nepal has to be a market-taker in terms of vehicle standards and specifications. As a result, Nepal may only be able to increase the availability of new alternatively-fuelled vehicles and increase its emission standards if the Indian vehicle market and regulatory environment moves in that direction too. The size of the Indian vehicle market limits the speed at which the Nepalese market can progress in terms of availability of alternatively-fuelled vehicles and increased emission standards.

Maintenance of alternative fuelled vehicle fleet. There is already limited vehicle maintenance capacity. A move to alternative-fuelled vehicles would exceed maintenance capacity to maintain them and would need new investment and capacity building.

Social and Economic costs, benefits and financing of low-carbon transport measures and policy approaches: Politicians and citizens have other priorities around poverty reduction, employment creation and inclusive economic development. Co-benefits from low-carbon transport are available in these areas. Revenue generated from tax on importation of petroleum products give government significant revenue, but conversely, benefits could accrue from reduced foreign exchange if fuel demand was reduced.

Data on emissions and impact of measures to reduce on greenhouse gases. Whilst national emission inventories are being created, data on emissions characteristics of transport sector are very limited. Tools to assess the impact of transport sector policies in reducing greenhouse gases that are validated and calibrated with local data do not exist.

6.2 Opportunities

Political Support for Energy security. As a land-locked country that, in the last few years, suffered a nine-month blockade on petroleum products, the political environment is keen on import substitution, energy security and reliability of energy supply. There is a policy imperative to move away from imported petroleum products towards a domestic supply of renewable energy. This political support for energy security through a move to renewable energy provides an opportunity for promoting low-carbon approaches using renewable energy in the transport sector, in line with the political desire for energy security.

Significant potential for hydro: The majority (95%) of the country's 1,073 MW of generating capacity is hydro-electric and there is potential for substantially greater hydro-electric generating capacity. This means any move towards electric mobility can in the future be supplied entirely by renewable energy.



7. Overview of process

As part of the study, a scoping mission was conducted to Nepal from 9-13 December 2019. Data collection and consultation was conducted following a standardised approach, the details of which are contained in Appendix D. This involved a series of qualitative interviews conducted with a small number of stakeholders between the 9 –12 December. In addition a stakeholder workshop was held on the 13 December 2019 with a wider range of stakeholders across the Nepalese Transport and Energy Sectors. The character of these activities is set out in the next sections.

7.1 Interviews (9th-12th December 2019)

Face to face qualitative interviews were conducted with 10 people during the mission. These were composed of:

- Two academics
- Three consultants
- Two Government officials
- Two NGOs

The details of the interviewees are contained in Appendix B. The findings from the stakeholder interviews are incorporated throughout this report. Many of the challenges and opportunities that have been cited by previous studies and reported in Section 6 were also echoed in the stakeholder interviews. The interviews also provided very useful case material and detail to the impact and importance of the challenges that previous research identifies. The stakeholder interviews also informed the areas of possible research and detailed research questions that were then also highlighted by the stakeholder workshop.

7.2 Workshop (13th December 2019)

Following on from and informed by the stakeholder interviews, a stakeholder workshop was held on the morning of the 13 December 2019. This was attended by 25 people from the following stakeholder categories:

- Six Government officials
- Eight consultants
- Two academics
- Two private sector stakeholders
- Six NGOs

The details of the participants are contained in Appendix A. The workshop followed the structure and methodology set out in the Appendix D and all participants engaged.

Figure 3: Photos from workshop plenary sessions and group discussions



Workshop Plenary Session



Group discussions



Group discussions



Group discussions

The workshop provided a space for engaged, interactive and wide-ranging discussions amongst the participants. Participants were provided with an introduction to the area of low-carbon transport, to the High Volume Transport Research Programme and the objectives of the workshop. Participants were subsequently separated into three break-out groups, with each group composed of representatives from different stakeholder categories. The break-out discussion groups identified a number of challenges and opportunities. These included:

- The limited capacity for transport planning, in terms of the ability to manage and direct any particular policy or technical direction upon the transport sector. The limited effectiveness of regulatory institutions covering the transport sector was also highlighted, as was the limited amount of technical capacity and expertise within transport sector institutions, especially around an effective transition to a low-carbon sector.
- Limited understanding of the current level of emissions and carbon use within the transport sector and the resulting areas to prioritise for action to deliver an effective transition to a low-carbon transport sector.
- The need for the development of an enabling policy environment to support the transition to low-carbon mobility. This requires the development of policy and legislation as well as the economic and financial resources and incentives to encourage transport stakeholders, such as transport operators and households, to change behaviour and make financial investments in low-carbon transport technology
- The need to develop public and consumer awareness of the benefits of a low-carbon transport system, their role in any transition to a low-carbon sector and awareness of the capabilities of existing low-carbon transport technology. This includes highlighting the negative effects of existing transport in terms of local and global emissions, promoting a vision of a high-quality public transport alternative to private mobility, raising the awareness of the availability and capability of existing and developing low-carbon transport technology

The break-out groups also highlighted the wide range of groups and stakeholders who need to be involved in a transition to a low-carbon sector and the many different individuals and organisation who are often working separately to address specific areas of change. These include SMEs seeking to develop manufacturing of electric 3-wheeled cargo vehicles, individuals purchasing electric scooters as early technology adopters and academics and government institutions leading research around understanding and mapping existing emissions and factors of change. The groups also identified the need for more imaginative views of important stakeholders in any transition and these include the entertainment industries and the media, especially in term of raising public awareness and changing consumer behaviour

Finally, the break-out groups also highlighted the need for experimentation and piloting of different approaches to assist in the transition to a low-carbon transport sector in order to assess what works



within the Nepalese context and to build-up technical expertise and public awareness in alternatives future for the transport sector.

As an outcome, the workshop also developed an AASGI Matrix (see Table 2 below). This reflected individual break-out group discussions about the top three research areas and main research questions that could be categorised within the framework of **A**ccessible **A**ffordable, **S**afe **G**reen and **I**nclusive. The response of all groups together is reflected in the table below. The degree of cluster is attributable to the degree to which discussion groups collectively characterised the research questions that need addressing.

Table 2: AASGI Matrix developed by the stakeholder workshop

	Accessible	Affordable	Safe	Green	Inclusive
Policy, Planning and Regulation			1	3	2
Finance and Economics		2	1		1
Governance and Institutions	2			1	3
Technology		3	1	2	
Data	2		1	3	2
Operations, Service and Management	2	1	2		
Infrastructure	3	2	1		

To conclude the workshop participants were asked to complete the evaluation form. 19 participants responded. The majority of responses found the workshop to be useful or very useful (88% of respondents), relevant (89% of respondents) and using appropriate methods of engagement (84% of respondents). The workshop met or exceeded the expected level of learning of 88% of respondents. 88% of respondents were also keen or very keen to respond to any forthcoming calls for proposals. Participants were also able to provide a range of useful suggestions for improvements to the workshop method, which are included in the appendices.



8. Final research themes

As a result of the scoping mission, the interviews with stakeholders and the engagement through the stakeholder workshop, the suggested final research themes are as follows:

Fostering markets for electric transport (Theme 1)

Insufficient infrastructure and underdeveloped markets for electric vehicles deter customers and hinder innovation and entrepreneurship in the private sector. Lack of investment in charging stations serves as a major barrier to increased electric vehicle adoption by reducing the convenience of ownership of electric vehicles. Also, the demand for electric vehicles is underdeveloped: customers are unaware of the advantages of electric vehicles; certain types of vehicles are hard to buy; average vehicle prices remain prohibitively high; spare parts are expensive; and electricity supply is uncertain. Although government has provided tax relief initiatives and increased the ratio of loan-to-value for electric vehicles, a lack of subsidy and other government incentives limit electric vehicle use. In fact, electric vehicle start-ups have insufficient financial support, which weakens entrepreneurship.

Research Questions:

- What are viable approaches to stimulating demand for electric mobility within Nepal?
- How can consumers and transport operators be encouraged and incentivised to invest in electric mobility?

Quantifying the social and economic costs and benefits of a low-carbon transport sector (Theme 2)

As a land-locked country that, in the last few years, suffered a nine-month blockade on petroleum products, Nepal's political environment is keen on import substitution, energy security and reliability of energy supply. There is a policy imperative to move away from imported petroleum products towards a domestic supply of renewable energy. This provides an opportunity for promoting low-carbon approaches in the transport sector. Co-benefits from low carbon transport are available in these areas. Revenue generated from tax on importation of petroleum products give government significant revenue, but conversely, benefits could accrue from reduced foreign exchange if fuel demand was reduced.

However, the current system provides mobility and employment for many parts of the Nepalese society. The current system also has its own institutional and social organisation. Any changes in the transport system must be understood in the context of the social and economic costs and benefits of existing and future systems.

Research Questions:

- What are the social and economic costs and benefits of a move to a low-carbon transport sector?
- What are the implications for government revenues of a reduction in petroleum based tax revenues or reduction in foreign exchange outflows for petroleum product purchase?
- What are the co-benefits around a low-carbon transport sector and how can their awareness be raised?

Emissions data and modelling (Theme 3)

Whilst national emission inventories are being created, data on emission characteristics of transport sector are limited. There is also a lack of robust and effective tools to inform decision-makers and support the use of effective action. This makes evaluating change and planning pathways for effective reductions in greenhouse gases and improvements in local air pollution difficult.



Research Questions:

- What are the characteristics of greenhouse gas emissions in the transport sector?
- What tools can be developed that are calibrated and validated with local primary data to assess the impact on greenhouse gases of low-carbon transport policies?

Delivery of quality, low-carbon, public transport offering (Theme 4)

Public transport in Nepal is delivered by a wide range of private operators. Often these private operators are unionised and politically powerful. As such, they will need to be incorporated into any plans towards formal, low-carbon public mass transport. There exists a significant viability gap for major mass transit system investment, limited freight demand for viable long-distance rail investment, substantial challenges to public private partnership in these areas and a lack of political priority to resolve them.

Research Questions:

- What are the viable approaches to the incorporation of a complex private ownership structure of public transport into the development of a quality, mass transit system?
- What are the viable financing approaches to delivering affordable urban mass transit?

Building the technical capacity to deliver a low-carbon transport sector (Theme 5)

Institutions across the transport sector responsible for the promotion, regulation, planning and management of a move towards a low-carbon transport sector face challenges with retaining technical knowledge and institutional memory when turnover of technical staff can be high. Technically capable professionals are being trained but there are constraints and challenges to their effective utilisation and retention within sector institutions. The lack of technical capacity can also restrict the potential for manufacturing low-carbon transport locally in Nepal.

Research Questions:

- What are the viable and strategic approaches to develop capacity in a low-carbon transport sector at the institutional, planning, technical and vocational levels?



9. Summary

A scoping study has been conducted on the research priorities around low-carbon transport for Nepal. The scoping study sought to identify key challenges in transport and energy, and research gaps, in Nepal and determine a prioritised research agenda that can facilitate the transition to a low-carbon transport system. In particular, it sought to explore the key challenges to low-carbon transport in Nepal and the type of knowledge and research activities that could be undertaken to assist in overcoming these challenges.

The study involved both a literature review and a scoping mission to engage with stakeholders in Nepal. The mission identified a series of opportunities, challenges and research priorities to the development of low-carbon transport in Nepal. These included the opportunity presented by the high proportion of electricity that is already generated by renewable sources within Nepal.

In addition, the mission also identified the need for data to inform decision-making and evaluation; the need for research to understand viable approaches to develop demand for low-carbon mobility; the need for research to understand how to effectively improve public transport; the need for research to understand the social and economic costs and benefits of a move to low-carbon mobility; and the need to develop capacity within the research and policy communities.



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Appendix A: List of workshop attendees



	Participants attending workshop	Organization/Dept	Designation	Contact Details
1	Kapil Koirala	Nepal Architect Consultants (NAC)	Civil Engineer	9841711136
2	Mr. Bal Krishna Prasai	Ministry of Environment	Former Secretary	9851088417 prasaibk@gmail.com
3	Nabina Mahar	Environment & Resource Management Consultant (ERMC) Bagmati River Basin Improvement Project	Civil Engineer	9841138530 aniban06@gmail.com
4	Hemant Tiwari	The Accelerating Public and Private Investment in Infrastructure Component (APPIIC)	Traffic and Transportation Engineer	977-9841512244 hemu.ioe@gmail.com
5	Kamal Banskota	https://www.linkedin.com/in/kamal-banskota-4aa12852/?originalSubdomain=np	Low carbon economic development/Independent Consulting Economist	9851084325 kamalbanskota@gmail.com
6	Indra Kant Jha	Mahindra Electric vehicle manufacturing company	Engineer	9801909237, 51890364 indrakant.jha@agnigroup.com.np
7	Chiranjivi Sharma	Rural Access Programme3 Mugu Humla Link Road (RAP3 MHLR)	Environmental Specialist	9841410388 Chiranjivi.Sharma@rapnepal.com
8	Ayasta Pokharel	Rural Access Programme Mugu Humla Link Road (RAP3 MHLR)	Senior Engineer	9818725732 Ayasta.Pokharel@rapnepal.com
9	Kumud Shrestha	Nepal Foresters' Association	Chairperson	9851189760 kumudshrestha2000@gmail.com
10	Padmakshi Rana	Sustainability champion	Nepal Communitere	9851229997 padmakshi@communitere.org
11	Keshav Panthi	Independent Consultant	Mechanical Engineer	kpanthi99@gmail.com
12	Nawraj Bhattarai	Pulchowk Campus	Head, Department of Mechanical Engineering	9841344978 bnawraj@ioe.edu.np
13	Maheswor Ghimire	Department of Local Infrastructure (DOLI)	Senior Divisional Engineer	9841256306



	Participants attending workshop	Organization/Dept	Designation	Contact Details
14	Keshav Mangal Joshi	Independent Consultant	Senior Mechanical Engineer for transport	9841280483 kmjoshii@gmail.com
15	Gunjan Ghimire	Orbitech International Pvt Ltd.	Alternative Energy	echo.ghimire@gmail.com
16	Deepak Acharya	Association of Community Radio Broadcasters Nepal (ACORAB)	CIN Chief	9841855813
17	Isvar Man Amatya	Institute of Engineering, IOE, Tribhuvan University	Associate Professor/Environmentalist	9851051722 iswar@ioe.edu.np
18	Amrit Dhakal	Lotus Energy	Technical Manager	9851135107 amritd@lotusenergy.com.np
19	Ashrika Sharma	Independent Consultant		9841982993 sharashu7@gmail.com
20	Pratik Poudel	Rural Access Programme Mugu Humla Link Road (RAP3 MHLR)	Road Engineer	pratik.paudel@outlook.com
21	Jibgar Joshi	School of Environmental Science and Management, Pokhara University	Faculty Member/Urban plan engineer	9841229557jibgarj@gmail.com
22	Dori Nguyen	UTOPIA Kathmandu	Managing Parnter	9818167181 dori.nguyen@utopia.do
23	Jason Finch	TRANSAID		9818085551
24	Prashanta	Independent Consultant	Urban Transport (freelance)	9841401236
25	Indra Lal Pradhan	Independent Consultant	Civil Engineer	9841598021



Appendix B: Stakeholders Interviewed



S.N	Name of participants attending Interview	Organization/Dept	Designation	Contact Details
1	Brinda Dewan	Doko Recyclers	Representative of Doko Recyclers	986-4691636, 980-2071578 brinda@dokorecyclers.com
2	Ishwar Man Shrestha	Nepal Strategic Road connectivity and Trade Improvement Project	Transport Economist	9841244190/ 4278362 ishwar888@hotmail.com
3	Kamal Banskota	https://www.linkedin.com/in/kamal-banskota-4aa12852/?originalSubdomain=np	Low carbon economic development/Independent Consulting Economist	9851084325 kamalbanskota@gmail.com
4	Kumud Shrestha	Nepal Foresters' Association	Chairperson	9851189760 kumudshrestha2000@gmail.com
5	Padmakshi Rana/Keshav Panthi	Sustainability champion	Nepal Communitere	9851229997 padmakshi@communitere.org/ kpanthi99@gmail.com
6	Mani Nepal	ICIMOD	Principal Investigator: Climate Change and Cities	Mani.Nepal@icimod.org
7	Nawraj Bhattarai	Pulchowk Campus	Head, Department of Mechanical Engineering	9841344978 bnawraj@ioe.edu.np
8	Keshav Mangal Joshi		Mechanical Engineer for transport	9841280483 kmjoshii@gmail.com



Appendix C: Detailed workshop agenda



**HIGH VOLUME TRANSPORT RESEARCH PROGRAMME WORKSHOP
ON
LOW CARBON TRANSPORT IN NEPAL**

13th December, 2019

09:30-13:30

AGENDA

09:30 - 09:45	Registration and welcome refreshments
09:45 - 09:50	Welcome and Introductions
09:50 – 10:00	Opening Remarks
10:00 – 10:15	Introduction to the HVT Scoping Study, its objective and structure
10:15 – 11:30	Group exercise 1: To identify challenges to low carbon transport and possible research questions and projects
11:30 - 11:45	TEA BREAK
11:45 - 12:00	Presentation of HVT Part 1 evidence review and key research questions
12:00 – 12:45	Group Exercise 2: To categorise and prioritise research questions and projects
12:45 – 13:00	Feedback and Closing Remarks
13:00 – 13:30	LUNCH



Appendix D: Workshop documents



Interviews and Workshop Methodology

The Scoping Mission followed a standardised approach that composed of:

- A small number of in-depth qualitative stakeholder interviews with participants drawn from a range of stakeholder categories; and
- A consultative stakeholder workshop that brought together a larger number of stakeholders for interactive discussions.

The details of the methodology followed are set out below.

Stakeholder Interviews (9th-12th December, 2019)

The objective of the stakeholder interviews was to identify **key barriers** to low carbon transport in the target country, determine a **provisional list of research needs/projects** that would enable the country to make the transition to low carbon transport.

Interviews were undertaken with 2-3 senior individuals from each of five stakeholder groups: (i) government; (ii) international organisation, (iii) industry and industry association; (iv) NGOs; and (v) research institutes.

The output of the interviews provided a **list of research themes** with examples of **research questions** that could be discussed at a stakeholder workshop.

The interviews took approximately **60-75 minutes** and where possible a **recording** of the interview was made.

The interviews were also an opportunity to **obtain local knowledge and find out/obtain key publications** relevant to the target country (e.g. policies, national level studies, etc). Throughout the interview, the consultant should aim to substantiate comments/opinions with relevant references.

Interview Questions

The following questions were asked during the interviews:

- What are the key challenges that are making the implementation of low carbon transport difficult to achieve, and what research is needed to overcome these challenges?
- What priority is given to reducing greenhouse gas (GHG) emissions in national/ local decisions that affect transport?
- How desirable is it to promote low carbon transport over the coming years? Why is it important (or not) to promote this?
- What knowledge is needed to overcome these challenges (e.g. developing capacity, and sharing knowledge/good practice/tools)?

Stakeholder Workshop (13th December, 2019)

The objective of the stakeholder workshop was to provide a **provisional list of research projects** that meet a specific need, including any additions from the stakeholder interviews.

The workshop was divided into the following sessions:

- Introduction to the HVT/EEG study its objectives and structure.
- An exercise to identify challenges to low carbon transport and possible research projects that could be undertaken to assist addressing these challenges (**Challenge- Research Project – Research Actor – Beneficiaries**)
- Presentation of the HVT phase 1 seven key research questions and comparison with the stakeholder list to gain a common cluster/revision.



- A second exercise to categorise the selected questions and according to the **AASGI matrix** and to prioritise in terms of importance, followed by which actors should be could undertake such projects.

Exercise 1 – determining research projects that will assist in the transition to low carbon transport in the target country

This exercise aimed to get the stakeholders to think about the challenge to low carbon transport in their country, to identify specific research projects that may assist in addressing that challenge and possible beneficiaries.

Participants were randomly divided in to four groups consisting of 5-7 individuals per group.

Each group were asked to consider the following questions and to propose at least three research projects.

- What are the key challenges to low carbon transport in your country?
- What type of research could be undertaken to assist in overcome these challenges?
- Which actors/organisations/research institutes are best placed to undertake this research?
- Who will be the main beneficiaries of such research?

Each group presented their questions to the other participants in a plenary. At the end of the session, there was a provisional list of research projects with the following information (challenge – research project – actors- beneficiaries).

Exercise 2 –prioritisation and categorisation of research projects/questions

This exercise Focused on prioritising the provisional list of research projects:

- Which project are the most important?
- Which project could have the greatest impact?

The group were asked to collectively prioritise the provisional list of questions. This was through an interactive discussion and by an activity (each group ordering list of questions by using stickers on a common chart).

The group were presented with the AASGI matrix. Each group were given three/four questions to consider and to categorise according to the matrix. Each group using stickers will then place their stickers on a common matrix each numbered question. The aim of this exercise was to get an idea of the themes considered in the questions and to generate a 'heat map' of research needs.

The **final workshop output** was:

- List of low carbon transport barriers
- List of elaborated/validated and prioritised research questions/projects
- List of national research organisations/actors who may undertake such research
- A completed AASGI matrix with the research questions categorised.

The participants were then be requested to complete a **self-evaluation form** to provide feedback.



Report back from the Workshop Break-out groups

Group 1:

Challenges:

Policy instruments: What are the incentives? What are the benefits? What are the taxes? What are the policy changes to modify vehicles? When it comes to vehicle modification, we can modify a bike to an electric bike and a study on such topics can help to progress towards low carbon vehicles. There is a gap between policy and current standards as there so many stringent policies but hardly of these policies are implemented. For example, the traffic police cannot handle increasing traffic in Kathmandu valley. The lack of resources is one thing. There are so many resources such as traffic signals, but they are not being used. The solar panels are not being cleaned. This gap needs to be changed.

Unmanaged transport planning: Traffic signals that are not in use, chaos caused by the interaction of pedestrians, shops and parking within urban road space all contribute to vehicles emissions.

Technical knowhow: There is a lack of technical capacity. Technically capable professionals are being trained but there are constraints and challenges to their effective utilisation and retention within sector institutions. There are also challenges for institutions to retain technical knowledge and institutional memory when turnover of technical staff can be high. The lack of technical capacity can also restrict the potential for manufacturing low-carbon transport locally in Nepal.

Implementation: Standards and rules are not implemented.

Group 2

Challenges:

Problems in existing system: Need to understand the factors that contribute to carbon emissions and how we can change the existing systems or behaviour of people to solve the problems.

Technology: Need to think about what needs to be maintained in existing vehicles and practices to reduce carbon emission. There is talk of switching to electrical vehicles but the reality there is no capital investment. There is a need to think about existing technologies, and if there is a way these can be improved those technologies to meet a limited budget.

Environment: How can an enabling environment be created to foster a switch to low carbon transport? What infrastructure would be needed on existing roads to move to electric vehicles, charging stations and associated infrastructure.

Legislation and governance: How can an enabling environment be created that drive the nation to a more sustainable environment? Legislation that is currently only on paper needs to be transformed into action.

Behaviour of user groups: Understanding users' behaviour is a challenge because there are no data why people move around and other related data.

Creating trust in electric vehicles and public transport: It is not that there is no public transport or there are no electric vehicles. Public transport and electric vehicles already exist but if users do not trust the resources that exist then they will not make the switch.

Public awareness: There was an incident that an electric vehicle could not climb up a hill road and got stuck in the middle of the road. Maintenance of electric vehicles is different to that of diesel vehicles.



Do the public know that their own behaviour is causing problems in the electric vehicle? This is also a challenge to look into whether or public is aware of this.

Alternatives to make the switch: There are electric vehicles but there are no charging stations. The only stations might be at home or office and this may discourage people from using electric vehicles. What are the alternatives available in terms of infrastructure and how we can people move to those alternatives?

Technology and resources available in the country: The inability to manufacture car and vehicles in Nepal is a problem.

Improving road condition: The condition of roads also influence vehicle emissions.

Driving market towards low carbon: There is a need to move for the market to move in certain directions and people will then invest and begin to switch. The challenge is to drive the market towards local carbon transport.

Incentives from government to reduce carbon emission: If the private company wants to invest what incentives will they get? Without incentives, businesses would not want to make a switch to low carbon transport unless there is an economic benefit.

Group 3

Challenges

- Second hand vehicles
- Infrastructures- good quality road
- Funding
- Policy clarity
- Behaviour change awareness
- Education
- Culture of maintenance
- Corruption/lack of decision making
- Alternative- lacking jobs for informal transport
- Syndicate/political nexus
- Function of institutions
- Feasibility study of low carbon transport

In addition, the different discussion groups in the workshop identified a series of possible research questions and actors involved in such work. These are set out by the different groups:

Group 1

Types of Research:

Diversification of different model study: This means how do we study transport? Do we study the manufacturing aspect of it? Where should we establish a manufacturing industry? Should it be in the Himalayan belt? Should it be in the Terai belt? The other type of study is how are the patterns and behaviour inside the valley, outside the valley, inside cities and outside cities? How is the increase of airports going to affect the carbon content in Nepal? Did anybody think about that? We have now airports being built and we are creating more carbon content out there. Did anybody think about the amount of carbon being produced by airplanes? Should we have electric airplanes that are being built out there? Should we bring those electrical technologies here? These are the issues we need to think about, and it should be a multi-dimensional study we need to focus on.

Financing and economic model: If we adopt the economic concept from India or China or any other countries will that help us? Is that the thing we need to study, or should we come up with our own



economic model? Should we involve our local engineers, local financiers, local ex bureaucrats, local politicians? How should we come up with the financial model that is viable for us?

Low carbon pilot city: We need to test the model first instead of implementing the model all over the country?

Awareness of public transportation: It is important to have a psychological-based assessment and evaluation and the process to change the mindset of people which is also an important research study we need to consider.

Actors and Beneficiaries:

Academic institutions: There is need for greater investment in universities producing relevant research for engineers, policy makers and the finance sector to aid effective decision-making and implementation

Government institutions: Government institutions have significant challenges to effective decision-making and implementation.

Entertainment industry: There could potentially be a role for effective marketing of low-carbo options through the use of popular entertainment media. The broadcasting of an advert, for example, of a popular celebrity riding an electric bicycle could help transfer information and awareness much faster to the general public.

Commercial banks and venture capital: Commercial banks could provide affordable loans or similar credit schemes for electric vehicles. Private sector venture capital needs to think how they can improve the environment and could bring innovative ideas to low-carbon mobility that currently doesn't exist. For example, currently in a charging station, people may wait for around 30 minutes for their vehicle to charge. Having a coffee shop at the charging station may mean people will spend money for coffee while charging their vehicles. Such integrated thinking from venture capital and entrepreneurs may be needed.

Beneficiaries

Public, senior citizens, students

Investment actors

Entrepreneurs: If the country can develop small businesses in the area of low carbon transport that will really be helpful to move forward in this sector.

Group 2

Types of Research:

Data driven research: Because we do not have a lot of data in different things like user behaviour that influences the decision making processes. We do not have data on why things are planned the way they are planned and how they can be transformed. We need data on what kind of maintenance and technologies are existing and what do we need to change in our current scenario for the betterment? Therefore, data is very important.

Actors:

Collaboration between different actors and bringing expertise together to lead the research.

User design experts

Beneficiaries

Government agencies, urban residents, private companies and enterprises, research institutes



Group 3

Types of research

- Who are the actors influencing policy change in Nepal? What are the different financial mechanisms? Who are decision making authority?
- Do the current policies support the low carbon transformation that we all are talking about?
- What are the challenges for low carbon transport and how can it be addressed?
- How do we develop skills capabilities, knowledge, roles and responsibilities of institutions?

Actors

- Government
- Syndicate
- Businesses

Beneficiaries

- Researchers, automobile industries, citizens



HVT Low Carbon Transport Scoping Study Workshop Evaluation Form

Male:	
Female:	
Workshop location	NEPAL
Date:	13 th December, 2019
Name of workshop:	LOW CARBON WORKSHOP IN NEPAL

This form is intended for internal use within the HVT programme. The data provided in this form will be treated with strict confidentiality and will be analysed purely towards improving the programme's provision of validation workshops activities.

1. Reaction

How would you rate the overall content of the workshop in the following areas?

1.1. Usefulness:	Poor	1	2	3 (2 participants)	4 (9 participants)	5 (4 participants)	Excellent (4 participants)
1.2. Relevance:	Poor	1	2	3 (2 participants)	4 (5 participants)	5 (9 participants)	Excellent (3 participants)
1.3. Methods:	Poor	1	2	3 (3 participants)	4 (9 participants)	5 (6 participants)	Excellent (1 participants)

2. Learning

Thinking about the overall topic of the workshop how much have you learned about understanding the research gaps in low carbon transport in your country?

Much less than expected	Less than expected (2 participants)	As expected (9 participants)	More than expected (8 participants)	Much more than expected
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<p>Do the outputs from the workshop address low carbon transport needs and priorities in your country? If yes briefly explain</p> <ol style="list-style-type: none"> Yes. The workshop has provided insights on various aspects and low carbon transport needs and priorities in Nepal. Air pollution is increasing, vehicle congestion is increasing, health hazards increasing. Yes. The workshop covered quite a lot of needs in the country. Yes. The discussion and prioritization of challenges were centred based on the Nepalese scenario and represent the needs of country as well.



- 5 Yes. The output from group activities were relative to the current scenario.
- 6 This field broad areas, perhaps a follow up focus session would establish priorities.
- 7 Yes it does but more discussion is needed in this area.
- 8 Yes. The country is badly in need of this.
- 9 Mostly, but not as much emphasis on lowering need/demand of frequency and length of trips.
- 10 This has opened up eyes on potential of low carbon transport.
- 11 This is time for policy draft and finalise so it is useful on these.
- 12 Yes, not enough. More discussion from wider perspectives required.
- 13 Yes, as day be the environmental pollution is increasing. We can minimise the pollution by minimising the low carbon emission.
- 14 The issue of transport management and low carbon in challenging and emerging in Nepal. So it is very relevant.
- 15 Yes it was good to know in multidimensional view.
- 16 It prioritises some of the research topics but details are lacking.
- 17 Yes, but it has to have a follow up with real world projects.
- 18 Yes. It address the need of low carbon transport and priorities. As the country is developing, it has much more scope.
- 19 Yes, many ideas came up in group activity that showed how those were contributing on carbon emission and possible solution to deal with them.

3. Behaviour

	Never	1	2	3 (5 participants)	4 (9 participants)	5 (2 participants)	Guaranteed (1 participants)
How likely are you to submit a research proposal for any of the suggested topics							

- If yes, please provide any information on particular area of interest (optional)
- 1 Policy Reforms
 - 2 Yes, about the human behaviour of mobility and urban planning integrated to reduce the carbon emission.
 - 3 Energy efficiency in transport sector.
 - 4 Challenges on LCT in Nepal.
 - 5 Technological intervention portion
 - 6 Inclusive transport, innovation in LCT.
 - 7 I am still thinking. But big vehicles without stop/express in long volume.
 - 8 E-bus based transit system, walkable and accessible city for low-carbon mobility.
 - 9 Urban transportation



10 Research on supplying electric vehicles for e-commerce activities.

- 11 Electric vehicles, technology, start-up, LCs.
- 12 Urban, transport planning

How likely are you to continue your relationship with the HVT programme in your research proposal/work (optional)

Never	1	2 (1 participant s)	3 (1 participant s)	4 (7 participant s)	5 (9 participant s)	Guaranteed (2 person)
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4. Reflection

What can we improve to make this process better in the future research scoping? (optional)

- 1 Allowing more time.
- 2 Discussion groups to be pre-formed considering background of participants. A group that has bigger variety of people gets to engaged more broadly and think outside the box.
- 3 Some more details and workshop exposures and group activities.
- 4 Time aspects: For such as important topic the half day program might not be enough.
- 5 The overall session was informative.
- 6 Grading of importance in selecting priority areas will be even better.
- 7 More urban planners/practitioners, women professionals, socioeconomic specialists.
- 8 We should come with activity for proposal.
- 9 Discussion in specific topics- some baselines before discussion.
- 10 We must focus on electric vehicles and less use of private vehicles. As this type of policy regulation must be supported by the Government.
- 11 Include more stakeholders and make it a bit wider.
- 12 Workshop should be more detailed and long.
- 13 Invite younger people.

Thank you for taking the time to provide this valuable feedback!



Appendix E: Research proposals



Development pathways and scenario planning for low-carbon transport: *Problem:* There are significant institutional, financial and behavioural challenges to promoting the take up of low-carbon forms of transport by government, transport operators and households within Nepal.

Research Questions: What are viable approaches to stimulating demand for electric mobility within Nepal? How can consumer and transport operators be encouraged and incentivised to invest in low carbon mobility?

Social and economic costs and benefits of a low-carbon transport sector:

Problem: There are lots of benefits and winners attributed to a transition to a low-carbon transport system. However, the current system provides mobility and employment for many parts of the Nepalese society. The current system also has its own institutional and social organisation. Any changes in the transport system must be understood in the context of the social and economic costs and benefits of existing and future systems.

Research Questions: What are the social and economic costs and benefits of a move to a low-carbon transport sector? What are the implications for government revenues of a reduction in petroleum based tax revenues or reduction in foreign exchange outflows for petroleum product purchase? What are the co-benefits around a low-carbon transport sector and how can their awareness be raised?

Emissions data and modelling:

Problem: There is a significant challenge in understanding the nature, scale and contributory factors around local and global emissions. There is also a lack of robust and effective tools to inform decision-makers towards effective action. This makes evaluating change and planning pathways for effective reductions in greenhouse gases and improvements in local air pollution.

Research Questions: What are the characteristics of greenhouse gas emissions in the transport sector? What tools can be developed that are calibrated and validated with local primary data to assess the impact on greenhouse gases of low-carbon transport policies?

Delivery of quality, low-carbon, public transport offering:

Problem: Public transport is currently delivered mostly by a privately-owned structure of numerous operators. These operators are organised in a variety of structures in a highly complex arrangement. The industry is also characterised by very limited financial investment and institutions managing, regulating and planning the sector with weak capacity

Research Questions: What are the viable approaches to the incorporation of a complex private ownership structure of public transport into the development of a quality, mass transit system? What are the viable financing approaches to delivering affordable urban mass transit?

Technical capacity to deliver a low-carbon transport sector:

Problem: Institutions across the transport sector responsible for the promotion, regulation, planning and management of a move towards a low-carbon transport sector face a challenge in terms of capacity for what is a relatively new area of policy.

Research Questions: What are the viable and strategic approaches to develop capacity in a low-carbon transport sector at the institutional, planning, technical and vocational levels?

Development of low carbon transport living lab:

Problem: There is a significant amount of technical guidance and knowledge available globally around the development of a low-carbon transport sector. There is also a political willingness and institutional engagement to deliver change towards a low-carbon sector. There are also many different stakeholders working separately to pursue specific areas of action for progressing towards a low-carbon transport sector. However, there is very limited translation of how and what knowledge and experience will work in translation to a Nepalese context.



Research Questions: What are the individual and integrated impacts of co-creating a range of innovative solutions to low carbon transport through a partnership of innovators, transport operators, financiers, government institutions, creative agencies and marketing professionals and transport users?



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