Assessment of Skills and Knowledge Gap in Energy Efficiency within the Transport Sector in Sri Lanka

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Acronyms

AETI	Automobile Engineering Training Institute
AirMAC	Air Resource Management Centre
BEV	Battery Electric Vehicle
BMZ	Federal Ministry for Economic Cooperation and Development, Germany
C2E2	Copenhagen Centre on Energy Efficiency
CBOs	Civil Society Organizations
CBSL	Central Bank of Sri Lanka
CCs	Core Competencies
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CGTTI	Ceylon-German Technical Training Institute
CINEC	Colombo International Nautical and Engineering College
CleanCo	CleanCo Lanka Limited
COP	Conference of the Parties
CPC	Ceylon Petroleum Corporation
CPD	Continuing Professional Development
CPE	Continuing Professional Education
DATS	Diesel & Motor Engineering Academy for Technical Skills
DESD	Decade of Education for Sustainable Development
DMT	Department of Motor Traffic
DPMC	David Pieris Motor Company (Pvt) Ltd
EcoSri	Laugfs Eco Sri Limited
EE	Energy Efficiency
EGR	Exhaust Gas Recirculation
EST	Environmentally Sustainable Transport
FCV	Fuel Cell Vehicles
FE	Fuel Economy
ESD	Education for Sustainable Development
FQS	Fuel Quality Standards
GDP	Gross Domestic Product
GFEI	Global Fuel Economy Initiative
GHG	Greenhouse Gas

GIZ	German Corporation for International Cooperation GmbH
HDT	Heavy-Duty Track
IAESL	Institute of Automotive Engineers of Sri Lanka
ICCT	International Council on Clean Transportation
ICE	Internal Combustion Engine
INDCs	Intended Nationally Determined Contributions
ISCED	International Standard Classification of Education
ITUM	Institute of Technology University of Moratuwa
KDU	Kotelawala Defense University
LDV	Light-Duty Vehicle
LOs	Learning Objectives
MoMD&E	Ministry of Mahaweli Development & Environment
MoMP&WD	Ministry of Megapolis and Western Development
MoP&RE	Ministry of Power & Renewable Energy
MoP&E	Ministry of Power & Energy
MoT&CA	Ministry of Transport & Civil Aviation
MoTSM	Ministry of Transport Services Management
NCPC	National Cleaner Production Center
NDCs	Nationally Determined Contributions
NGOs	Non-Governmental Organizations
NMT	Non- Motorized Transport
NSBM	National School of Business Management
NTC	National Transport Commission
NVQF	National Vocational Qualifications Framework
OECD	Organization for Economic Co-operation and Development
OUSL	Open University of Sri Lanka
PHEV	Plug-in Hybrid Electric Vehicle
POs	Programme Outcomes
RCE	Regional Centres of Expertise
SD	Sustainable Development
SDC	Sustainable Development Council
SDGs	Sustainable Development Goals
SEU	South Eastern University
SI	Spark Ignition
SLEMA	Sri Lanka Energy Managers Association
SLIAT	Sri Lanka Institute of Advanced Technological Education

SLIDA	Sri Lanka Institute of Development Administration
SLIIT	Sri Lanka Institute of Information Technology
SLQF	Sri Lanka Qualifications Framework
SLSEA	Sri Lanka Sustainable Energy Authority
SLTB	Sri Lanka Transport Board
SUT	Sustainable Urban Transport
SUTP	Sustainable Urban Transport Project
ToR	Terms of Reference
TOYOTA	Toyota Lanka (Private) Limited
UDA	Urban Development Authority
VET	Vehicle Emission Testing
VKT	Vehicle Kilometers of Travel
UN	United Nations
UNEP	United Nations Environment Programme
UNECE	UN Economic and Social Council
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UoVT	University of Vocational Technology
UCK	University College of Kuliyapitiya
UoC	University of Colombo
UoJ	University of Jaffna
UoK	University of Kelaniya
UoM	University of Moratuwa
UoP	University of Peradeniya
UoR	University of Ruhuna
USJP	University of Sri Jayawardenapura
UWU	Uva Wellassa University of Sri Lanka
WUSL	Wayamba University of Sri Lanka

Section 01: Introduction

1.1 Transportation and Sustainable Development

The economic development of any country is strongly coupled to the demand for mobility, which is predominantly catered by transport systems and infrastructure, as signifies by the strong correlation between GDP growth and growth in passenger-km and ton-km. Further, as the transport energy demand is catered primarily by petroleum fuels, there is a steady increase in the demand for petroleum fuels. In fact, globally the demand for oil in the transport sector was doubled during the thirty-year period from 1987 to 2017, and the contribution of the transport sector to the oil consumption contributed was increased from about 50% to 60% during the same period [1]. In spite of the benefits provided, the utilization of petroleum oil for transportation has led to issues associated with both quantity and quality, as petroleum oil (and other fossil fuels) are depleting resources and are responsible for much spoken health and environmental impacts, from local level air quality degradation to global level climate change issues. These issues in turn defy socio-economic developments and thus deliberated extensively in different international agendas and related national level interventions. For examples, the need to address the issues in the transport sector is evident in the 2030 Agenda for Sustainable Development together with Sustainable Development Goals (SDGs), and Paris Climate Agreement together with Nationally Determined Contributions (NDCs).

The road vehicles contribute to the major share of transportation demand, thus the petroleum oil consumption therein is primarily driven by growth in the road vehicle population, especially private passenger vehicles, as well as total vehicle distance travelled. This is largely due to rapid motorization taking place in developing countries and emerging economies, particularly with cars and motorcycles [2]. Other important aspect of the transport sector is the resource/energy consumption. The transportation sector is responsible for approximately 28% (91 EJ) of global final energy demand in 2012, in which road transport accounts for more than 70% [3]. Present global vehicle population exceeds 1 billion and estimated to reach 2 billion by 2035. It is estimated that the transport sector will account for 97% of the increase in world primary oil use between 2007 and 2030 [4]. Furthermore, more than 90% of cities in Asia are experiencing unhealthy levels of air pollution, in which transport sector is the major contributor [5]. Therefore, consequent energy security and environmental sustainability implications mean that reducing the fuel used is one of the highest priorities for all countries. In general, there is a number of basic approaches for mitigation of adverse effects of transport sector, but has to be implemented simultaneously by considering all the aspects in order to best achieve the targets. The main framework for such strategic action is commonly referred to as Avoid/Reduce-Shift-Improve (A-S-I) approach, which contributes to the overall energy efficiency (EE) improvement in the transport sector, while addressing other issues highlighted above [6].

1.2 Energy Efficiency in the Transport Sector

The demand for fuel (or energy) in the road transport sector depends on the modal share and vehicle fleet characteristics including fuel usage of each mode of transport. For a given vehicle category, the fuel demand could be estimated by three key factors viz fuel efficiency of the vehicle (which is determined by the technical energy efficiency), vehicle travel (which denotes the type of travel/driving and the number of distance driven) and the vehicle population (which is the number of vehicles on the road). The fuel efficiency of a vehicle is usually described by different terms such as fuel economy (FE), fuel consumption, energy efficiency (EE), etc., which are used with different definitions and measurement units around the world, thus sometime causing linguistic confusion. Typically, FE refers to fuel consumption per unit distance travelled (e.g. litres/100 km) or distance travelled per unit amount of fuel consumed of a vehicle (e.g. km/litre) under given driving pattern (refers to as the driving cycle). Another important aspect to be considered, particularly when comparing FE of different transport modes, is the average occupancy of a given vehicle category, as larger vehicles could carry more passengers and/or freight though their fuel consumption is higher than smaller vehicles in general. Here, FE could be expressed as litres per passenger-km or litres per ton-km [7].

Although all transport modes are expected to show substantial increases in activity, private vehicles in particular will continue to have dominant effects on the overall transport energy and petroleum use in the future. This in turn will provide greater opportunity

Table 1.1: Fuel economy status LDVs worldwide and long-term GFEI target comparison

Region	Performance Parameter	Year			
		2005	2010	2015	2030
Global average	Average FE (l/100km)	8.8	8.1	7.6	
	Annual improvement rate of FE (% per year)	1.64%		1.27%	
		1.46%			
GFEI target	Average FE (l/100km)	8.8			4.4
	Required improvement rate of FE (% per year)	-2.73%			
				2015 base year →	-3.58%

for the mitigation of adverse impacts in the transport sector, including EE improvements and greenhouse gas (GHG) mitigation. Accordingly, the Global Fuel Economy Initiative (GFEI) was launched by the United Nations Environment Programme (UNEP) and its partners, to secure real improvements in FE, and the maximum deployment of existing EE technologies in vehicles across the world through in-country policy support, analysis and advocacy. The overall objective of the GFEI is to stabilize GHG emissions from the global light-duty vehicles (LDVs) fleet through a 50% improvement of vehicles fuel efficiency worldwide by 2050 (thus referred to as "50 by 50" campaign) with respect to the base-year of 2005. The GFEI target is to double the efficiency of all new LDVs by 2030 and to achieve the same for the complete global vehicle fleet by 2050 [8]. This target is in accordance with the Target 7.3 of SDG7, which requires the global rate of improvement in EE to be doubled by 2030. Further, in 2017, GFEI announced targets for heavy-duty (freight) trucks (HDTs), as a 35% improvement of FE by 2035 (relative to 2005).

GFEI keeps a track on the vehicle industry and analysis the FE status to update the targets. Table 1.1 presents the fuel economy status of LDV and personal cars worldwide and long-term GFEI target comparison (adopted from [9]).

The global average of fleet fuel economy in 2015 was at about 7.6 l/100 km (gasoline equivalent), with the annual rate of improvement from 2005 to 2015 is lower than what is expected in order to reach the GFEI target. As such, there will be a need to accelerate annual improvements to about 3.6% per year from 2015 to 2030 in order to achieve the target set by GFEI.

More recently, GFEI Partners have revisited the GFEI targets to account for ongoing developments in vehicle fuel efficiency, expand the focus to incorporate all road transportation vehicles, and to frame the targets in terms of both vehicle efficiency and GHG gas emissions. The related reassessments have taken into account the more comprehensive approaches and targets of the 2030 Agenda and the Paris Climate Agreement adopted globally in 2015, in which the vital role of policies that improve vehicle fuel economy and accelerate the transition to zero emission vehicles, in combination with measures that avoid the need travel and shift activity to less carbon intensive modes are emphasised. The new targets, published in May 2019, reaffirm the earlier targets for new LDVs and HDTs in 2030 and 2035 respectively, establish more stringent 2050 targets for new LDVs and HDTs, establish first-ever targets for two and three wheelers and buses in 2035 and 2050, as shown in Table 1.2. More detailed descriptions of these targets and related interventions are presented in Annex A [10].

Table 1.2: GFEI revised targets

Vehicle type	Fuel Economy / CO$_2$ Improvement		
	2030	2035	2050
Passenger Light Duty Vehicles (LDVs)	50%*		90%
Heavy Duty (Freight) Trucks (HDTs)		35%*	70%
Transit Buses		65%	95%
Two Wheelers and Three Wheelers		80%	95%

Note: All improvements from a 2005 baseline. All improvements shown as 'per-kilometre CO$_2$ emissions', except original GFEI targets marked with (*) which remain as 'per-kilometre fuel consumption'. These CO$_2$ targets require the carbon intensity of the global electricity grid to decrease by at least 90% between 2020 and 2050.

The GFEI targets for new vehicles and related assessment scenarios show continuing improvement to road transport efficiency can significantly reduce carbon emissions. Though the targets are appropriately ambitious and policy relevant, the related interventions are highly transformative in nature and require significant efforts for materialization. The situation becomes more complex when one considers the fact that the real-life performances of active vehicle fleet differ from those of new vehicle due to high dependency on a range of other technical and non-technical parameters, such as traffic pattern, road condition, vehicle condition (including level of repair & maintenance), and driver behaviour. Thus, analysis of overall EE of a transport system is a complex topic, particularly in the urban environment, and needs holistic approach to comprehend the interconnectedness and interactions among different factors and elements. Here, the overall performance in the transport sector in relation to EE is determined by three main elements, namely system efficiency, travel (or trip) efficiency and vehicle efficiency. In fact, these three elements are linked to the A-S-I approach briefed in Section 1.1 above. Here, system efficiency relates to how the demand for transport (and the different modes of transport) is generated, while travel efficiency relates to the energy consumption of different modes of transport and vehicle efficiency concerns with vehicle technology, design features and driving technics affecting per-kilometre fuel consumption of different vehicles [11]. In particular, the third aspect refers to the diversification the sector towards more sustainable transport fuels and technologies, including greater market penetration of energy efficient vehicles operating on electricity, hybrid technology and other advanced technologies

It should be noted that, battle to move towards a cleaner, more efficient global fleet has been hard-fought, when the COVID pandemic came along. The combination of lockdowns closing many factories to safeguard workers' health, limitations on movement dramatically reducing vehicle use, and widespread economic uncertainty have impacted the operational characteristics of the transport sector. In particular, though the marked increase in on-line modes of communication and supply chains has led to avoidance/reduction of need to travel, thus effecting improvements in system efficiency, there have been adverse impacts on economy and society. It is still not clear what the "new normal" would be and its impact on the transport sector in particular and the pathways to sustainable development (SD) and climate actions in general. In any case, the government must look to improve the fuel efficiency of their national fleet and play their part in an increasingly globalised economic and environmental policies, while taking into consideration the local circumstances and development priorities.

1.3 Clean and Efficient Vehicle Technologies

The ambitious targets set in the transport sector highlighted above, particularly those of GFEI in responding to the Paris Climate Agreement commitment to reduce global impacts to safer limits, signify the important role of rapid development and large scale deployment of clean and efficient vehicle technologies. In this respect, ICE technology has historically followed an evolutionary path with many small steps combining to achieve significant progress in the performance; yet there are many more opportunities to improve further. In fact, a major transformation of transportation technologies is expected over the next 20–35 years and, in case of LDVs, the major improvement would be through evolution of vehicle propulsion systems towards more advanced and efficient alternatives [12], particularly the electric propulsion as envisioned in the GFEI targets (see Annex A for more details). The related technologies include battery electric vehicles (EBVs), hybrid-electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs) and hydrogen fuel cell vehicles (FCVs). Although the penetration of these propulsion systems is still low, significant increasing trends are seen in the recent past, in particular, due to advances in battery technologies [7].

The trends in the market penetration of alternative powertrain technologies over the next decades suggest that a considerable proportion of new vehicles will continue to use an ICE. Thus, it is essential to maintain focus on improvements to the ICE vehicle application, while research and development (R&D) programmes are carried out in parallel on components and systems for electrification of the vehicle. This approach will ensure the contribution of ICE technologies to sustainable mobility. Decarbonisation of the ICE itself will be achieved through efficiency improvements and the use of low carbon fuels, particularly biofuels. Some technological areas in advanced ICE vehicles include [13]:

- Air and exhaust gas management:
  - High efficient turbo compressors with extended map width (passenger car) and high pressure ratios (heavy duty);
  - Variable turbine geometry for Diesel and gasoline engines;
  - Low friction bearing and low inertia wheel design for improved transients;
  - Combined/controlled 2-stage charging including supercharging;
  - High and low pressure exhaust gas recirculation (EGR).

- Fuel preparation and injection systems:
  - High pressure common rail direction injection;
  - Multiple injection and rail pressure control.
- Thermodynamic combustion engine process:
  - Variable valve cam phasing;
  - Variable valve timing and lift;
  - Variable compression ratio;
  - High energy ignition systems;
  - Stoichiometric homogenous spark ignition (SI) combustion;
  - Lean homogenous and stratified SI combustion;
  - Extended range homogeneous charge compression ignition (HCCI);
  - Diffusion compression ignition (CI) combustion (lean and stoichiometric); engine architecture for high peak firing pressure (heavy duty).
- ICE control systems:
  - Model based control systems incl. Virtual sensors;
  - Multi-mode combustion control.
- Other areas:
  - Light-weight designs (engine and other vehicle components);
  - Aerodynamic designs;
  - Size reduction;
  - Automotive transmission (both manual and automatic);

- Waste heat recovery systems;
- Advanced cooling technologies.

The achievements in technology advancements in ICEs (with both conventional and hybrid drive-trains) have been persuaded by the strong regulatory efforts in number of countries including Japan, Europe, and the United States. In addition, several other measures could be implemented to promote fuel-efficient vehicles usage in a country. For example, Table 1.3 summarizes such major approaches to reduce fuel consumption and GHG emissions from LDVs [14]. Further to these instruments, there is a portfolio of policy and regulatory interventions to improve the energy and environmental performance of transport sector covering technical/non-technical aspects and supply/demand sides, including promotion of non-motorized transport (NMT) modes.

Although most countries have emission regulations in road vehicles, they usually deal with air pollutants than GHG emissions. However, most Organization for Economic Co-operation and Development (OECD) countries have established programmes to address transportation related GHG emissions. FE programmes and GHG emission targets, either mandatory or voluntary, have proven to be among the most cost-effective tools in controlling oil demand and GHG emissions from vehicles, thus could be adopted worldwide. The overall effectiveness of standards can be significantly enhanced if combined with fiscal incentives and consumer information. Taxes on vehicle purchase, registration, use, and motor fuels, as well as road and parking pricing policies, are important determinants of vehicle energy use and emissions [7].

Table 1.3: Measures to promote energy-efficient vehicles

Approach	Measures/forms		Country/region
Standards	Fuel economy	Numeric standard averaged over fleets or based on vehicle weight-bins or sub-classes	US, Japan, Canada, Australia, China, Republic of Korea
	GHG emissions	g CO_2/km or g CO_2/mile	EU, California (US)
Consumer Awareness	Fuel Economy/ GHG emission labels	mpg, km/l, l/100 km, g CO_2/km	Brazil, Chile, Republic of Korea, US and others
Fiscal Incentives	High fuel taxes	Fuel taxes at least 50% greater than crude price	EU, Japan, Sri Lanka
	Differential vehicle fees and taxes	Tax or registration fee based on engine size, efficiency & CO_2 emissions	EU, Japan, China, Sri Lanka
	Economic penalties	Gas guzzler tax	US
Support for new technologies	R&D programmes	Funding for advanced technology research	US, Japan, EU, China
	Technology mandates and targets	Sales requirement for Zero Emission Vehicles (ZEVs), Plug-in HEVs and EVs	California (US), China
Traffic control measures	Incentives	Allowing hybrids to use high occupancy vehicle (HOV) lanes	California, Virginia and others states in the US
	Disincentives	Banning SUVs on City Streets Inner city congestion charges	Paris, London

1.4 Fuel Economy Standards

In case of a vehicle, the FE could be defined as the fuel efficiency relationship between the distance travelled and the amount of fuel consumed by the vehicle under typical driving pattern or conditions (refers to as the driving cycle). Certification of FE performance (and GHG emission) for new vehicles is based on test procedures intended to reflect real world driving conditions and behaviour in each country. Accordingly, FE standards are specified in terms of volume of fuel to travel a given distance (e.g. litres/100 km), or the distance travelled per unit volume of fuel consumed (e.g. km/litre) under a specific driving cycle. Automobile GHG emission standards are usually expressed as mass per unit distance (e.g. g CO_2/km). FE testing methods followed differ from country to country, and include different driving cycles. In general, driving cycles are used to assess the FE and emission performance (both GHG and air pollutants) of vehicles as well as traffic impact [15].

Improved vehicle FE has potentially high economic, energy saving and environmental benefits. Some countries have mandatory FE standards, while some others have vehicle labelling schemes for FE. FE labels can also be linked to other tax-based incentives. Many countries also have subsidy schemes to promote EVs. As presented in Section 1.2 and Section 1.3 above, it is possible to reduce average vehicle fuel consumption of vehicle by using existing state-of-the art technologies. Further, transitions to alternative vehicles/fuels and avoiding motorized transport could contribute further to improve the FE and mitigate GHG emissions [16].

1.5 Local Scenario

Sri Lanka relies heavily on road transport with 95% share of passenger transport and 97.5% share of freight transport. The present active vehicle fleet of Sri Lanka is over 5 million, which is three-fold increase with respect to year 2000. The main contributions for this change are from the growth of private vehicles, particularly three wheelers, two wheelers, and cars. Meanwhile, number of buses has not increased significantly, indicating shift from public transport modes to private vehicles. Although buses are only about 1% of the active vehicle fleet, it contributes to about 45% of the passenger transport [17].

Increase in private vehicles has resulted in increased traffic congestion, reduction in FE and higher emissions. The vehicles are primarily powered by imported petroleum oil, and about 70% of the petroleum is consumed by the transport sector in the country, which is about 3 billion liters per annum, where the main fuel is diesel, contributing to about 65% and the balance is gasoline. The high expenditure for the importation of petroleum has become a major factor affecting adversely the economy of the country. Presently, the total expenditure for petroleum imports is about 6% of gross domestic product (GDP) of the country. The growth in transport sector has resulted in deterioration of air quality, particularly in the urban sector, compelling the government to initiate mitigation measures such as Vehicle Emission Testing (VET) programme and Cleaner Fuel & Vehicles Road Map. Further, the transport sector is one of major GHG emitting sources, contributing to 40% of the total GHG emissions of 12,588 Gg CO_{2e} in 2010 [18]. Thus, as a signatory to the Paris Climate Agreement adopted at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC), a major contribution for the national commitments could be expected from the transport sector, as signified in the NDCs submitted by the government [19]. The more details on the national climate actions in the transport sector are presented in Section 2.6. The transport sector NDCs have a main focus on improving EE in the transport sector as a whole that described by the three interconnected elements of system efficiency, travel efficiency and vehicle efficiency. Moreover, Sri Lanka Voluntary National Review on the Status of Implementing SDGs published in 2018 stressed that improvements in EE in the transport sector are mandatory for achieving SDG7: Ensure access to affordable, reliable, sustainable and modern energy for all [20].

All these interventions imply direct contribution to the improvement of overall EE of the transport sector. Accordingly, EE in transport sector could be considered as a national priority and due emphasis should be given by the decision makers and other actors to realize the targets and goals of the sector.

Although the importance of the improvement in both EE and FE in the transport sector is reflected at policy level and action plans, the implementation of the related activities are not very visible at large. Emphasis given to EE within major programmes implemented in the transport sector is not prominent. Further, no specific regulatory intervention to promote EE in vehicles, except the interventions related to electric mobility. The introduction of vehicle importation tax concessions for EBVs and HEVs has led to significant and rapid increase of HEVs in recent years. Another notable activity is the national programme titled Energy Efficient and Environmentally Sustainable Transport (E3ST) System in Sri Lanka, which was developed and implemented by Sri Lanka Sustainable Energy Authority (SLSEA), as a knowledge management programme, with the assistance of number of international organizations, including Hong Kong Polytechnic University, Clean Air Asia (CAA) Centre and UNEP. Presently, UNEP and GFEI provide assistance to establish vehicle FE baseline and to develop FE policies

in Sri Lanka. Further, SLSEA provides assistance to number of local Universities to develop driving cycles in urban cities. University of Moratuwa has completed the work to derive driving cycle in Colombo. With the development of driving cycles to represent key urban areas in the country, SLSEA expects to introduce FE labelling programme within this year. The management of energy efficiency improvements in all the end-use energy sectors including transport is mandated to SLSEA under the SLSEA Act No. 35 of 2007. Although, government policies and user perceptions show a strong preference towards energy efficient and environmental-friendly transport option, more specific actions with details in sufficient depth to identify implementation challenges and the potential benefits/ impacts are still lacking [21], [22].

On the subject of related knowledge and skills, the importance of EE and its potential benefits are known to many. Yet, the actual implementation of programmes at national as well as sub-national levels and their progress signify that the understanding on EE is primarily focused around electricity and to some extend in thermal energy applications, but its role in transport (as reflected in the concept of E3ST) is not only overlooked and but also misinterpreted. This situation highlighting not only the lack of adequate number of knowledgeable and skill staff, but also the gaps in the education system as a whole. In fact, there is a serious concern over the achievability of related sectoral targets at national/sub-national levels, such as NDCs in the transport sector, relevant targets in SDGs and other national and sectoral policies and action plans including National Transport Policy (Draft) [23], and 'Vistas of Prosperity and Splendour' – the National Policy Framework of the Sri Lankan government [24]. On the other hand, introduction of EE into education system too is challenging due to the presence of variety of gaps and barriers, such as:

- The complexity of the topic itself (interdisciplinary, multidisciplinary and transdisciplinary nature of transport sector EE themes);

- Absence of overarching framework and institutional setup for the formal education system across different levels (such as tertiary/university, technical/vocational and continuing professional development);

- Inadequate coordination and cooperation between transport sector actors and educationalists;

- Lack of understanding on the governing principles of EE in transport;

- Ambiguity in the required competencies;

- Difficulty in engaging traditional disciplines in a transdisciplinary framework of EE;

- Inflexibility in the curricula of formal educational programmes;

- Inconsistencies between Programme Outcomes (POs) and Learning Objectives (LOs) of formal educational programmes; and

- Lack of educational resources (expertise, educational materials, teaching methods, assessment tools, etc.).

More comprehensive reviews of transport sector and education sector of Sri Lanka are presented in Section 2 and Section 4, respectively.

The brief situational analysis presented above signifies the need of strategic intervention for enhancement of competencies related to EE in the transport sector.

1.6 Background of the Assignment

In spite of the significant emphasis on the EE improvements in the transport sector locally and internationally, the ground level implementation appears to be not progressive enough to achieve the set targets, indicating presence of many challenges. One of the main hindrance factors in this regard is the lack of knowledgeable and skilled persons at all levels of governance and across all actors (both public and private stakeholder institutions) to develop and implement EE programmes and projects. The broader levels of knowledge, skills and competency requirements for this purpose emphasize the need of holistic approach in developing comprehensive education portfolio. Hence, there is a need to support initiatives with skills and knowledge, both among the in-service professionals working in the EE sector and individuals proceeding out from the educational system, which sets in the need to review the taught programmes in secondary and tertiary technical high schools, as well as in universities. In response this need, Copenhagen Centre on Energy Efficiency (C2E2) has initiated a programme to improve skills for EE within the developing countries. Within this programme in Sri Lanka, following aspects are to be investigated:

- The different components within the transport sector where EE projects can be implemented and the skills required for each of these components.

- The current skillsets among the professionals working on EE in the transport sector in Sri Lanka and how, when and where these skills would be acquired.

- Preparedness and capacity of the educational system in Sri Lanka to provide the required skills.

- The changes and modifications to be made to the current programmes so that they can provide the required skills.

Accordingly, this assignment is formulated to gather baseline data and information in related areas to

perform situational analysis for gaining better insight of the aspects listed above on EE in transport sector.

1.7 Main Objective and Specific Outputs/Deliverables

As per the terms of reference (ToR) the main objective of the assignment is to make a contextual assessment of knowledge and skills gaps among professionals working on EE in the transport sector (mainly urban transport) and in the educational programmes that train these professionals.

The above objective is to be achieved through the following four specific outputs:

- An inception report that will contain the methodology, including a strategy to conduct the survey, questionnaires/survey forms/interview questions;

- Report on what skills are required for energy efficiency in the transport sector based on existing skills of individuals working in the public and private sector on energy efficiency in transport sector;

- Report on assessing the content of the programmes taught in universities and technical schools and defining the gap of skills;

- Recommendations for policymaking on how to update educational profiles according to local needs and international state; and

- A dissemination workshop and a workshop report.

1.8 Scope of Work

The scope of work of the assignment, as defined in the ToR, is to undertake the following studies in steps with consultation of the stakeholders and the dissemination of the results through a workshop, thus achieving the said objective:

- An assessment of the demand for skills and knowledge amongst technicians, government officials and professionals working on EE in the transport sector;

- An assessment of the taught programmes at universities and technical schools in terms of their coverage of EE skills and knowledge in programmes;

- In consultation with C2E2 and the Ceylon Chamber of Commerce staff, identify the education institutes to be surveyed and in-service professionals to be surveyed/interviewed and conduct the survey of education institutes and in-service professionals; and

- Help in the organization of a consultation workshop.

Section 02: Transport Sector in Sri Lanka – An Overview

2.1 Country Profile

Sri Lanka is an island located in Indian Ocean. The maximum length and width of Sri Lanka is 432 km North to South and 224 km West to East, respectively. Total area of Sri Lanka is 65,610 km², which comprised of 62,705 km² land area and 2,905 km² inland water area. The total forest cover is 16,598 km². The island consists mostly of flat-to-rolling coastal plains, with a mountainous area in the south-central part. In 2018, the estimated mid-year population of Sri Lanka was about 21.67 million and population growth rate was 1.1%, with a population density of 346 persons/km². Sri Lanka is a lower-middle income developing nation with a Gross domestic product (GDP) of about US$ 88.9 billion in 2018 and per capita GDP of about US$ 4,102. Sri Lanka has seen modest economic growth of 3.2 per cent in 2018. During last three decades or so, Sri Lanka's export-oriented policies have seen a shift from agricultural exports (tea, rubber, coconut and spices) to the services and manufacturing sectors. In 2018, the services sector accounted for almost 57.7% of GDP, while that of industrial sector was 26.1%. The agriculture sector, though decreasing in importance to the economy, accounts for around 7.0% of GDP [25], [26].

The primary energy supply in Sri Lanka is mainly based on four sources: biomass, petroleum oil, coal and hydroelectricity. In 2017, the total primary energy supply was approximately 528.9 PJ, in which petroleum accounted for 43.9%, biomass 36.5%, coal 10.8%, major hydro 5.8%, and the balance 3.1% is new renewable energy resources (including small hydro, wind, biomass and solar). In the same year, total energy demand was 423.8 PJ, in which domestic & commercial sector contributed to about 39.4%, while transport and industrial sectors contribute to 36.3% and 24.3%, respectively. There has been steady increase of the percentage share of transport sector energy demand, about 12% in 1980 to over 36% in 2017, signifying its growth compared to other sectors [27].

Sri Lanka does not have fossil fuel resources, but recent explorations indicate presence of gas reserves (most probable). During the year 2018, the crude oil and refined petroleum products imports were 1,674 and 4,959 thousand metric tons, with annual expenditure of about 0.98 and 2.93 billion US$, respectively. The total expenditure for petroleum imports was about 4.4% of GDP [25]. In 2017, about 64% of the petroleum is consumed by the transport sector, where the main fuel is diesel. The salient feature of the demand trend for petroleum products is the sharp increase in the demand for gasoline. This is mainly attributed to the high growth rate of two-wheelers, three-wheelers and motor cars. The contribution of the local refinery to meet the demand for petroleum products has come down over the years, reaching about 27% in 2017 [27]. Hence, the increase of domestic demand has basically met from the imported products. Accordingly, the country has spent an increasing proportion of its import bill on the importation of refined petroleum products. The high expenditure for the importation of petroleum has become a major factor affecting adversely the economy of the country, thus improvement of energy efficiency/fuel economy in the transport sector has become a national priority.

2.2 National Transport Statistics

Sri Lanka relies heavily on road transport, which, in year 2016 contributes to about 111.8 billion passenger-km/y (93.6%), while the rail contributes to the balance 7.6 billion passenger-km/y (6.4%). Major contribution to the passenger transport was from buses (47.6%), while private vehicles (such as cars, motor tricycles, motor cycles, duel-purpose vehicles) contributed to 46.1% [28]. In case of freight, road transport contributes to 6,436 million ton-km/y (97.5%), while rail 135 million ton-km/y (2.0%) and water transport 32 million ton-km/y (0.5%), in 2011 [29]. Use of air transport within the country is very limited.

The characteristics of the types of vehicles used on ground transport could be derived from the first registration data recorded by Department of Motor Traffic (DMT). The data is usually published by DMT under main vehicle categories, including the fuel type, in each month for a given year of registration. A summary of the first registration of vehicles for the years 2014 to 31st July 2020 is presented in Table 2.1. In year 2019, 76.7% of the new registrations are motor cycles, 10.3% are motor cars, 4.5% are three wheelers, and the balance include duel-purpose vehicles, buses, lorries and others [30]. Note that few of these vehicles may not be in the active fleet due to major operational/technical issues. In Sri Lanka, de-registration of vehicles is possible through preventing annual revenue licensing due to failure in either the tailpipe emission testing or additionally for heavy duty vehicles, mechanical fitness testing.

The annual vehicle registration data is available from the year 1955, which could be used to estimate the

Table 2.1: First registration of vehicles 2014 – July 2020

Vehicle Category	Year of First Registration						
	2014	2015	2016	2017	2018	2019	2020-July
Buses	3,851	4,140	2,685	3,331	2,957	1,613	405
Dual Purpose	20,799	39,456	26,887	16,742	16,931	13,745	7,843
Cars	38,780	105,628	45,172	40,803	80,776	38,232	17,396
Land Vehicles	7,070	9,977	10,285	8,821	7,460	5,696	2,365
Lorries	5,121	7,142	7,563	11,432	9,371	4,937	2,268
Motor Cycles	272,885	370,889	340,129	344,380	339,763	284,301	121,235
Three Wheelers	79,038	129,547	569,45	23,537	20,063	16,308	6,674
Others	2,012	2,128	3,662	4,228	3,478	3,288	1,799
Total	429,556	668,907	493,328	453,274	480,799	370,639	159,985

historical growth of cumulative vehicle registrations. At the end of the year 2019, the total cumulative vehicle registration is 8.09 million, a 4.8-fold increase from 1.69 million in the year 2000, which is equivalent to average growth rate of 8.6% per annum. The main contributions for this change are from three wheelers and two wheelers, where the numbers have increased by 11.5 times and 5.6 times, respectively. The cars, dual-purpose vehicles and land vehicles have increased by approximately 4.0, 3.3 and 2.4 times, respectively, while number of buses has increased only by 1.6 times, indicating shift from public transport modes to private LDVs. In 2019, motor cycles contribute to the main part of the total vehicle registrations with 57.7%, followed by three wheelers (14.5%), motor cars (10.8%) and dual-purpose vehicles (5.5%). The contribution of the buses is only 1.4%. Quadricycle is a new vehicle category introduced in 2018, and only 1,972 units have been registered at the end of the year 2019 [30].

Although the centralized procedure of new vehicle registration at DMT provide accurate data on number of vehicles registered, there is no such procedure for yearly registrations of in-use vehicles for obtaining revenue license. This is done by divisional secretariat levels and the information is not managed by a central database system. Therefore, compilation of the data has to be done manually, and usually reported in the publications of Central Bank of Sri Lanka (CBSL). Figure 2.1 presents the historical growth of active vehicle fleet based on valid revenue licenses for the period 2002 to 2018 [31]. During this period, the active vehicle fleet has increased from 1.10 million

to 5.03 million (4.6-fold increase), which is equivalent to average growth rate of 8.3% per annum. The main contributions for this change are from three wheelers and two wheelers, where the numbers have increased by 8.6 times and 5.4 times, respectively. The cars, dual-purpose vehicles and land vehicles have increased by approximately 4.0, 2.9 and 2.0 times, respectively, while number of buses has increased only by 1.7 times.

The total vehicle population in the active vehicle fleet in 2018 is about 5.03 million. Meanwhile, the data from DMT indicate that the cumulative value of the vehicle registered at the end of 2018 is 7.73 million. That is, the survival rate of the entire vehicle population is about 65%. The total cumulative vehicle registration as at 31st July 2020 is 8.25 million.

Figure 2.2 presents graphically the distribution of vehicle categories in the active fleet in the year 2018, based on the valid revenue licenses. This data shows similar pattern as with the total vehicle registration. Motor cycles give the highest contribution to the active vehicle fleet with 54.26%, followed by three wheelers (19.32%), motor cars (11.58%) and dual-purpose vehicles (7.23%). The contribution of the buses is only 1.08%.

In the resent past, there have been a considerable preference for hybrid (and electric) vehicles in the market. This is largely due to the differential tax system introduced by the government to promote cleaner and efficient technologies. Figure 2.3 shows the first registration of cars by fuel type, which clearly demonstrates the emergence of hybrid vehicles in the local market [30].

Figure 2.1: Historical growth of active vehicle fleet based on valid revenue licenses
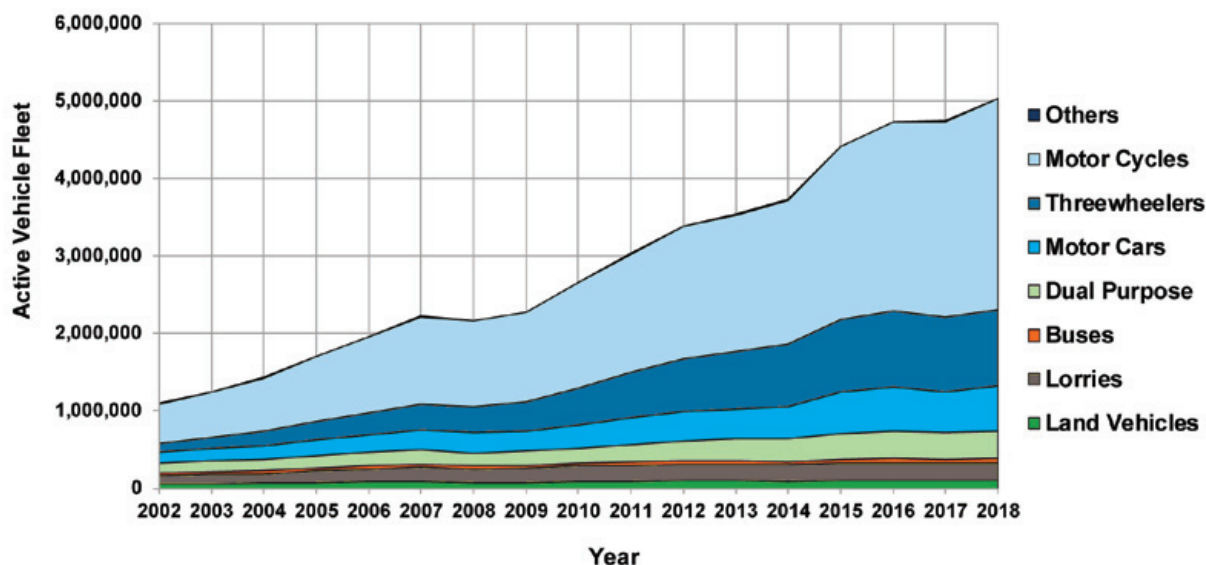
Figure 2.2: Vehicles with valid revenue licenses at the end of 2018 (Total = 5.03 Million)

Motor Cycles
54.26%

Motor Cars
11.58%

Three Wheelers
19.32%

Dual Purpose
7.23%

Buses
1.08%

Lorries
4.35%

Land Vehicles
2.15%

Quadricycle
0.04%
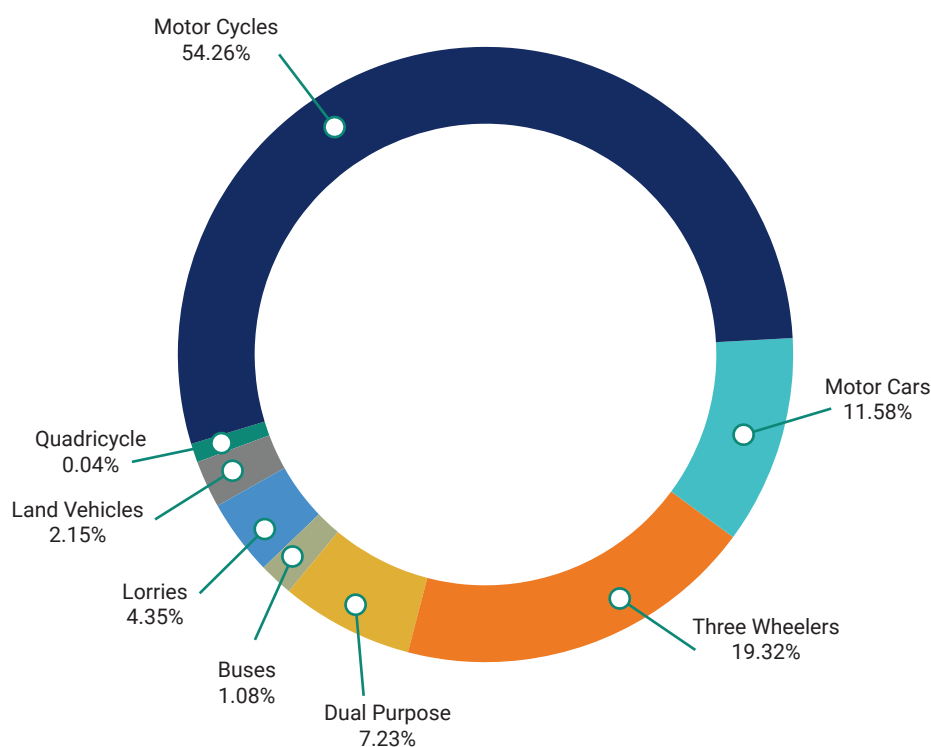
Though there was some significant growth of electric cars during 2015 to 2017, the trend was not continued, primarily due to lack of charging infrastructure and also some concerns over the battery life and recycling. However, hybrid cars (particularly petrol-electric) continue to dominate in the market.

Although the contribution from rail on the total passenger transport is much less than that of road transport, it plays a vital role as more energy efficient, convenient and affordable transport mode. Further, the contribution of rail in the urban centers is usually higher than the national average. Therefore, the rail is expected to play a major role in the promotion of E3ST system in Sri Lanka, particularly in the urban sector,

Figure 2.3: First registration of cars by fuel type from 2008 to 2019

Chart legend: Diesel, Petrol, Hybrid, Electric. Y-axis: Number of First Registration (Cars), X-axis: Year (2009–2019)
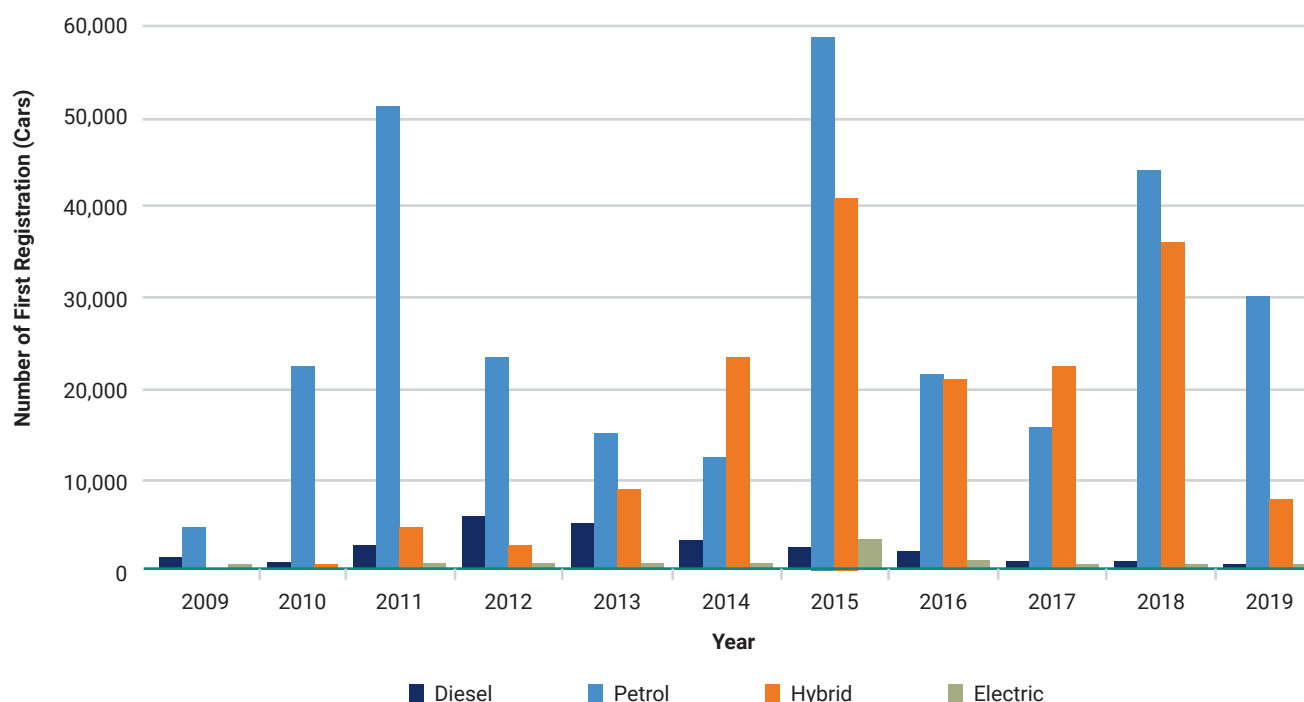
with parallel development in other public transport systems such as busses [28]. At present, nearly all rail services in the country are operated by Sri Lanka Railways (SLR), a government department functioning under the Ministry of Transport. The passenger intercity, commuter rail and freight transport are operated by SLR, while few private operators provide some services with SLR's equipment and infrastructure. In 2018, number of rolling stock used for the services by SLR includes 84 locomotives, 149 power sets, 825 passenger carriages and 787 wagons. In the same year, total number of passengers travelled is 137.5 million with 7.7 billion passenger-km, while total weight of freight transported is 1.8 million tons with 119.8 million ton-km. The fuel used for railway engines and power sets is 37.6 million liters of diesel [32].

2.3 Environment Regulations

Another important area having effects on transport sector is the environment laws and regulations, as the main source of air pollution particularly in the transport sector is considered as ground vehicles. The National Environment Act No 47 of 1980 (NEA) and subsequent amendments are the main legislation that encompassed environmental management and protection in Sri Lanka. The enactment of NEA provided the platform to set up the necessary institutional framework to safeguard the environment, thus facilitated the creation of the Central Environmental Authority (CEA), which was mandated to function as the regulatory and coordinating agency. Meanwhile, the Ministry of Environment the main institution for the

sectoral policy and decision making, which is presently designated as the Ministry of Environment and Wildlife Resources.

The main intervention of controlling air pollution is achieved through enforcement of emission standards for in-use vehicles. This programme is referred to as Sri Lanka Vehicle Emission Testing (SLVET) programme, implemented by DMT in collaboration with other stakeholder agencies and authorities. Other important interventions include [7]:

- National ambient air quality standards;
- Ambient air quality monitoring;
- National Environmental (Air Emission, Fuel & Vehicle Importation Standards), regulations;
- Establishment of Air Resource Management Centre (AirMAC) as a multi-stakeholder partnership to manage air quality;
- Fuel quality improvements (lead-free gasoline, low sulphur diesel);
- Development of Clean Air Action Plan;
- Prohibition of importation of 2-stroke three wheelers and spare parts.
- Nationally Determined Contribution (NDC);
- Vehicular Exhaust Emission Standards for Importation, Manufacturing or Assembling of Vehicles (Equivalent to Euro 4);
- Promotion of clean vehicle technologies (such as EBVs and HEVs).

2.4 Climate Actions

As a signatory to the UNFCCC ratified on 23 November 1993 and entered into force on 21 March 1994, Sri Lanka is committed to addressing the threat of human-induced climate change in all sectors, both by increasing the resilience of its people and ecosystems through adaptation measures, and by decreasing the intensity of climate change itself through mitigation measures. Subsequently, Sri Lanka submitted its Intended Nationally Determined Contributions (INDCs) in October 2015, and improved version of INDCs in April 2015, at the time of signing the Paris Climate Agreement. NDCs of Sri Lanka were prepared based on the Readiness Plan for the Implementation of the INDCs 2017-2019. A range of actions and interventions is proposed in the transport sector NDCs, as listed below [18], [19]:

- Establish E3ST systems by 2030.
- Upgrade of Fuel Quality Standards (FQS) to reduce harmful emissions that cause environmental pollution and health hazards.
- Reduce unproductive transport systems from current usage.
- Shift passengers from private to public transport modes.
- Enhance the efficiency and quality of public transport modes.
- Reduce GHG emissions in the maritime sector.
- Gazette new emission standards to reduce GHG emissions.
- Encourage and introduce low emission vehicles such as electric and hybrid.
- Reduce traffic congestion in order to reduce GHG emission.
- Reduce GHG emissions in the aviation sector.
- Establish a database management system for monitoring transport NDCs.

Subsequently, in 2019, the transport sector NDCs have been further reviewed through stakeholder consultation process to derive more specific NDCs with GHG mitigation potentials. The list of revised NDCs are as follows:

- NDC1 - Shift Freight from Road to Rail:

  1.a Promote transporting flour by rail

  1.b Promote transporting petroleum products by rail

  1.c Promote transporting petroleum products via pipelines

  1.d Introduce rail based Inland Container Depot (ICD) system.

- NDC2 – Promote public passenger transport:

  2.a Shift passengers from private vehicles to public buses

  2.b Shift passengers from private vehicles to existing rail.

- NDC3 – Electrification of railway system.
- NDC4 – Promote mass rapid transit for passenger transport:

  4.a Introduce Light Railway Transit (LRT) system

  4.b Introduce new railway line.

- NDC5 – Promote non-motorized transport modes:

  5.a Construct new bicycle lanes and bicycle parking areas.

- NDC6 – Introduce carbon tax based on fuel consumption (with a dedicated environment fund to implement low carbon transport projects).
- NDC7 – Promote electric vehicles for specific transport purposes:

  7.a Provide subsidies when replacing old vehicles with electric vehicles

  7.b Increase the tax rebates for electric vehicles

  7.c Provide subsidies to continue using electric vehicles.

- NDC8 – Introduce carbon price for the vehicles entering into identified cities.
- NDC9 – Improve the efficiency of vehicle fleet:

  9.a Conduct awareness on Eco-driving

  9.b Promote Intelligent Transport System (ITS).

- NDC10 – Introduce canal transport.

Recently, with the change of government and ministry portfolios, another round of consultation for updating NDCs has been commenced and first stakeholder consultation for validation of the revised NDCs in the transport sector was conducted on 17th September 2020, with the participation of Secretory, Ministry of Transport and other government officials. Number of additions to the above list was discussed and it is expected that the NDCs will be further reviewed and enhanced in line with the policies and priorities of the new government, before submitting to UNFCCC by the end of this year.

2.5 Policy Environment

Absence of updated sectoral policy has been a key highlight in the transport sector, as the present National Policy on Transport in Sri Lanka was approved in 2009. Over the years, number of attempts have been taken by different governments to improve and update the policy, but it is still in a draft version. Though a draft version, the policy document

emphasizes that the present transport system in Sri Lanka needs significant improvements, and one of the six policy principles therein is "Energy Efficiency & Environmental Protection", emphasizing that all modes of transportation should be guided towards an efficient and cost saving energy policy [23]. Recently, the new government has appointed a national expert committee to revisit the draft policy and the committee has developed a policy framework to consider by the Ministry of Transport for adoption as the National Land Transport Policy-2020, which has been submitted in mid-September 2020. The content of this policy document is yet to be publicized.

However, the new National Policy Framework titled 'Vistas of Prosperity and Splendour' of the Sri Lankan government emphasises the importance of sustainable transport systems in national development efforts. One of the key highlights related to the transport sector in this policy document is "Developing transport network for an efficient and environmentally friendly public transport system". A series of specific activities in the transport sector is detailed, including, among others, the following [24]:

• Metro Rail system in the Colombo district,

• Light Rail Transit (LRT),

• Introduce a Radial and Circular road system while adding sky bridges, vertical parking lots and flyovers in key areas,

• Rehabilitate unfinished roads connecting respective economic corridors,

• Complete construction of expressways,

• Resurface and modernize rural road network,

• Develop an alternative road system to access to main roads and expressways,

• Introduce "park and ride" system,

• Assist private passenger transport bus operators to re-fleet and comply with the green transport,

• Re-fleet the current bus stock and introduce environmentally friendly (Green Transport) busses to ply within the city limits of the New Colombo,

• Use rail transportation to transport containers,

• Develop road and rail based three container depots in three cities with the participation of private sector,

• Establish and expand facilities required to transport cargo via trains to four ports,

• Develop bus routes linking rail services to ensure proper intermodal connectivity,

• Promote and expand rail based cargo transportation with required infrastructure and rolling stock facilities,

• Electrify three railway lines,

• Develop and extend canal transportation as a new mode of transport.

As this National Policy Framework is meant to guide the government ministries and departments in implementing their policies, it could be expected that the above interventions will be reflected in the proposed National Land Transport Policy-2020.

2.6 Transport Sector Governance

Primarily, transport is a subject of national government, by virtue of 13th Amendment to the Constitution. Provincial Councils are not vested with power to make statues with respect to the functions set out in the so called Reserved List. Hence in addition to policy formulation and enactment, the implementation of any subject or function (which has not been explicitly included in the so called Provincial Council List or Concurrent List) can be enforced by the national government through Acts of Parliament, such as the Motor Traffic Act, Railway Ordinance, Civil Aviation Authority Act, Maritime Act, Sri Lanka Ports Authority Act, National Transport Commission Act, Sri Lanka Transport Board Act, and Road Development Authority Act. The subjects Concurrent list which are devolved to the Provincial Councils include regulation of road passenger and goods transport services by motor vehicles within a province and provision of road transport services within a province [33].

The Ministry of Transport Services Management (MoTSM), formerly Ministry of Transport and Civil Aviation (MoT&CA), is the main government body responsible of policy making and regulations in the transport sector. However, there are number of other ministries and agencies in national, provincial and local governments with some responsibilities transport sector related policy development, planning and management and programme implementation, as illustrated in Figure 2.4 (adopted from [29] and updated to present portfolio of the cabinet).

In case of local governments, there are 23 municipal councils (MC), 41 urban councils (UC) and 271 divisional councils (DC), with a total of 335. In addition, there are other organizations relevant to the transport sector such as:

• Ceylon Petroleum Corporation (CPC) under the Ministry of Petroleum Resource Development, which is the main agency for the supply of fuels for the transport sector;

• Urban Development Authority (UDA) under the Ministry of Urban Development, Water Supply & Housing Facilities, which is responsible of urban infrastructure development;

• Traffic Police, under Sri Lanka Police, Ministry of Defense, which is responsible for Enforcement of

traffic laws & regulations, control traffic on highways and assist the public in various social events and functions where motor traffic is involved;

- SLSEA under the Ministry of Power & Energy (MoP&E), which is the agency responsible for promoting EE (including the transport sector);

- Ceylon Electricity Board (CEB) under the MoP&E would also become an important agency in the

transport sector with the emergence of electricity as an energy source for transportation;

- Private sector entities involved with the transport sector such as transport & logistic companies, vehicle & spare part importers and vehicle maintenance & repair facilities.

Figure 2.4: Transport sector organizations
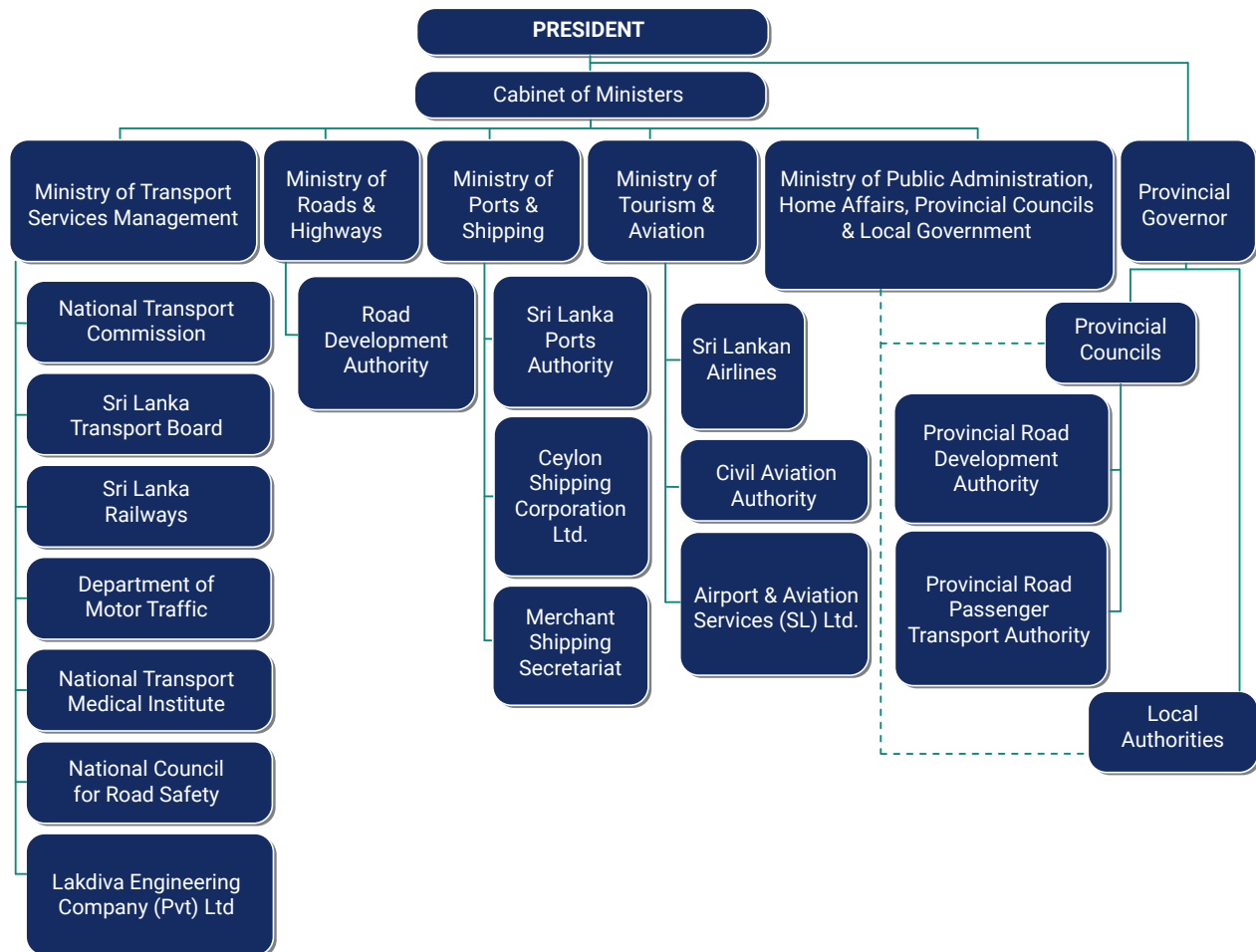
Note that there has been some changes to the institutional arrangement given in Figure 2.4 with the recent changes in the ministerial portfolios. Further, above agencies are apart from educational and training institutes, which is discussed separately in Section 4.

Source: Talat Munshi

Section 03: Methodology

3.1 The Overall Approach

The complexity of the transport sector signifies that, any educational intervention related to EE therein should be comprehensive enough to address the range of issues taking into account the national and sub-national circumstances in a holistic manner. Accordingly, the proposed methodology has been formulated with the following main elements:

- Review global status of education for sustainable development (ESD) with particular emphasis on EE education and best practices in curriculum development/delivery (Literature review);

- Conceptual mapping of EE in transport sector covering key intervention areas, subject topics and required competencies in the cognitive, functional and attitudinal domains (Literature review + Field surveys + Stakeholder consultations + Data analysis);

- Curriculum framework for overarching educational plan programme on EE in transport sector covering Core competencies (CCs), Programme outcomes – POs, Learning outcomes – LOs and Subject topics (Literature review);

- Positioning the EE education in tertiary/university and technical/vocational levels: (Literature review + Field surveys + Stakeholder consultations + Data analysis);

- Gap analysis and recommendations for improvements of the curricula, together with strategies for introductions of EE in transport sector to educational programmes (Data synthesis and analysis).

- Communication and validation of findings (Reporting + Stakeholder consultations).

3.2 Approach for the Data Collection

3.2.1 The Basis

Apart from data/information collection through secondary sources in literature, the key emphasis in the methodology of the present study is given to data collection from stakeholder consultations and field surveys through questionnaires and interviews. The main objectives of the stakeholder consultation are:

- To identify the gaps in competencies of the transport sector actors in formulating and implementing energy efficiency projects;

- To obtain expert opinion on potential areas for energy efficiency improvement in the transport sector;

- To identify the gaps in the educational and training programmes for competency building in relation to transport sector energy efficiency;

- To obtain professional opinion on the opportunities for curriculum upgrading for effective competency building in relation to transport sector energy efficiency.

The data collection is primarily planned through self-completion questionnaires and structured/ semi-structured interviews. In both modes, the questions are administered in two stages, firstly to identify appropriateness or readiness of the respondent for the data collection, and secondly to gather required data on skill and capacity gaps, in case of actors in the transport sector and teaching/leaning gaps and opportunities in case of educationalists.

The main steps of the data collections are as follows:

- Identification of Stakeholder Institutions (covering both transport sector actors and educationalists)
- Identification of Staff Categories
- Development of Questionnaires
- Development of Interview Questions
- Framework for Stakeholder analysis.

The above steps are elaborated in the following sub-sections.

3.2.2 Identification of Stakeholder Institutions

The review of the policy, regulatory and institutional arrangements in the transport sector presented in Section 2.5 and Section 2.6 provides the basis for identification of stakeholder institutes and agencies, covering all levels of governance (central government, provincial councils and local authorities), and both public and private sectors. Further, the civil society organizations (CSOs) and non-governmental organization (NGOs) too are considered as a stakeholder group. The main categorizations of the scope of the institutions and agencies identified in each category and the relevant staff categories are presented in Table 3.1.

Table 3.1: Scope of Stakeholder Institutions

Area	Sector	Domain of Stakeholder Institutions
Transport	National Government	Transport
		Energy
		Environment
		Development
		Infrastructure
	Local Authorities	Transport
	Private Sector	SLVET Operation
		Vehicle Imports
	Others	CSOs & NGOs
Education[1]	National Government	Undergraduate & postgraduate degrees and diplomas
		Technical and vocational degree and diplomas
		CPD programmes
		Training programmes
	Private Sector	Undergraduate & postgraduate degrees and diplomas
		In-service training
		On-the-job training
	Professional bodies / Other agencies	CPD programmes
		Training programmes

[1] More details of the educational and training institutes selected are presented in Section 4.

The selection of institutions/agencies is primarily based on the areas of involvements and assigned or applicable subjects and functions in the transport sector activities affecting the overall EE performances.

3.2.3 Identification of Staff Categories

Once the stakeholder institutions are identified, a sample of staff members has to be selected for the consultation. In case of transport sector actors, the different roles in identification, formulation and implementation of energy efficiency projects in the transport systems indicate three broader categories of staff as Strategic level, Tactical level and Operational level. This categorization is analogous to the three management levels in business enterprises namely Top-level management, Middle-level management and Operational management. In case of education sector actors (educationalists), the basic functions lead to only two broader categories of staff as curriculum or programme developers and lecturers or trainers. These classifications are presented in Table 3.2.

The selection of staff/actors is based on their involvement, roles and responsibilities in the employment and/or expertise under each staff categories, particularly related to the EE in the transport sector.

3.2.4 Development of the Questionnaires

Two questionnaires are proposed, one targeting the transport sector actors and the other for the educationalists. The basic structure of the questionnaire for the transport sector actors is comprised of four main elements, as:

- Section 1: *Basic information* to establish the relevancy of the respondent to the topic of study, in relation to the Interest & Influence in transport related activities and Awareness & Competency on energy efficiency in transport sector;

- Section 2: *Detailed information* for situational analysis and gap identification in relation to three levels of competencies as cognitive, functional and attitudinal;

- Section 3: *Professional/Expert opinion* on different components of the transport sector (particularly Urban Transport Systems) where EE project can be implemented;

- Section 4: *Guidance note* for the respondents covering the overall energy efficiency concept in a transport system, the hierarchical levels for potential impacts by and competencies of transport sector actors.

Table 3.2: Categorization of staff for consultation

Area	Staff Category	Functions
Transport	Strategic level staff	Policy making; Regulatory development; Strategy formulation; Planning; Advisory function
	Tactical level staff	Programme design & development; Coordination; Impact assessment; Evaluation
	Operational level staff	Implementation; Operation; Supervision; Data management; Reporting
	Transport experts	Critical review of the sector; Provision of expert opinions and recommendations
Education	Curriculum/Programme developers	Curricula development including setting of programme outcome, leaning outcomes, competencies; Formulation of syllabi; Evaluation of programme delivery
	Lecturers/Trainers	Course/programme delivery; Direct engagement with students; Evaluation of students
	Educational specialists	Critical review of the programmes/curricula; Provision of professional opinions and recommendations

- The basic structure of the questionnaire targeted for the educationalist is similar to the above, but tailored for the sector as:

- Section 1: *Basic information* to establish the relevancy of the respondent to the topic of study, in relation to the Type of module & Level of involvement and Awareness & Proficiency on EE in the transport sector;

- Section 2: *Detailed information* for situational analysis and gap identification in relation to educational programme and module including POs, LOs and competencies;

- Section 3: *Professional/Expert opinion* on different components of the transport sector (particularly Urban Transport Systems) where EE topics could be included in the curricula;

- Section 4: *Guidance note* for the respondents covering the overall energy efficiency concept in a transport system, the hierarchical levels for potential impacts by educationalists on EE in transport sector in relation to the type of module, level of involvement and level of expertise.

Further to the above, two more questionnaires are formulated to obtain expert/professional opinion from transport/educational sector specialists. In case of transport sector experts, feedback is sought in the following areas:

- Recommendation on competency levels required for different staff categories for Implementation of EE projects in the transport sector;

- Recommendation on type of educational/training programmes through which the above competencies could be best acquired for each category of staff;

- Recommendation on different component of the transport sector (particularly Urban Transport Systems) where EE project can/should be implemented.

The relevant areas of feedback sought from the education sector specialists include:

- Recommendation on competency levels catered by transport EE education;

- Recommendation on scope/depth of Study under each category of EE area in the transport sector (namely, system efficiency, trip efficiency and vehicle efficiency).

The final formats of the above four questionnaires are presented in in Annex B.

3.2.5 Development of the Interview Questions

The collection of feedback through circulation of questionnaire among the respondents is complemented/supplemented by interviewing (both physical and online modes). The scope covered in the interview is similar to those in the questionnaire, but in more concise forms, as listed below. The relevant question sheets used in the interviews are attached in Annex B.

Stakeholder Category: Transport Sector Actors

Stage 1: Basic Information for Relevancy

- Affiliation (Institution; Division/Department)
- Relevancy and involvement in transport related activities (particularly urban)

- Awareness & competency on energy efficiency in transport sector (particularly urban).

Stage 2: Detailed Information for Assessment

- Academic & Professional Qualifications
- Specific Trainings related to transport
- Job title and years of experience
- Management level
- Roles and responsibilities
- Cognitive competency (knowledge) levels on main EE areas of urban transport sector (System efficiency, travel efficiency and vehicle efficiency) in relation to Planning, Implementation and Operational aspects
- Functional competency (skill) levels on main EE areas of urban transport sector (System efficiency, travel efficiency and vehicle efficiency) in relation to Planning, Implementation and Operational aspects.

Stakeholder Category: Educationalists

Stage 1: Basic Information for Relevancy

- Affiliation (Institution; Faculty; Department)
- Relevancy and involvement in transport related study programmes
- Knowledge & proficiency on energy efficiency in transport sector (particularly urban)

Stage 2: Detailed Information for Assessment

- Academic Qualifications
- Specific Trainings & professional training related to transport systems
- Job title & years of teaching experience

- Transport related subjects offered (at PG, UG and Diploma levels)
- Roles & Responsibilities (Curriculum development; Teaching; Research; etc.)
- Details of the study programmes already offered (related to transport systems in general and EE in particular) and need / opportunities for further development.
- Details of the new study programme/s proposed (related to transport systems in general and EE in particular).

3.3 Framework for the Stakeholder Analysis

The potential of transport sector actors to impact on EE in transport depends partly on their interest (or attentiveness) and influence (or power) related to the affairs in the employment and partly on their expertise (awareness & competency) to accomplish the responsibilities and tasks. Similarly, the educationalist's ability to impact on capacity building of learners (target group) in any educational or training programme depends on the level of involvement in the curriculum development and delivery, the emphasis of the particular subject module/lesson within the programme, as well as the level of expertise (or proficiency) on the related subject matters/ topics. These attributes provide a sound basis for the stakeholder analysis in the present study, as presented in Table 3.3.

A set of significant levels in each indicators is used for the assessment, as detailed in Section 5.4 for transport sector actors and Section 6.4 for educationalists.

Table 3.3: Framework for the stakeholder analysis

Stakeholder Category	Criteria	Sub-criteria	Indicators
Transport Sector Actors	Potential impacts by transport sector actors on EE in transport	The relevance	Level of interest
			Level on influence
		The expertise	Level of awareness
			Level of competency
	Competencies of transport sector actors for implementation of EE projects in transport systems		Knowledge level
			Skill level
Educationalists	Potential impacts by educationalists on competency building for EE in transport	The opportunity for competency building	Type of the module
			Level of involvement
		The expertise	Level of awareness
			Level of proficiency

3.4 Methodology for Analysis of Competency Gaps

The gap analysis is initiated with the identification of key intervention areas for EE improvements in the transport systems, particularly covering the three fundamental aspects of system efficiency, travel efficiency and vehicle efficiency, as detailed in Section 4.3. Implementation of programmes and projects in the intervention areas identified need generic and specific competencies, which are ascertained through consultation of literature and analysis of feedback of stakeholders and experts in the transport sector. The basic framework of the competencies is presented in Table 3.4, and details are provided in Section 4.4. Here a set of core competencies is established covering the following three fundamental competency areas [34]:

- Cognitive competencies (knowledge);

- Methodological (or functional) competencies (skills and know-how); and

- Attitudinal competencies (behavioural and values).

In case of transport sector actors, these competencies should have the particular focus on transport systems, particularly related to the three areas of EE in transport systems, namely system efficiency, trip efficiency and vehicle efficiency. Further, the roles and responsibilities of the three categories of staff signify that there should be specific competencies within the core competencies listed in Table 3.4, based on the type of interventions, such as policy making, regulatory interventions, designing/planning, implementation, operation, etc. Accordingly, feedback of the stakeholders are obtained to comprehend the competency requirements and gaps therein. The basic framework for the competency analysis is given in the Table 3.5, and the five levels of significance L1 to L5 are defined in Section 5.4.2.

Table 3.4: The competency framework for EE in the transport systems

Competency Category	Core competencies
Cognitive Competencies (Knowledge) → Leaning to Know	Information competency
	Systems thinking competency
	Critical thinking competency
Methodological or Functional Competencies (Skills and know-how) → Leaning to do	Anticipatory competency
	Strategic competency
	Integrated problem-solving competency
Attitudinal Competencies (Behavioural and Values) → Leaning to be	Normative competency
	Collaboration competency
	Self-awareness competency

Table 3.5: The framework for competency analysis for EE in transport systems

Energy efficiency intervention areas of the urban transport systems		Competency levels (Knowledge & Skills)				
		L1	L2	L3	L4	L5
System Efficiency Reduce/avoid travel or the need to travel (by organizing land use, social and economic activities in such a way that the need for transport and the use of fossil fuels is reduced)	Policy making					
	Planning					
	Implementation					
	Operation					
Trip Efficiency Shift to more energy efficient modes (by making use of resource-efficient modes like public transport and non-motorized modes to reduce resource consumption per trip)	Policy making					
	Planning					
	Implementation					
	Operation					
Vehicle Efficiency Vehicle technology & operational characteristics (by using advanced technologies & cleaner fuels and by optimizing vehicle operation to consume as little resources as possible per vehicle-km)	Policy making					
	Planning					
	Implementation					
	Operation					

The intervention areas in the EE of the transport systems and associated competency requirement will provide the basis for the development of appropriate educational and training programmes, particularly the curricula comprising of the following elements:

- Programme outcomes (POs);
- Core competencies (CCs);
- EE Thematic Areas;
- Subject Topics / Lessons;
- Specific Competencies (SCs);
- Leaning Outcomes (LOs).

These elements of curricula could be used as benchmarks to identify gaps in the present educational programmes and propose appropriate interventions to improve them.

3.5 Activities

In accordance with the scope of work detailed in Section 1.8 and methodology described above, following activities and sub-activities are planned for successful implementation of the project assignment during a period of nine months, commencing from 17th February 2020:

Activity 1: Inception of the Study.

Sub-activity 1.1: Consult Copenhagen Centre on Energy Efficiency (C2E2) and Ceylon Chamber of Commerce (CCC) for the feedback on the study proposal,

Sub-activity 1.2: Finalize the study methodology and activity plan,

Sub-activity 1.3: Identify stakeholder institutes/ agencies/experts (covering central government, local government, private sector, academia/experts),

Sub-activity 1.4: Identify relevant staff categories within stakeholder institutes/agencies,

Sub-activity 1.5: Establish the scope of questionnaires/ survey forms/interview questions (covering roles, responsibilities, educational levels and capacity building needs),

Sub-activity 1.6: Substantiate the feedback of C2E2 and CCC on stakeholders (institutes/agencies/experts and staff categories) and questionnaires.

Sub-activity 1.7: Prepare the Inception Report.

Activity 2: Collect information on global scenario on education of EE in transport sector.

Sub-activity 2.1: Literature survey on best practices / case studies of relevant educational programme,

Sub-activity 2.2: Characterize key features of the curriculum frameworks covering core competencies (CCs), programme outcomes (POs), learning outcomes (LOs) and subject themes/topics,

Sub-activity 2.3: Identify the methodologies used in the introduction of EE aspects into the educational programmes and curricula.

Activity 3: Characterize the opportunities of EE in the transport sector, with particular emphasis on urban transport.

Sub-activity 3.1: Literature survey on factors governing the EE in the transport sector and related opportunities (covering the interventions under broader contexts of system efficiency, travel efficiency and vehicle efficiency) and strategies (covering three strategic areas of avoid/reduce, shift and improve),

Sub-activity 3.2: Literature survey on EE interventions proposed and implemented in the country (with particular emphasis on global commitments such as NDCs and SDGs, and national/local development plans),

Sub-activity 3.3: Select stakeholder staff categories within relevant institutes/agencies/ experts identified in Sub-activity 1.4 for consultation,

Sub-activity 3.4: Develop questionnaires/survey forms/interview questions for field survey based on the scope identified under Sub-activity 1.5 (covering roles, responsibilities, educational levels and capacity building needs),

Sub-activity 3.5: Conduct stakeholder consultation workshops in five cities (i.e. Colombo, Kandy, Matara, Jaffna and Trincomalee) in five provinces (i.e. Western, Central, Southern, North and Eastern) and analyse the feedback,

Sub-activity 3.6:. Consult stakeholders through interviews/field surveys to complement the Sub-activity 3.5 and analyse the feedback,

Sub-activity 3.7: Conceptual mapping of EE in transport sector covering key intervention and strategic areas, subject topics and required competencies in the cognitive, functional and attitudinal domains.

Sub-activity 3.8: Prepare a report to present the findings of sub-activities 3.1 to 3.7.

Activity 4: Curriculum framework for overarching educational plan programme on EE in transport sector.

Sub-activity 4.1: Establish CCs and POs of the overarching educational programme based on local needs and international experiences,

Sub-activity 4.2: Establish LOs and Subject themes/topics of the overarching educational programme based on local needs and international experiences,

Sub-activity 4.3: Perform curriculum mapping (LOs vs POs, LOs vs CCs and Subject topics vs LOs).

Activity 5: Establish present status of EE education in tertiary/university, technical/ vocational and continuous professional development levels.

Sub-activity 5.1: Identify educational institutes, programmes and educationalist for consultation,

Sub-activity 5.2: Develop questionnaire for field survey on present EE educational programme, opportunities and challenges for introduction,

Sub-activity 5.3: Conduct stakeholder consultation workshops (these are to be organized as an integral part of Sub-activity 3.5),

Sub-activity 5.4: . Consult stakeholders through interviews/field surveys to complement the Sub-activity 5.3,

Sub-activity 5.5: Establish present status of EE education in the selected programmes.

Sub-activity 5.6: Review critically the transport related EE education in Sri Lanka to identify gaps and recommendations for improvements of the curricula, together with strategies for introductions,

Sub-activity 5.7: A report on the findings of sub-activities 2.1 to 2.3, 4.1 to 4.3 and 5.1 to 5.6.

Activity 6: Completion of the Study.

Sub-activity 6.1: Prepare final draft report for stakeholder consultation

Sub-activity 6.2: Conduct final dissemination workshop to share the main findings of the project activities with the key stakeholders and get further feedback from them on the same.

Sub-activity 6.3: Final report of the project including the details of the dissemination workshop.

The Gantt chart of the above activity plan is presented in Annex C.

Source: Talat Munshi

Section 04: Education on Energy Efficiency in the Transport Sector

4.1 Education System in Sri Lanka

4.1.1 An Overview

Sri Lanka has achieved a significant progress in education compared to many other developing countries, as signified by basic education indicators. The base for this is the government policy of providing free education from the primary stage to the first degree level of university education. There is a network of schools all over the country, even covering very rural areas. The resources for the government schools and the payments for the teachers are a responsibility of the government. The general education span is of 13 years from age 5 to 18 years. This is classified into three levels as Primary schools (Grade 1 - 5, Age 6 - 10); Junior secondary school (Grade 6 - 9, Age 11 - 14); Senior secondary school or General Certificate of Examination GCE- Ordinary Level (Grade 10 - 11, Age 15 - 16); and Collegiate or GCE Advanced Level (Grade 12 - 13, Age 17 - 18). At present education is compulsory up to 14 years. Those who successfully

completed the GCE-A/L are eligible to join universities or tertiary institutes for higher education and those who leave schools have opportunities in vocational training. Accordingly, the different stages of education can be classified as [34]:

- Early Childhood Care and Education.
- General Education (school education).
- Tertiary and University Education.
- Technical and Vocational Education.

General organisation structure of the education system in Sri Lanka is presented in Figure 4.1.

The schools administered by the Ministry of Education of the central government are designated as national schools and other schools administered by the provincial councils as provincial schools. At the higher education level, the University Grants Commission, under the Minister of Higher Education, is the primary university administrator responsible for allocating funds, maintaining academic standards, and regulating university admissions. The number of degree awarding

Figure 4.1: Formal education system in Sri Lanka [35]
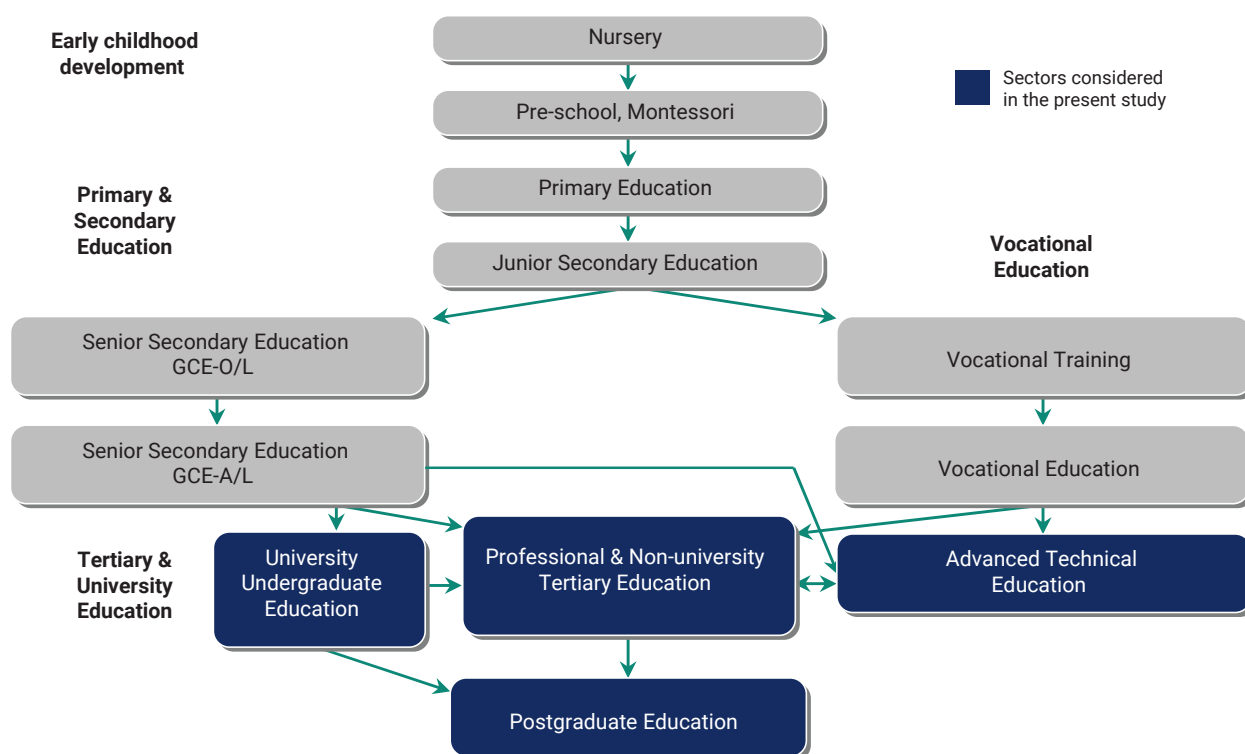
institutes includes 23 universities and 28 institutes. This ministry also oversees number of technical and vocational degree and higher diploma awarding institutes. In the technical education, skill development institutes/training colleges are overseen by number of institutes under Ministry of Skills Development, Employment and Labour Relations. The Department of Technical Education and Training, Vocational Training Authority and Tertiary & Vocational Education Commission are among the institutes under this ministry.

In fact, the general education system in Sri Lanka presented above could be viewed within the International Standard Classification of Education (ISCED) of UNESCO. A set of broader levels within formal education system could be identified in ISCED, which is primarily based on the attributes such as educational properties, institutional context, entrance age and requirements, target group, programme duration/intensity, educational attainment and regulatory framework. Within this framework, most relevant levels of education for the present intervention could be recognized as Tertiary/University (including postgraduate and professional) and Technical/Vocational, as highlighted in shaded frames in Figure 4.1 above and detailed in Table 4.2 below [35], [36].

Some more information of the above two levels of education in Sri Lanka is provided in Section 4.1.2 and Section 4.1.3.

4.1.2 Vocational and Technical Education

Vocational and Technical Education in Sri Lanka commenced with the establishment of the Government Technical College in 1893 in Maradana, initially to train the blue collar personnel who performs manual labor to run the Railways and the Tea Factories. This sector of education in Sri Lanka was neglected for many years, having many institutions involved. However, in the recent past, there have been several initiatives and sectoral changes to improve this situation and now there is a much improved overall institutional structure, governance management, particularly with the introduction of the National Vocational Qualifications Framework (NVQF). The NVQF consists of seven levels of instruction in three categories of professions.

Although the institutional mechanism and infrastructure facilities for delivery of Technical & Vocational education is in place, there are issues on effective delivery, mainly due to lack of properly trained staff in the relevant trade fields, with exposure to the new and emerging subject areas such as EE. Therefore, the incorporation of EE related topics into the curriculum is still not evident. However, this situation is improving, and major curriculum revisions are being introduced. For example, the University of Vocational Technology (UoVT), offers a number of BTech degrees, where topics such as environment conservation and management, renewable energy, energy conservation, green built environment are included in the curricula, but yet again not much on transport sector. Meanwhile, the employment opportunities are limited for technical/vocational degree/diploma holders in institutions and agencies under consideration in the present assignment (which are mainly government entities). Some of the institutions providing employment for these graduates/diploma holders include DMT, RDA, CEB, SLSEA, and private sector agencies such as vehicle maintenance and repair facilities.

Table 4.1: Formal education levels identified for education for EE in transport systems

Technical & Vocational Education
- Designed for learners to acquire the knowledge, skills and competencies specific to a particular class of occupations or trades, and may have work-based components (e.g. apprenticeships, dual-system education programmes). Successful completion of such programmes leads to labour market-relevant vocational qualifications acknowledged as occupationally-oriented by the relevant national authorities and/or the labour market. This level programmes may commence at the level of lower secondary education, and structured around the stage of development up to a first-degree level with opportunities for lateral entries at different levels.
- Age: 10 years and above
- Offered by technical colleges, vocational training institutes and universities.

Tertiary & Higher Education
- Builds on secondary education and often designed to provide participants with academic and/or professional knowledge, skills and competencies, leading to a degree (bachelor, master or doctoral) or equivalent qualification in specialized fields. It aims at learning at a high level of complexity and specialization. Programmes are typically theoretically-based but may include practical components and are informed by state of the art research and/or best professional practice.
- Age: Usually 19 years and above
- Offered by universities and equivalent tertiary educational institutions.

4.1.3 University and Tertiary Education

There are over 600 undergraduate degree programmes offered by 51 universities and degree awarding institutes at the tertiary level in a wide range of disciplines. Distribution of key categories of disciplines is presented in Figure 4.2 [37].

In order to address the need for comprehensive, nationally consistent, flexible framework for all qualifications in post-secondary education and training, the Ministry of Higher Education has developed the Sri Lanka Qualifications Framework (SLQF). The SLQF applies to all public and private sector higher education institutions. It comprises twelve levels: first two levels (levels 1-2) are senior secondary level education qualifications and the next four levels (levels 3-6) are undergraduate qualifications. The other six levels (levels 7-12) are postgraduate qualifications. SLQF is comparable with NVQF in the technical and vocational education [38].

In general, the EE topic is covered only in engineering and engineering technologist fields. Even in these courses, the emphasis is more on domestic, commercial and industry end-us sectors and that in the transport sector is rarely covered. As such, major gaps in the curricula could be expected in many degree programmes. However, more general topics such as resource conservation, sustainability, productivity, etc. are covered in subject areas such as environment management, sustainable energy, energy management, SD, cleaner production, sustainable built environment, sustainable supply chain management, holistic waste

management, sustainable agriculture, etc, but not specifically in transport sector. In the majority of the cases, these topics are introduced either section within other related subjects or as new optional/elective subjects. Among the university degree programmes, the progress is observed only in Engineering, Engineering Technology and Science disciplines, and specifically in recently introduced degree programme, at both undergraduate and postgraduate levels. In addition, all universities and number of other institutes offer specific CPD programmes and/or postgraduate degrees that will have opportunities and relevance for the introduction of topics related to EE in transport sector.

Once the capacity needs of different staff categories are identified, relevant courses and curricula have to be reviewed to propose the necessary revisions. In order to establish the general and specific competency (knowledge and skill) requirements related to EE in transport sector, following subsections provide the basis and approach for the assessment of gaps and upgrading of relevant educational programmes.

4.1.4 Other Forms of Education

Apart from the formal education system highlighted above, there are other means of learning and capacity building. For professional level educations, several institutes and organisations conduct Continuing Professional Education (CPE) or Continuing Professional Development (CPD) programmes in various disciplines. Some examples are: Sri Lanka Institute of Development Administration (SLIDA), Sri Lanka Energy Managers Association (SLEMA),

Figure 4.2: Number of degrees offered under different disciplines

- Arts, Huminities & Social Sciences 207
- Applied Sciences 174
- Management, Business, Finance & Accountancy 105
- Natural, life & Formal Sciences 118
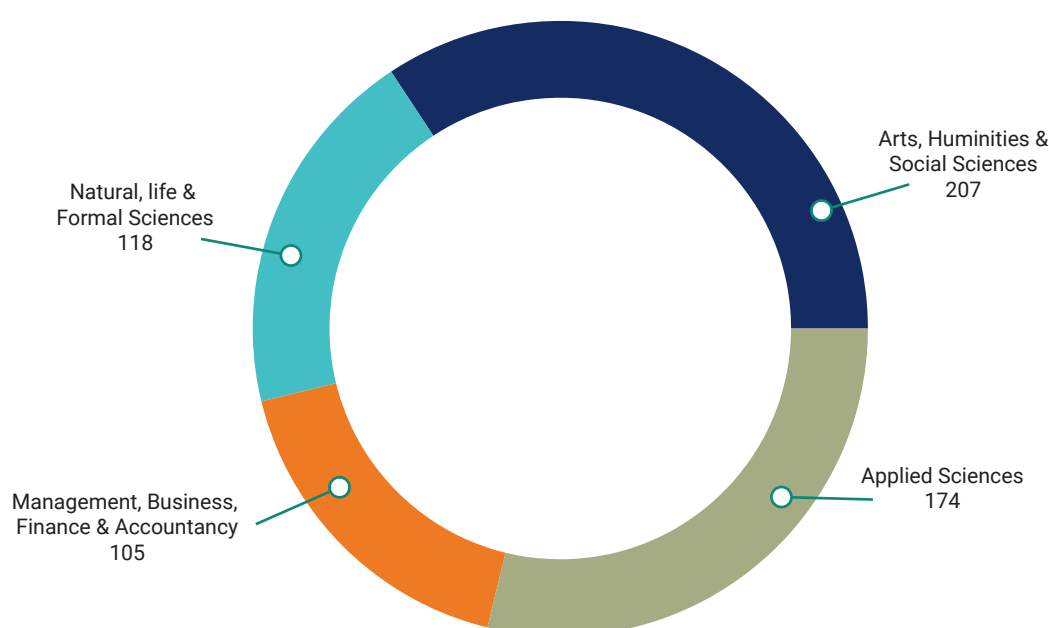
National Cleaner Production Center (NCPC), and SLSEA. Other less-structured forms of education also contribute to knowledge transfer, which is referred to as non-formal and informal educations. In particular, most of the staff of the transport sector agencies have acquired the related awareness and competencies through workplace-based "In-service" and/or "On-the-job" training. However, in most cases, the education is limited to general awareness on EE than competency building. The skill development could be seen in some cases, for example in-house trainings of SLVET programme operators and few leading vehicle importers, but the scope is limited to vehicle technology related areas without much emphasis on EE. The importance of these forms of education has been well-recognized globally, and there are initiatives to develop competency measuring frameworks for evaluation [39].

4.2 International Scenario on Energy Efficiency Education in Transport Systems

4.2.1 Background

The adverse impact of the transport sector, particularly related to resource depletion, environmental degradation and climate change has led to intense discussions on the need to shift towards SD pathways. It has been recognized that policy instruments or technological solutions alone are not sufficient and profound transformational change in the way people think and act (behavioural changes) was critical for facing societal challenges. The individuals require the knowledge, skills, attitudes and values that empower them to contribute to the efforts. Thus, the role of education and skill development in its broadest sense becomes a key strategy for achieving development goals [40]. In fact, SDGs include a separate goal on education as SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. In particular, ESD is explicitly recognized in the Target 4.7 of the SDG on education. Further, it is emphasized that ESD is crucially important for all the other 16 SDGs [41]. As the transport is one of the key sectors in economy, having direct impact on the environment and the society, the emphasis on the transport sector, including EE, in ESD is apparent in many national, regional and international initiatives.

4.2.2 Education for Sustainable Development

ESD was a United Nations (UN) programme that defined as education that encourages changes in knowledge, skills, values and attitudes to enable a more sustainable and just society for all. ESD aims to empower and equip current and future generations to meet their needs using a balanced and integrated approach to the economic, social and environmental dimensions of SD. ESD is the term most used internationally and by UN. The Agenda 21, instituted by UN in 1992, was the first international document that identified education as an essential tool for achieving SD and highlighted areas of action for education. In 2002, the UN General Assembly adopted a resolution for the initiative on Decade of Education for Sustainable Development (DESD) 2005-2014 [42]. United Nations Educational, Scientific and Cultural Organization (UNESCO) was designated as lead agency for the UN DESD. In response to the UN DESD, the United Nations University (UNU) called for the development of networks to promote ESD and to emerge as expertise centres for the research development of ESD, which has led to the establishment of Regional Centres of Expertise (RCE) supporting ESD.

In 2005, UN Economic and Social Council (UNECE) developed a Strategy for ESD, with the aim of encouraging the member countries to develop and incorporate ESD into their formal education systems, in all relevant subjects, and in non-formal and informal education [43]. It is expected to equip people with knowledge of and skills in SD, making them more competent and confident in facing challenges therein. The objectives of this Strategy, which will contribute to the achievement of the aim, include:

(a) Ensure that policy, regulatory and operational frameworks support ESD;

(b) Promote SD through formal, non-formal and informal learning;

(c) Equip educators with the competence to include SD in their teaching;

(d) Ensure that adequate tools and materials for ESD are accessible;

(e) Promote research on and development of ESD;

(f) Strengthen cooperation on ESD among member countries at all levels.

Further, the United Nations Environment Programme (UNEP) has facilitated the establishment of the Global Universities Partnership on Environment and Sustainability (GUPES) in 2012 as a flagship contribution to the UN DESD. GUPES aims to promote the integration of environment and sustainability concerns into teaching, research, community engagement, the management of universities, greening of university infrastructure and operations, as well as to enhance student engagement and participation in sustainability activities in the universities around the world. GUPES is anchored on three pillars, namely

education, training and networking. GUPES currently has close to 800 partner universities worldwide.

In 2013, the General Conference of UNESCO endorsed the Global Action Programme (GAP) on ESD as the follow-up to the UN DESD. The GAP employs a two-fold approach to multiply and to scale up ESD action, namely: (1) integrating SD into education, and (2) integrating education into SD [44]. The experience of the UN DESD lays the foundation for developing programmes to meet the educational needs required to achieve the SDGs [40]. Through the Incheon Declaration adopted at the World Education Forum in May 2015, UNESCO, as the United Nations' specialized agency for education, was entrusted to lead and coordinate the Education 2030 agenda with its partners. The roadmap to achieve the ten targets of the education goal is the Education 2030 Framework for Action, adopted in November 2015, which provides guidance to governments and partners on how to turn commitments into action [45].

4.2.3 Education for Energy Efficiency in Transport Systems

Within the broader context of ESD, importance of transport sector is emphasized in many interventions. For example, one principle of the strategy for ESD developed by UNECE indicate that ESD requires multi-stakeholder cooperation and partnership, in which the main actors include governments and local authorities, the education and scientific sectors, transport sector actors (and other sectors), the mass media, non-governmental organizations, various communities and international organizations, among others. Further one area of action identified is 'Promote SD through formal, non-formal and informal learning', in which it is stated that professional skills and knowledge of SD should be improved continuously and, consequently, be part of the lifelong learning of individuals including those in transport sector, among others [43]. Thus the priority in ESD for transport sector at strategic and tactical levels is apparent.

At operational level, more descriptive and comprehensive information is available on transport system related educational programmes, curricula, subject themes and specific modules, where the emphasis on resource/energy efficiency is clearly visible. One flagship programme of non-formal education for transport sector is the Sustainable Urban Transport Project (SUTP), hosted by German Corporation for International Cooperation GmbH (GIZ) on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ). It is supported by numerous partners including the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), and works with a wide range of

stakeholders in multinational and non-governmental organizations, development banks and academic institutions [11]. The interventions of the project are based on following ten principles for sustainable urban transport (SUT):

1. Planning dense and human scale cities;
2. Developing transit-oriented cities;
3. Optimizing the road network and use;
4. Encouraging walking and cycling;
5. Implementing transit improvements;
6. Controlling vehicle-use;
7. Managing parking;
8. Promoting clean vehicles;
9. Communicating solutions;
10. Approaching the challenges comprehensively.

The main activities and services of SUTP include:

- *Resources*: Developing and disseminating resources on all aspects of sustainable urban mobility including the SUTP Sourcebook series, Case Studies and Technical Documents on urban mobility;
- *Capacity building*: Designing and conducting training courses for organizations in developing cities, and providing an online guide to available training courses of partner organizations;
- *Policy advice and international exchange*: Policy advice on SUT and supports the international exchange on best practice and innovative solutions for urban mobility.

In particular, the SUTP Sourcebook for policy-makers covers all key topics to be considered for creating a comprehensive urban transport policy. The list of modules covered in SUTP Sourcebook is presented in Annex D. In particular, Module 5h: Urban Transport and Energy Efficiency is in fact the scope covered in the present study. Further, the training courses offered by SUTP include:

- Mass Transit Options
- Non-motorized Transport
- Public Awareness and Behaviour Change in Sustainable Transport
- Bus Regulation and Planning
- Cycling-inclusive Development
- Transportation Demand Management
- Financing Urban Transport.

Another regional project related to capacity building of transport sector actors is TRANSPORT LEARNING which is a European project, commenced in 2011,

designed to support practitioners to develop better solutions for urban transport systems [46]. The main objective of the project is to create knowledge and capacity on sustainable transport policies and measures in municipalities of Europe's convergence regions. With this strategy, it contributes to a modal shift towards more sustainable modes like walking, cycling and public transport, to a fair distribution of urban space and, in the process, to energy savings and cost reductions. At the beginning of the project, a training concept including training materials was developed by all project partners. Eight stand-alone training modules about SUT measures and policies were developed under the following themes:

- Parking space management
- Mobility management measures for Families, schools & kindergartens
- Walking & cycling
- Communication training
- Sustainable mobility campaigns
- Land use & housing
- Street design & traffic calming
- Public transport.

Subsequently, 64 training events were carried out in Europe's convergence regions, namely Bulgaria, Greece, Hungary, Italy, Poland, Portugal, Romania and Spain. The training has been replicated several times and training materials are now available for free. The project shows that creating knowledge and capacity is crucial to establishing the groundwork for SUT.

As highlighted earlier, the topic of transport is also covered in more generic topics in SD, in addition to the progammes dedicated to the sector. For instance, one study on Curriculum Framework for ESD conducted to support the GAP of UNESCO identifies one of the thematic areas as "Mobility, urban development and traffic" [47]. The thematic area is identified within the following guiding principles, thus signifying the role of transport in SD:

- Represent basic knowledge relevant to the learning area;
- Illustrate the multidimensional character of the guiding principle of SD;
- Address globalization and global development processes;
- Relevant to students' lives and make a global perspective possible;
- Grouped in a manner that is typical for the academic or social discourse;
- Draw from educational experience.

This thematic area has been elaborated more in the development of curricula for education for Sustainable Consumption & Production (SCP) in Sri Lanka. The subject topics identified under Mobility, urban development and traffic thematic area include [34]:

- The development of mobility – from bicycle to automobile and beyond
- Historical change of mobility and traffic
- Environment dimensions of transportation
- Transport planning: Avoid-Shift-Improve principle
- Transport sector and local air pollution; noise & light pollution
- Transport sector and climate change
- Transport sector and land use change
- Environmentally sustainable transportation (EST)
- Sustainable transport infrastructures
- Mass transport / public transport
- Non-motorized transportation (NMT)
- Transport demand management (TDM)
- Transport safety
- Sustainable urbanization, green cities and sustainable mobility
- ICT for transport demand management & Intelligent Transport Systems
- Cleaner fuels and vehicles
- Transport and SCP linkage
- Intermodal Transport systems
- Sustainable freight transport
- Aviation, ports and environment
- Ships, ports and environment
- Inland water transport and environment.

The list of the subject topics given above basically cover the transport sector in a broader context, and majority of them are centred around improving EE in the transport sector as a whole that described by the three interconnected elements of system efficiency, travel efficiency and vehicle efficiency. Therefore, the EE in the transport sector is already captured in the education plans globally as well as locally. However, in Sri Lanka, the interventions are yet at conceptual level and a significant effort is required for ground level implementation of appropriate education and skill development programmes. However, the advantage is that the conceptual framework for curriculum development is available with the local and global initiatives related to ESD, while case studies, best practices and lessons learnt are available around the world to refer [34, 40, 46].

4.3 The Concept of EE within a Transport System

Although the EE has a simple and direct meaning technical, the concept of EE in transport sector has much broader meaning, having three distinct but interconnected elements referred to as system efficiency, travel efficiency and vehicle efficiency, as described briefly in Section 1.2 in relation to A-S-I approach. This approach serves as a way to structure transport sector policy measures to achieve significant GHG emission reductions, reduced energy consumption, less congestion, with the final objective to create more livable cities. In the development community, the A-S-I approach was first embraced by international NGOs, as well as multilateral and bilateral development organizations working on transport, as a better alternative to the conventional predict–provide–manage approach. The A-S-I approach is focused on the demand side and offers a more holistic approach for an overall sustainable transport system design [48]. The interrelation between the three elements in the EE of transport system with A-S-I approach is illustrated in Figure 4.3, which facilitates the identification of the activities and programme for implementation under each intervention area [11].

Further to the above sources, many other information sources are available on transport sector interventions for energy efficiency improvements, which too become valuable resource base for the establishment of subject areas, required competencies, and thus the curricula in related educational programmes. Table 4.2 provide basic information of selected other information sources.

4.4 Education Programme and Curriculum Framework

4.4.1 The Basis

As education for EE in transport sector is a complex subject requiring transdisciplinary and inter-sectoral approaches, multiple tools and mechanism would be required to cater for different sectors and levels of education described previously. The educational programmes presented in Section 4.2 above suggests that the resources available globally as well as locally could be effectively used, with the feedback of the stakeholders, to identify areas of interventions required to improve the EE in the transport sector, while establishing the competency requirements for transport sector actors and gaps therein for the revision and introduction of relevant and appropriate educational and training programmes by the educationalist.

The different education programmes, courses and training programmes would be required to cater for the knowledge and skill needs in the transport sector to develop and implement EE improvement interventions. As all these educations and training are targeted for common goal of improving the overall EE in the

Figure 4.3: The overall energy efficiency concept in a transport system
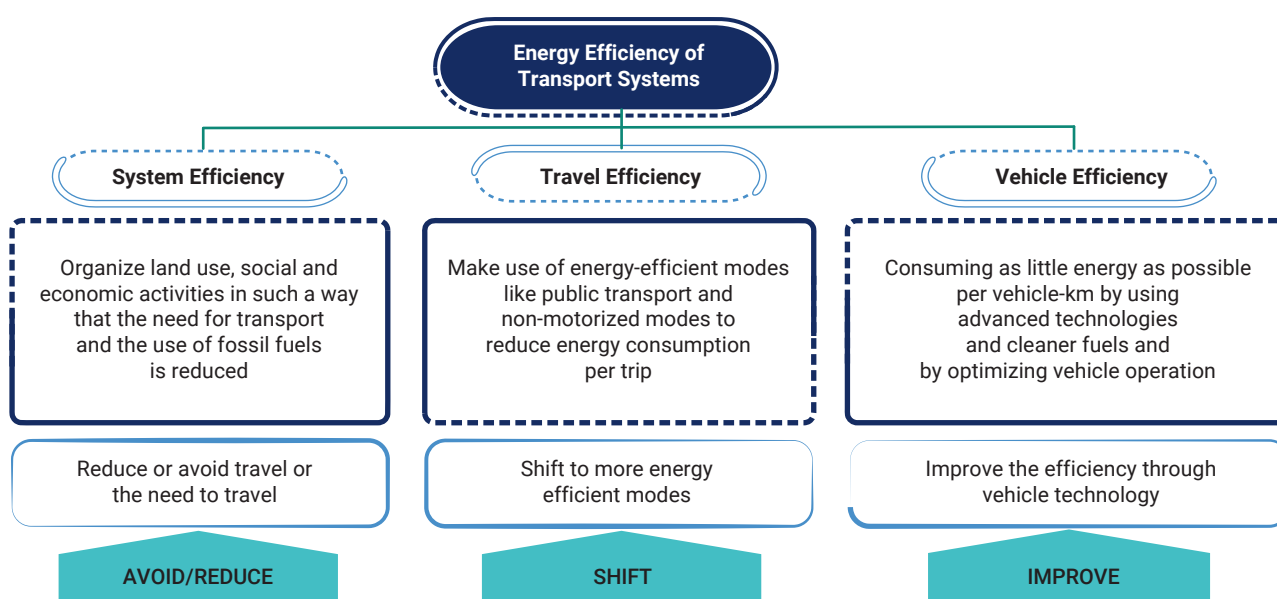
Table 4.2: Information sources for energy efficiency interventions in transport systems

Source	Title	EE Areas of Interventions
PEEREA: Protocol on EE and Related Environmental Aspects [49]	EE in the Transport Sector	✓ Technical and non-technical measures to improve EE; ✓ Policy measures to promote EE in the transport sector; ✓ Integration of EE measures in transport policies at the urban, national and international level.
SAARC Energy Centre [50]	Energy Efficiency in Road Transport Sector in the SAARC Member States	✓ A-S-I approach.
GIZ and Economic Commission for Latin America and the Caribbean (ECLAC) [51]	Energy efficiency and mobility: A roadmap towards a greener economy in Latin America and the Caribbean	✓ Fundamentals of EE and mobility ✓ A-S-I approach ✓ Development of markets for energy efficient mobility.
International Energy Agency (IEA) [52]	Technology Roadmap: FE of Road Vehicles	Technologies and measures for FE of: ✓ New vehicles ✓ In-use vehicles.

transport sector, it is more logical to follow a common curriculum development framework. Such framework would essentially include POs and CCs as the guiding elements for the development of other components such as SCs and LOs, as briefed in Section 3.4. The methodologies for development of curricula and related competency frameworks are well-established in the education field, including in ESD [34, 40, 46, 53].

4.4.2 The Programme Outcomes (POs)

POs are statements that describe learnings that are expected to attain and demonstrate by students

from all programmes upon completion. The POs provide guidance to different education and training programmes in defining their LOs relevant to the specific programme. Table 4.4 presents eight (08) POs established for the education of EE in transport systems in the present assignment.

4.4.3 The Core Competencies (CCs)

CCs define the desired knowledge, skills and attitudes of students completing the educational programme to successfully perform in professional, educational, and other life contexts. Accordingly, in line with the POs

Table 4.3: Programme outcomes of the EE education in transport systems

After completion of the education programme, the learner should be able to
1. Acquire, analyse and interpret data and information to understand the governing contexts in contextualizing a problem or action associated with EE in transport systems.
2. Create the conditions for critical thinking and analysis to question assumptions and to recognise and respect different trends and views in diverse and dynamic situations in EE.
3. Identify and connect economic, social and ecological dimensions of problems, conceiving conditions for systems thinking to work with complexity in supporting E3ST systems.
4. Envision scenarios for a desirable future and promote work with different visions and settings for such choices and future changes needed for ensuring EE in transport systems.
5. Create, select and apply proper techniques to complex transport problems in developing viable, inclusive and equitable solution options that promote EE in transport systems.
6. Creatively adapt strategic approaches in collective manner to develop and implement innovative actions jointly for fostering EE transport systems that further sustainability.
7. To engage in life-long learning approaches for nurturing EE in transport systems, with realization of interdisciplinarity, multidisciplinarity, and transdisciplinarity, while respecting needs, perspectives and actions of others and reflecting own norms and values,
8. Reflect on the norms, behaviours and values that inspire one's actions, while negotiating related sustainability values, principles, goals, and targets in realizing E3ST.

identified above, the CCs for EE in the transport systems are established as given in Table 4.4, with the use of the competency framework presented in Section 3.4.

4.4.4 The Thematic Areas

The list of thematic areas selected for the education of EE in transport systems is presented in Table 4.5. These themes reflect topics, which may be considered to have a broad relevance to the purposes of specific programmes for education of EE in transport systems and their wider context in the overall transport system. This list represents some indicative thematic areas and may not be comprehensive enough to capture the entire scope of the respective transport systems. When specific subjects or lessons are embedded within the curriculum, it is expected that they form an integral part of a programme of study, while learning and teaching activities are designed to take the POs and CCs into account. Further, the topics of the themes given are not prescriptive, recognizing that educators will be working within different educational programmes and

local contexts, governed in some cases by broader institutional strategies, thus need more flexibility. The topics cover the key areas within systems and sub-systems of the transport sector having direct and indirect bearing on EE. Thus the curricula and syllabi have to be developed in the context of EE in each area and sub-area in the list.

4.4.5 The Framework

The distinctly different features of courses and institutions demand specific attributes in the curriculum in each education programme. In particular, CCs, POs and thematic areas presented above have to be refined and tailored to suit each of the specific education programme/course or module. Accordingly, following requirements are established as guiding principles in developing course-specific EE education plan and curriculum:

- The specific course should demonstrate its contribution to EE education plan as well as the connectivity of their concepts and activities;

Table 4.4: Core competencies for EE in the transport sector

Cognitive Competencies (Knowledge)
1. *Information competency*: The ability to access, acquire and process information on topics of resource or energy efficiency (EE) in transport sector (covering the three areas of system efficiency, trip efficiency and vehicle efficiency in line with the Avoid/Reduce-Shift-Improve concept).
2. *Systems thinking competency*: The abilities to recognize and understand EE relationships; to analyze EE in complex transport systems; to think of how systems are embedded within different domains and different scales, and to deal with uncertainty.
3. *Critical thinking competency*: The ability to question norms, practices and opinions in relation to transport sector efficiency; to reflect on self-values, perceptions and actions in EE interventions; and to take a position in the sustainability discourse.

Functional Competencies (Skills and know-how)
4. *Anticipatory competency*: The abilities to understand and evaluate multiple futures – possible, probable and desirable of the transport sector EE; to create one's own visions for the future; to apply the precautionary principle; to assess the consequences of actions, and to deal with risks and changes in the area of EE in the transport sector .
5. *Strategic competency*: The abilities to collectively develop and implement innovative actions for energy efficient transport systems that further sustainability at the local level and further afield.
6. *Integrated problem-solving competency*: The overarching ability to apply different problem-solving frameworks to complex transport problems and develop viable, inclusive and equitable solution options that promote energy efficiency, integrating the above-mentioned competences.

Attitudinal Competencies (Behavioural and Values)
7. *Normative competency*: The abilities to understand and reflect on the norms, behaviours and values that underlie one's actions on EE in the transport sector; and to negotiate related sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions.
8. *Collaboration competency*: The abilities to learn from others; to understand and respect the needs, perspectives and actions of others; to understand, relate to and be sensitive to others; to deal with conflicts in a group, and to facilitate collaborative and participatory problem-solving in transport sector EE challenges.
9. *Self-awareness competency*: The ability to reflect on one's own role in the local community and (global) society; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires in relation to EE in transport.

Table 4.5: Thematic areas and subject topics for the EE education in transport systems

Main theme	Sub-themes/Subject topics
1. Transport and Sustainable Development	Mobility, Transport and Scio-economic development linkage; The paradox of transport and its costs - planetary boundaries, ecosystem ecology, industrial ecology, circular economy; Environment dimensions of transportation (local, global); Environmentally sustainable transportation (EST) and Sustainable urban transport (SUT); Resource/energy efficiency in transport modes/systems; Role of transport in International conventions and related national / local commitments (SDGs, NDCs).
2. Transport sector governance for energy efficiency and environmental sustainability	National development and sectoral policies and the role of EE of transport; Transport sector institutions and stakeholders and their role in EE; Economic instruments for EE in transport systems; Financing EST/SUT; Knowledge management for EE in transport; Systems approach to transport planning: Avoid/reduce-Shift-Improve (A-S-I) principle; EE model in transport (System efficiency, Travel efficiency and Vehicle efficiency).
3. Land use planning and transport demand management	Sustainable transport infrastructures; Land use planning and urban transport systems for EE; Optimization of the road network and its use; Transport demand management (TDM); Mobility management programmes and measures: minimum occupancy limitations, congestion/corridor pricing, flexible working hours, online working, education, transactions, purchasing; Parking space management, access restriction, speed control, improve traffic flow, traffic smoothing.
4. Energy Efficient and Environmentally Sustainable Transport (E3ST) Modes: Transit, walking and cycling	Mass transit options (BRT, LRT, Monorail) and public transport; Intermodal transport systems; Transit-oriented design features in cities and transport infrastructure (i.e. Transit Oriented Development – TOD); Regulations and planning for public transport; Non-motorized transport (NMT); Street design, streetscape and traffic calming; EE design features in transport infrastructure; Car-free developments.
5. Cleaner fuels and efficient vehicles	Cleaner transport fuels: fuel quality improvements in diesel and gasoline, natural gas, alternative fuels – biofuels, renewable electricity, hydrogen; Efficient vehicle technologies: advanced ICEs, EVs, Hybrids, Fuel cell; EE improvement options for new vehicles: air and exhaust gas management, fuel preparation and injection systems improvements, thermodynamic combustion engine process improvements, light-weight designs, aerodynamic designs, size reduction, automotive transmission, waste heat recovery systems, advanced cooling technologies; EE improvement options for in-use vehicles: inspection & maintenance, vehicle retrofit, alternative fuel conversions, fuel treatment/combustion improvement devices, accelerated retirement programmes; Intelligent transport systems (ITS); Eco-driving.
6. Impact assessment of the transport sector	Performance indicators and indices of transport modes and systems; Health and ecological impacts - direct, indirect and cumulative; Impact assessment frameworks and methodologies; Sustainability assessment tools; Transport sector performance and air quality management; Climate actions (mitigation and adaptation) in the transport sector; EE targets in transport sector.
7. Complementary themes	Diversity and inclusion in transport system: aspects related to human behaviour, culture, lifestyles, consumerism; Politics, advocacy and governance in the transport sector: SD and global agendas, environment governance, active citizenship, social empowerment, local policy initiatives and regulations; Globalization and sustainability: global interdependence and transport, international trade and EST, Sustainable globalization and transport; Inequality, poverty, social security and gender issues in the transport sector, demographic diversity and transport sector performance; Science and technological progression in the transport sector: future perspectives of technological development and innovations, social innovation for sustainability, principles of urban symbiosis towards E3ST systems; circulatory material/resources; digital lifestyle innovation; Internet of Things (IoTs) for transport systems.

- The sector/subject-specific competencies (SCs) should be established, aligning with the CCs presented in Table 4.4;

- The sector/subject-specific learning outcomes (LOs) should be established, aligning with the POs presented in Table 4.3; and

- The sector-relevant subject topics should be identified under relevant thematic areas presented in Table 4.5.

Figure 4.4 illustrates the above approach as a framework for development of specific educational programme within overall education for EE in transport systems.

The SCs, LOs and list of subjects lay the foundation for the development of curriculum for each course. Typically, each study programme in each of the education sector has a specific curriculum comprising of a set of subjects to cover the topics identified to develop relevant competencies and programme outcomes, and each subject has several sub-topics and few subject-specific LOs. Although the introduction of the EE concepts to the formal education system is central, non-formal and informal forms education too could be effectively used in successful delivery of educational and skill development programmes. Such integration would help to get recognition of non-formal and informal learning pathways as alternative and complementary prerequisites for successful learning of EE.

It is important to recognize at this juncture that the overall framework presented above for the education in EE of the transport sector is aligned with the SLQF and NVQF briefed in Section 4.1. The SLQF that developed for tertiary/university education sector integrates the NVQF that developed for technical/vocational education sector and identifies flexible pathways which assist in lateral mobility between the two sectors by providing basis for recognizing prior learning and credit transfer. Another important aspect is that the following objectives of the SLQF clearly support the expected outcomes of the present study [38]:

- Enhance the quality of higher education and training at all levels;

- Facilitate access to higher learning and thereby contribute to full personal development of learners and to social and economic development of the country;

- Enhance equity in higher education, training and employment opportunities;

- Assist employers to identify the levels of knowledge, skills and competencies of qualification holders;

- Develop positive attitudes in qualification holders;

- Help in developing higher education and vocational training programmes at appropriate levels;

Figure 4.4: Overall framework of EE education curriculum for a study programme
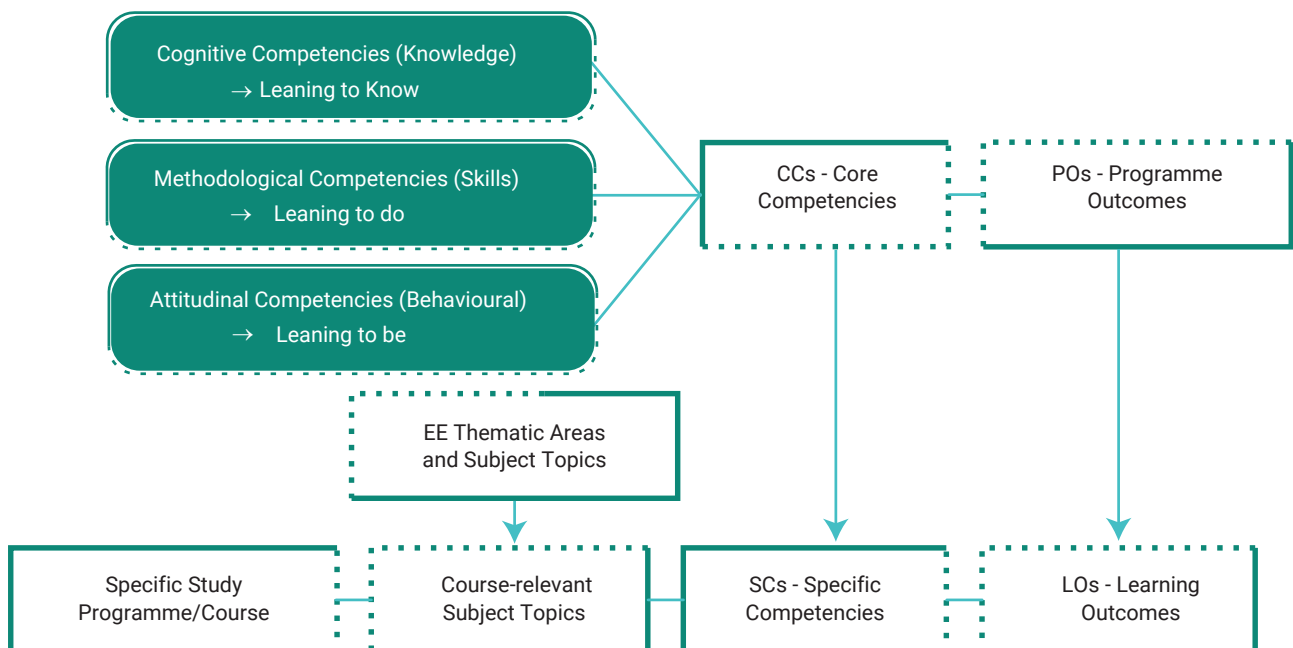
Table 4.6: The comparability of the levels in SLQF and NVQF

SLQF Level	Qualification awarded	Comparable NVQ Levels
12	Doctor of Philosophy / Doctor of Science / etc.	
11	Master of Philosophy	
10	Masters with coursework & research component	
9	Masters by course work	
8	Postgraduate Diploma	
7	Postgraduate Certificate	
6	Bachelors Honours	
5	Bachelors	7
4	Higher Diploma	6
3	Diploma	5
2	Advanced Certificate (GCE A/L or equivalent)	4
1	Certificate (GCE O/L or equivalent)	2 / 3

Further, the common framework for competencies, LOs and POs proposed above in the present study for all the educational programmes in different sectors signifying the significant similarities and interconnectivities too is evident in the comparability nature of the levels identified in SLQF and NVQF (see Table 4,6).

In conclusion, the establishment of sound frameworks for the competencies for EE in transport systems and the curricula for relevant educational programmes provides the basis for the identification and analysis of gaps in the stakeholder institutions, both in the transport sector and the education sector. The consultation of stakeholders provides the data and information for the gap analysis and identification of interventions. The next two sections provide the findings of the stakeholder consultation process for transport sector and education sector, respectively.

Section 05: Stakholder Analysis – The Transport Sector Actors

5.1 Introduction

In accordance with the methodology presented in Section 3.2, the data collection is performed through the distribution of the questionnaires among the staff identified in the selected institutions and agencies in the transport sector. The majority of the feedback is obtained through self-completion questionnaires from individual staff in online mode and structured/semi-structured interviews with physical meetings. Two physical meetings were conducted for private sector organizations, who are the operators of SLVET programme. Once the questionnaire is received, a screening is done to identify the level of completion for further consultation for completion, if required, or neglect if not relevant. This section provides the details of the respondents and the results of the stakeholder analysis in the transport sector.

5.2 Stakeholder Institutions: Transport Sector Actors

The stakeholder institutions selected for the analysis, in accordance with the framework presented in Table 3.1 of Section 3.2.2 under the methodology, are presented in Table 5.1. Altogether there are 34 institutions identified for the consultation.

Table 5.1: Stakeholder institutions selected form the transport sector

Sector (No.)	Domain (No. of Institutions)	Stakeholder Institution
National Government	Transport (05)	Ministry of Transport
		Department of Motor Traffic (DMT)
		SLVET Project Office
		National Transport Commission (NTC)
		Sri Lanka Transport Board (SLTB)
	Energy (05)	Ministry of Power & Energy (MoP&E)
		Sri Lanka Sustainable Energy Authority (SLSEA)
		Ceylon Electricity Board (CEB)
		Ceylon Petroleum Corporation (CPC)
		Lanka Electric Company Ltd (LECO): Semi Gov.
	Environment (02)	Ministry of Environment
		Central Environmental Authority (CEA)
	Development (02)	Sustainable Development Council (SDC)
		National Planning Department (NPD)
	Infrastructure (02)	Road Development Authority (RDA)
		Urban Development Authority (UDA)
Local Authorities	Transport (05)	Provincial Road Passenger Transport Authorities (RPTA) (in 05 Provinces)
Private Sector	SLVET Operation (02)	CleanCo Lanka (Pvt) Ltd
		Laugfs EcoSri Ltd
	Vehicle Importers (03)	Toyota Lanka (Pvt) Ltd
		Diesel & Motor Engineering PLC (DIMO)
		David Pieris Motor Company (Pvt) Ltd (DPMC)
	Support services (02)	GoEV - JLanka Technologies (Pvt) Limited
		I2C Pvt Ltd

Sector (No.)	Domain (No. of Institutions)	Stakeholder Institution
Others	Professional bodies (03)	Sri Lanka Society of Transport & Logistics (SLSTL)
		Sri Lanka Energy Managers Association (SLEMA)
		Institute of Automotive Engineers of Sri Lanka (IAESL)
	CSOs & NGOs (03)	CleanAir Sri Lanka (CleanAirSL)
		Janathakshan GTE Ltd
		SLYCAN Trust

The functions/assigned areas of the above institutions and the potential transport EE area/s are presented in Annex E. Some of these institutions are also involved with awareness and capacity building through in-service and on-the-job training programmes (see Table 6.1 in Section 6.2).

5.3 Staff of the Transport Sector Actors Selected for the Consultation

The feedback is obtained from selected staff in each institute identified in the previous section, in accordance with the methodology presented in Section 3.2.3, The sample is selected to cover the three categories of staff as Strategic level, Tactical level and Operational level. In the data collection, the tactical and operational level staff are treated in the same group (i.e. the same questions), but allowing the responses to highlight the two levels. The number of staff responded to the survey under each staff category in each institute is presented in Table 5.2. The number of transport experts contributed to the study too is indicated. Accordingly, the total number of respondents is 153. The details of the transport experts and the staff of transport sector institutes contributed to the survey are given in Annex F and Annex G. respectively.

Table 5.2: Categories and number of staff selected for consultation

Stakeholder Institution	Staff Category			Total
	Strategic	Tactical	Operational	
CEA	1	2	1	04
CEB	2	1	1	04
CleanAir SL	2	1	2	05
CleanCo Lanka (Pvt) Ltd	2	4	4	10
CPC	1	-	-	01
DIMO	1	-	-	01
DMT	1	4	2	07
DPMC		1	-	01
I2C Pvt Ltd	1			01
IAESL	1	1	-	02
Janathakshan GTE Ltd	1	2	-	03
JLanka Technologies Pvt Ltd	-	1	-	01
Laugfs EcoSri Ltd	1	3	8	12
LECO	1	-	-	01
Ministry of Environment	2	2	6	10
Ministry of Power & Energy	1	1	-	02
Ministry of Transport	1	-	-	01
NPD	1	2	-	03
NTC	1			01
RDA	1	3	2	06

Stakeholder Institution	Staff Category			Total
	Strategic	Tactical	Operational	
RPTA (North Western Prov.)	-	1	-	01
RPTA (Sabaragamuwa Prov.)	-	1	-	01
RPTA (Southern Prov.)	1	-	-	01
RPTA (Uva Prov.)	2	-	-	02
RPTA (Western Prov.)	-	-	2	02
SDC	2	2	6	10
SLEMA	1	1	1	03
SLSEA	4	3	5	12
SLSTL	-	2	-	02
SLTB	1	2		03
SLVET Project Office	1	2	8	11
SLYCAN Trust	2	1	6	09
Toyota Lanka (Pvt) Ltd	1	-	-	01
UDA	3	5	2	10
Sub-total	40	46	56	144
Transport Sector Experts	09	-	-	09
Total Respondents				153

5.4 Stakeholder Analysis – Transport Sector Actors

5.4.1 Potential for impact upon EE in the transport sector

As presented in Section 3.3, the potential of transport sector actors to impact on EE in transport is evaluated based on two set of criteria, namely (i) their relevance, as determined by the levels of interest and influence, and (ii) their expertise, as determined by the levels of awareness and competency. A set of significant levels for each indicators is set, as described below:

(a) Level of Influence

The influence characterizes the power of the transport sector actor to impact upon actions of others. Three levels of significance in relation to this character are defined here as:

- *High* (H)- having characters/attributes such as direct authority, higher management level, well-connectivity (strong contacts) and prominent professional respect.
- *Moderate* (M)- having characters/attributes such as some specific authority, middle management level, some-connectivity (certain contacts) and evident professional respect.

- *Little/No* (L)- having character/attributes such as low/no specific authority, middle or low management level, limited contacts and early stage of professional development.

(b) Level of Interest

The interest portrays the relevancy and focus of the employment of the transport sector actor on the area of concern, which in turn signifies the potential to support and facilitate relevant interventions. Three levels of significance in relation to this character are defined here as:

- *Primary* (P)- directly related to the roles & responsibilities of the employment.
- *Secondary* (S)- no direct relevance to the roles & responsibilities employment, but frequent contributions are made under team activities and/or specific tasks.
- *Little/no* (L) Little/no relevance to the roles & responsibilities employment, and contributions made under team activities and/or specific tasks are occasional/none.

(c) Level of Expertise

This is depicted through two aspects as awareness and competency (knowledge and skills), each with three levels of significance as:

- For the knowledge:

- *Sound* (S)- up to date, wide-ranging information on the subject is acquired/accessible.
- *Fair* (F)- general trends & basic information on the subject is acquired/accessible.
- *Low/none* (L)- related information is rarely/not pursued and limited/no acquisition.
- For the competency:
  - *High* (H)- well practiced, versatile knowledge; recognized as a sector expert.
  - *Fair* (F)- adequate knowledge, practiced through common engagements; recognized as a sector player.
  - *Low/none* (L)- basic knowledge, development stage of skills, newcomer to the sector.

The feedback of the respondents on the above attributes is presented in Annex H. The results of the stakeholder analysis based on the above criteria, indicators and level of significance are presented in the following sub-sections.

Levels of Interests and Influence

Figure 5.1 presents the mapping of the levels of interests and influence of all the respondents of the stakeholder institutes of the transport sector, in which each cell presents % number of the respondents. The overall potential for impacted upon the EE improvements in the transport sector are identified by broadly categorizing the interest and influence levels together into two groups as High/satisfactory (in light blue) and Low/unsatisfactory (in dark blue). The high/satisfactory potential group is taken as the ones in the cells [P,H], [P,M], [S,H] and [S,M]. The results show that the percentage of staff who could contribute significantly to EE improvements in the transport sector is about 71.9%.

Figure 5.1: Levels of interests and influence of transport actors − All staff

Influence		Minor/None	Secondary	Primary
	High	0.0%	6.5%	25.5%
	Moderate	0.0%	17.6%	22.2%
	Low/None	3.8%	17.0%	7.2%
		Minor/None	Secondary	Primary
			Interest	

Potential for Impact on EE
- High Potential
- Low Potential

Figure 5.2: Levels of interests and influence of transport actors − Strategic level

Influence		Minor/None	Secondary	Primary
	High	0.0%	22.2%	44.9%
	Moderate	0.0%	10.2%	20.4%
	Low/None	0.0%	6.1%	6.1%
		Minor/None	Secondary	Primary
			Interest	

Potential for Impact on EE
- High Potential
- Low Potential

Figure 5.3: Levels of interests and influence of transport actors – Tactical level

		Minor/None	Secondary	Primary
Influence	High	0.0%	2.1%	33.3%
	Moderate	0.0%	14.6%	33.3%
	Low/None	0.0%	14.6%	2.1%
		Minor/None	Secondary	Primary
			Interest	

Potential for Impact on EE

- High Potential
- Low Potential
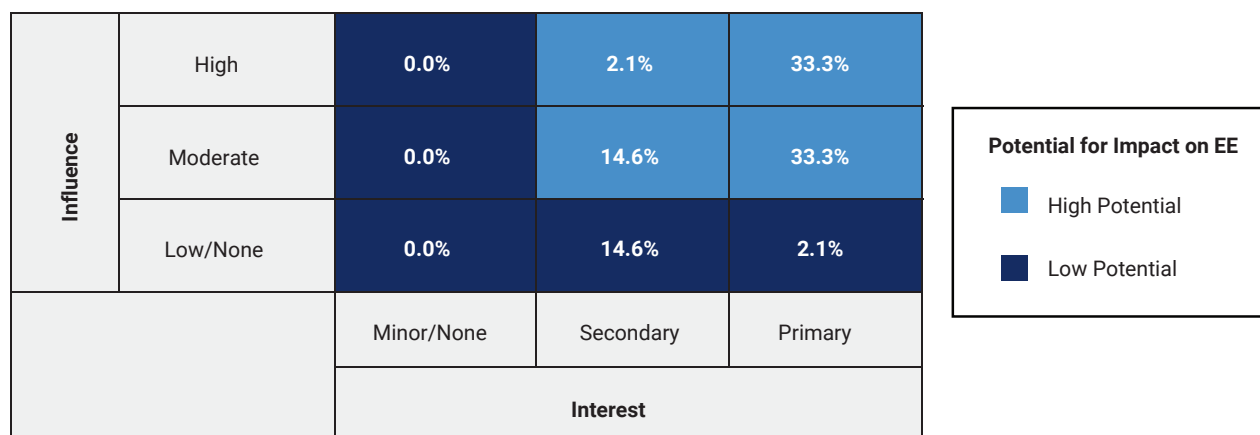
Figure 5.4: Levels of interests and influence of transport actors – Operational level

		Minor/None	Secondary	Primary
Influence	High	0.0%	5.4%	1.8%
	Moderate	0.0%	26.8%	14.3%
	Low/None	10.7%	28.6%	12.5%
		Minor/None	Secondary	Primary
			Interest	

Potential for Impact on EE

- High Potential
- Low Potential
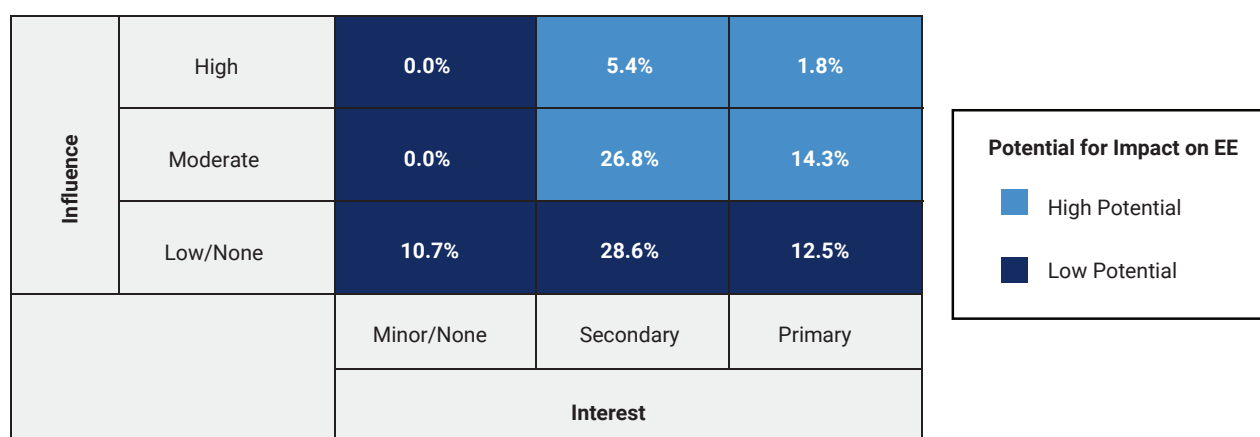
Similar mapping could be performed for the three staff categories separately to have a better understanding on the potential for impact on the EE of transport systems by the actors, based on their interest and influence levels. The results are presented in Figure 5.2 to Figure 5.4, where each cell presents % number of the respondents.

The above results signify that, based on the interest and influence, the majority of the staff at both strategic level (87.8%) and tactical level (83.3%) have the potential for contributing to EE improvements, while that of operational level staff is only 48.2%. This indicates the need for more emphasis on competency building of operational level staff in implementation of EE interventions in the transport sector. Note that, as the total number of staff under each of the three categories is not the same, the percentage estimations presented in Figure 5.1 will have a bias towards the category having high number of respondents. Alternatively, the simple average of the estimates of the three categories (as presented in Figures 5.2 to 5.4)

could be used to obtain more representative estimates for the population the staff as a collective group with equal importance. The corresponding results are presented in Figure 5.5.

The above results show that the percentage of staff who could contribute significantly to EE improvements in the transport sector is about 73.1%, which is slightly higher than the value of 71.9% derived earlier. Another notable feature is the inclination towards more interest than influence in the topic of EE project implementation in the transport sector.

The percentage of staff who could contribute significantly to EE improvements in the transport sector based on satisfactory levels of interest and influence estimated above are presented graphically in Figure 5.6 for easy interpretation. The figure clearly shows the lower percentage of operational level staff under High/ satisfactory group compared with the other two staff categories.

Figure 5.5: Levels of interests and influence of transport actors – All staff with equal weight for the three categories

Influence		Minor/None	Secondary	Primary
	High	0.0%	6.6%	26.7%
	Moderate	0.0%	17.2%	22.7%
	Low/None	3.6%	16.4%	6.9%
		Minor/None	Secondary	Primary
			Interest	

Potential for Impact on EE
- High Potential
- Low Potential
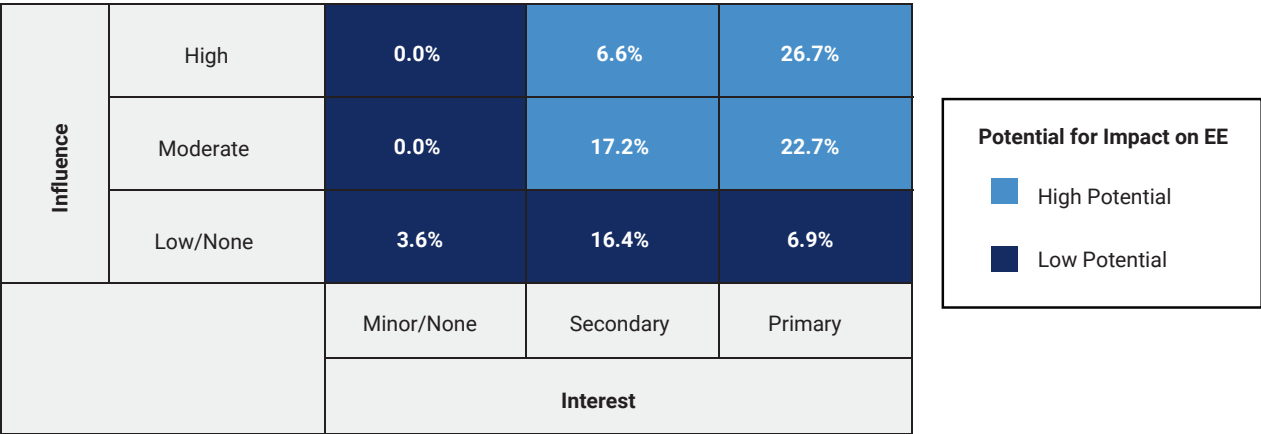
Figure 5.6: The percentage of staff who could contribute significantly to EE improvements based on satisfactory levels of interest and influence

Legend:
- Low/Unsatisfactory
- High/Satisfactory

Staff Category	High/Satisfactory	Low/Unsatisfactory
Strategic Level	89.8%	10.2%
Tactical Level	87.5%	12.5%
Operational Level	64.3%	35.7%
All Staff	80.5%	19.5%
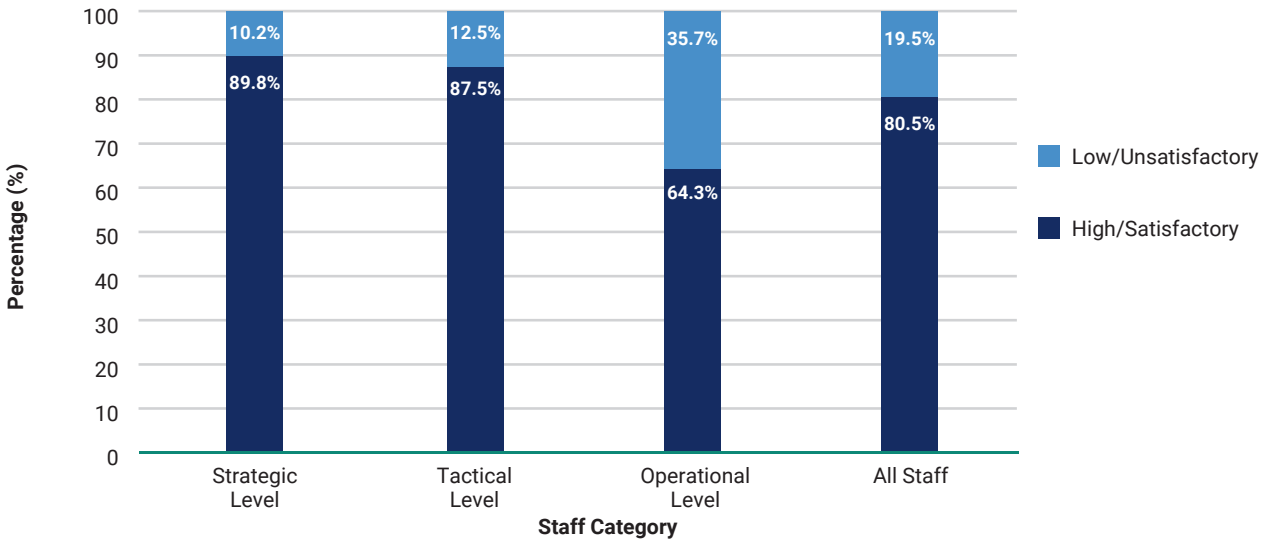
Awareness and Competency Levels

As above, stakeholder mapping could be carried out based on the awareness and competency (knowledge and skills) levels, and the results are presented in Figure 5.7 to Figure 5.10, with % number of the respondents is given in each cell. In this case too, the overall potential for impacted upon the EE improvements in the transport sector is identified by broadly categorizing the awareness and competency levels together into two groups as High and Low.

As with the case of levels of interest and influence, the overall feedback could also be derived from equal weights for the three staff categories, as presented in Figure 5.11, to minimize the effect that could arise from the differences of the absolute number

of staff consulted. These results on awareness and competency levels show similar pattern as those on interest and influence levels presented earlier. The overall percentage of the staff who could contribute to effective development and implementation of EE projects in the transport sector is about 80%. The corresponding figures for strategic, tactical and operational staff categories are 89.8%, 87.5% and 64.3%, respectively. Another significant feature is that the highest number of the staff in each of the three categories are in the middle segment of the awareness-competency matrix showing fair levels in both attributes. Further, there is an inclination towards awareness levels than competency levels. This highlights the need for more emphasis on competency (knowledge and skills) developments of the relevant staff for the effective implementation of EE

Figure 5.7: Awareness and competency levels of transport actors – All staff

Influence		Low/None	Fair	Sound
	High	0.0%	1.3%	22.9%
	Moderate	0.0%	38.6%	17.0%
	Low/None	11.1%	8.5%	0.7%
		Low/None	Fair	Sound
			Awareness	

Potential for Impact on EE
- High Potential
- Low Potential
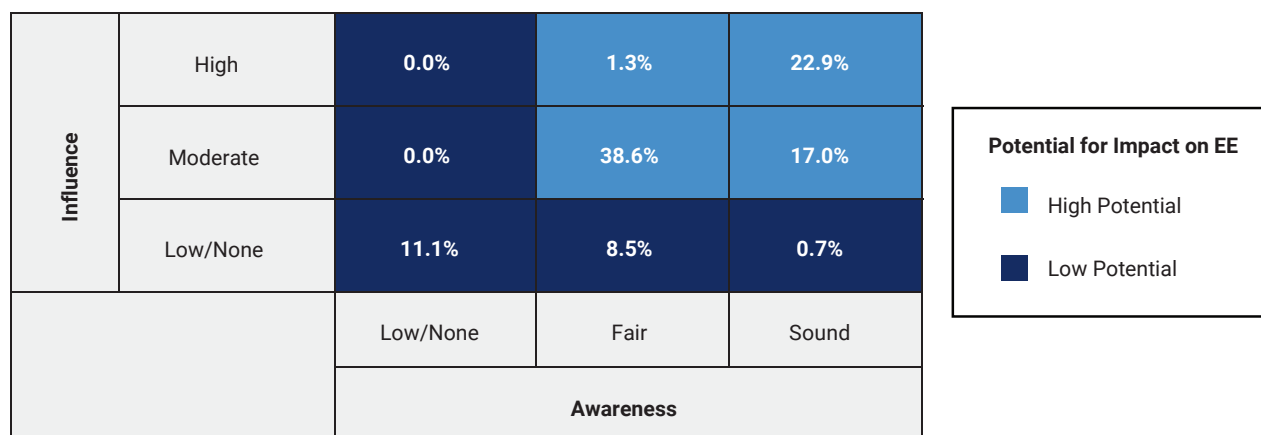
Figure 5.8: Awareness and competency levels of transport actors – Strategic level

Influence		Low/None	Fair	Sound
	High	0.0%	0.0%	36.7%
	Moderate	0.0%	38.8%	14.3%
	Low/None	0.0%	10.2%	0.0%
		Low/None	Fair	Sound
			Awareness	

Potential for Impact on EE
- High Potential
- Low Potential
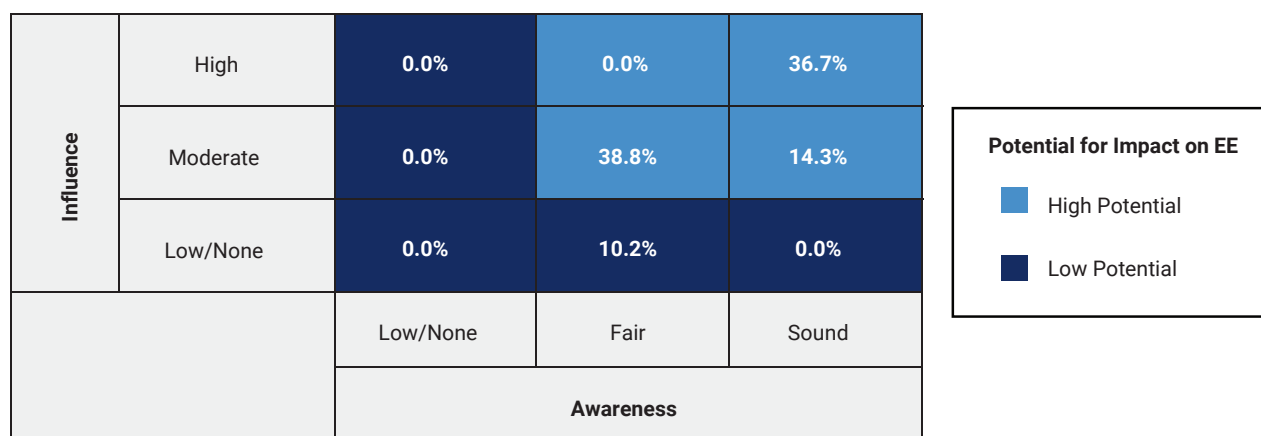
Figure 5.9: Awareness and competency levels of transport actors – Tactical level

Influence		Low/None	Fair	Sound
	High	0.0%	0.0%	20.8%
	Moderate	0.0%	41.7%	25.0%
	Low/None	10.4%	0.0%	2.1%
		Low/None	Fair	Sound
			Awareness	

Potential for Impact on EE
- High Potential
- Low Potential
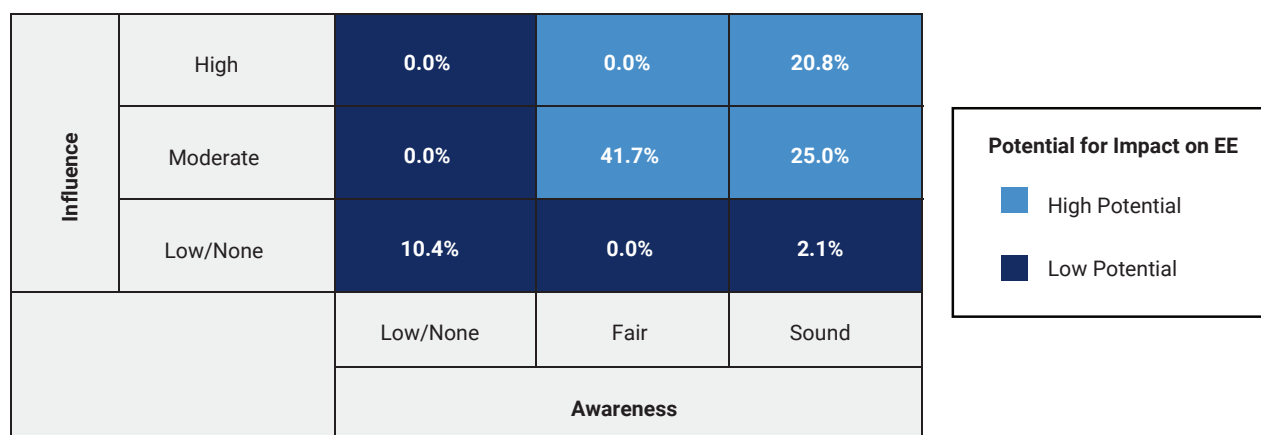
Figure 5.10: Awareness and competency levels of transport actors – Operational level

Influence	High	0.0%	3.6%	12.5%
	Moderate	0.0%	35.7%	12.5%
	Low/None	21.4%	14.3%	0.0%
		Low/None	Fair	Sound
		Awareness		

Potential for Impact on EE
- High Potential
- Low Potential
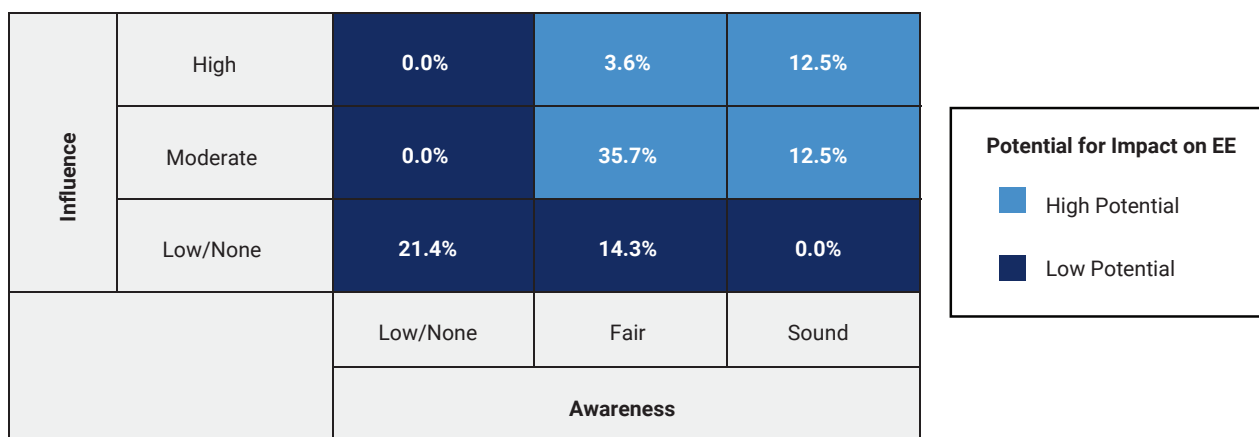
Figure 5.11: Awareness and competency of transport actors- All staff with equal weight

Influence	High	0.0%	1.2%	23.4%
	Moderate	0.0%	38.7%	17.3%
	Low/None	10.6%	8.2%	0.7%
		Low/None	Fair	Sound
		Awareness		

Potential for Impact on EE
- High Potential
- Low Potential
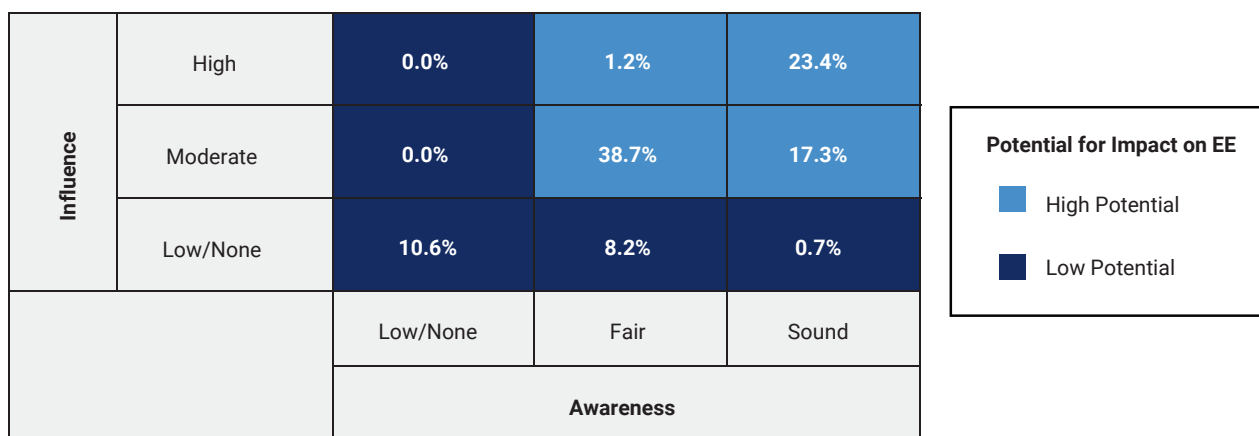
Figure 5.12: The percentage of staff who could contribute significantly to EE improvements based on satisfactory levels of awareness and competencies

Legend:
- Low/Unsatisfactory
- High/Satisfactory

Staff Category	High/Satisfactory	Low/Unsatisfactory
Strategic Level	89.8	10.2
Tactical Level	87.5	12.5
Operational Level	64.3	35.7
All Staff	80.5	19.5
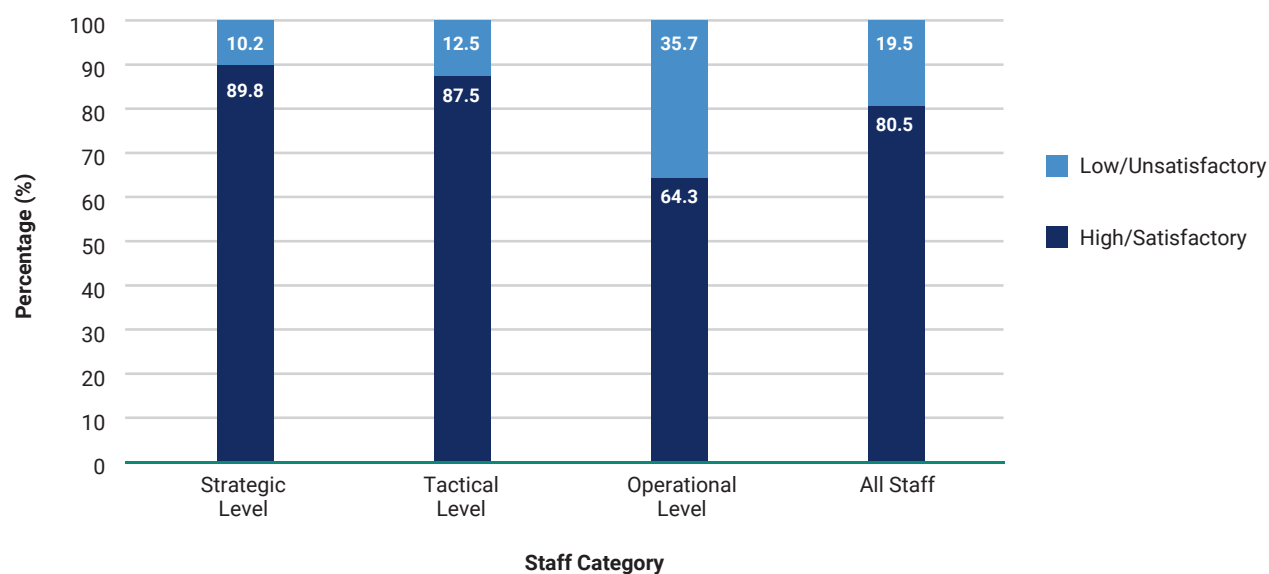
projects in the transport sector. One critical reflection the analysis is that 21.4% of operational staff have neither awareness nor the competency at substantial levels to contribute to EE in transport systems. This aspect too needs particular attention when designing and implementing capacity building programmes for transport sector actors.

The percentage of staffs who could contribute significantly to EE improvements in the transport sector based on satisfactory levels of awareness and competencies estimated above could be presented graphically for better interpretation, as shown in Figure 5.12. Similar to the case of interest/influence, it is apparent that the operational level staff has lower satisfactory level than the other two staff categories. However, in comparison, awareness/competencies attribute shows better situation in all staff categories than interest/influence attribute.

5.4.2 Detailed assessment of competencies of transport sector actors

The detailed assessment of competencies of transport sector actors is performed based on the following aspects:

- Academic qualifications
- Professional qualifications
- Modes of education specific to transport
- Roles & responsibilities in the employment / profession

- Levels of cognitive competencies under each EE area in the transport sector
- Levels of functional competencies under each EE area in the transport sector.

In addition, feedback was obtained on recommendations for the implementation of EE projects, in specific components or sub-systems of the transport sector covering the three EE areas, namely system efficiency, travel efficiency or vehicle efficiency. The specific components or subsystems may include type of main transport modes such as public transport (buses), personal vehicles (2W, 3W, 4Ws), non-motorized transport, etc. and also could be further divided geographically (rural, urban, semi-urban) or by technology (ICE, Hybrid, EVs), or by fuel type, or by operator (government, private companies, individual private operators) or by functions (long-distance / intercity, short distance, intermodal transport, school buses, government vehicle fleet) or support systems (such as vehicle repair facilities/garages, spare part industry, information management systems, transport infrastructure, fuel supply/distribution system). The potential interventions may include generic or specific policy, legislations, regulatory, facilitations, technological, infrastructure, fuel, information, knowledge / capacity building, etc. that could lead to direct or indirect improvements in the three EE areas. The feedback are summarized in Annex I and Annex J.

Figure 5.13: Highest academic qualifications and professional qualifications

Postgraduate 54.2%

Undergraduate 26.8%

Other 2.6%

Diploma 16.3%

Highest academic qualification

Yes, 56.9%

No, 43.1%

Possessing of professional qualification
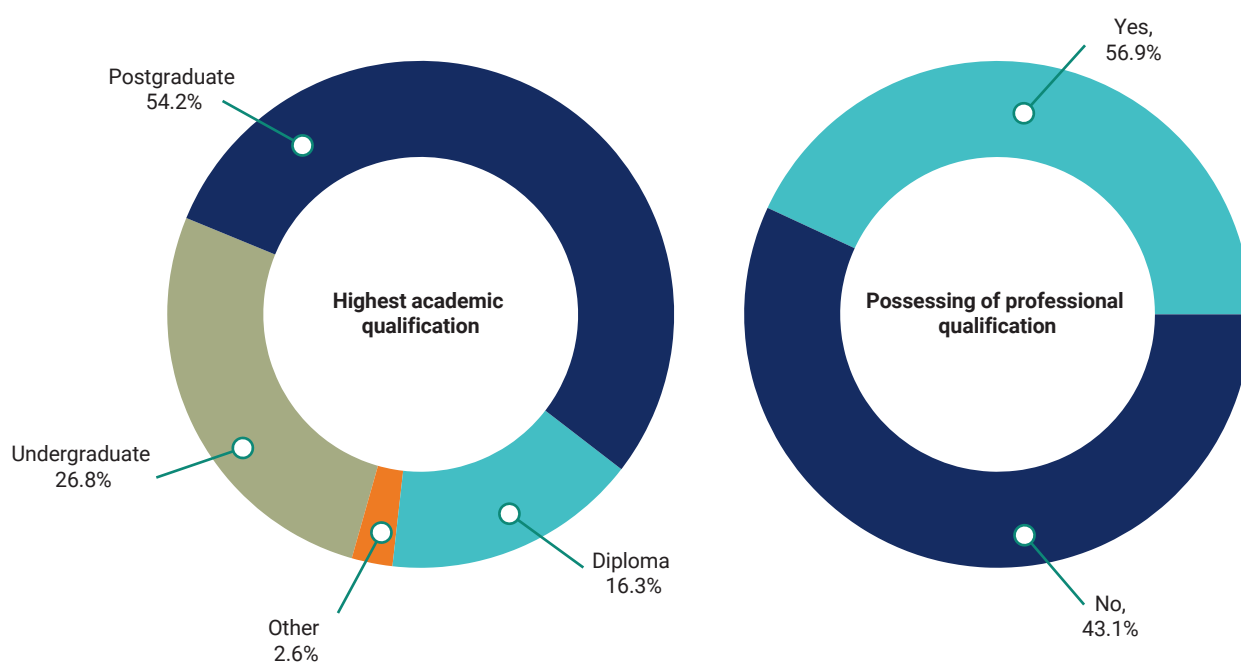
Figure 5.14: Modes of acquiring awareness and education on transport
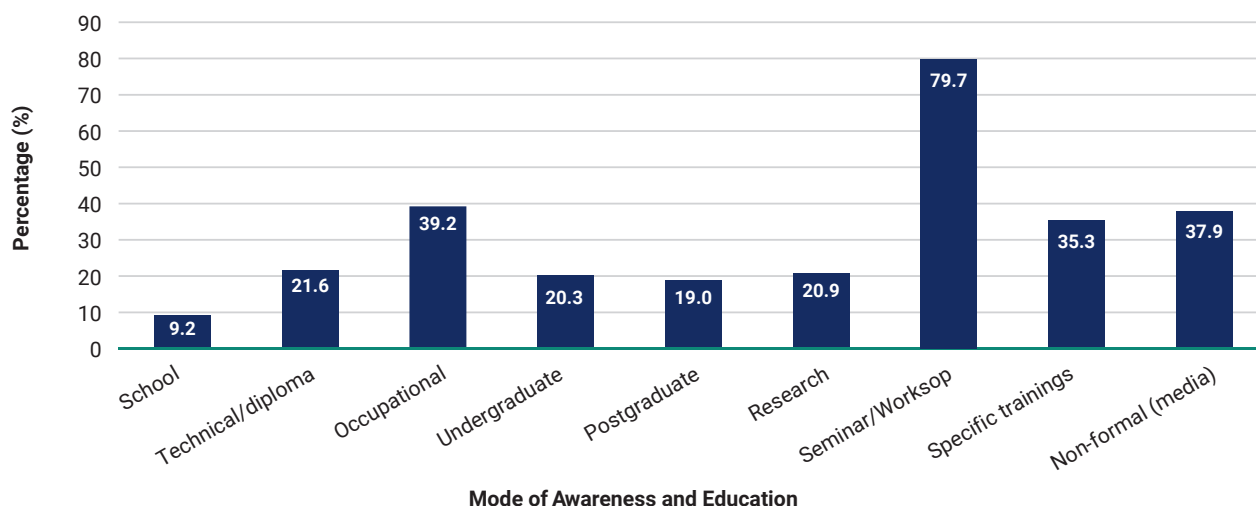
Academic qualifications

The distribution of highest academic qualifications, categorized as (i) Postgraduate, (ii) Undergraduate, (iii) Diploma, and (iv) Other or no response, is shown in Figure 5.13-(a), as percentage of the total respondents (i.e. 151). It can be seen that the majority of 81.5% has either postgraduate or undergraduate degree, signifying the capacity to acquire further competencies. Further, as shown in Figure 5.13-(b), about 44% of the respondents have professional qualifications (such as memberships in professional bodies), which indicate the preference for further professional developments (beyond the academic qualifications).

Modes of awareness and education on transport

Figure 5.14 presents the distribution of different modes/means used by the transport sector actors for acquiring awareness and education on the subject.

Note that a given respondent has used more than one mode in general. Further, though the percentages are calculated based on the total number of respondents (i.e. 153), all respondents may not have the opportunity to get awareness and education in all modes, particularly the formal education modes of technical, undergraduate and postgraduate. It is apparent by the above analysis that the main mode or means of acquiring awareness and education on the subject of transport is through seminars and workshops (79.7%), followed by occupational (39.2%), non-formal/media (37.9%) and specific training programmes (35.3%). The contribution from the school education is the lowest at 9.2%. The other modes (technical, undergraduate, postgraduate and research) have similar contribution of around 20% each.

Note that, as highlighted at the beginning of the previous paragraph, all the respondents did not have equal opportunity to follow the formal education modes of technical, undergraduate and postgraduate level and the results presented in Figure 5.14 related to these three modes should be interpreted in conjunction with the results presented in Figure 5.13-(a) on highest academic qualifications. Accordingly, as only 54.2% of the respondents (i.e. 83 out of 153) have postgraduate qualifications, it could be estimated that the transport subject is covered in about 34.9% of the postgraduate level educational programmes. Further, with the assumption that all the postgraduate degree holders have undergraduate degree qualifications too, the transport subject is covered in about 37.3% of the undergraduate level courses. In case of respondents having technical/diploma level of education, majority of them (i.e. 22 out of 25 or 88.0%) have acquired the knowledge and education on transport during the relevant programmes. This is due to the fact that the diploma holders consulted in the study primarily represent those involved in the automobile sector and thus followed technical diplomas related to vehicles/automobiles. Almost all the respondents in the other sectors related to transport have university or tertiary level education even in operational level staff category.

Roles & responsibilities

Although the broader level of roles and responsibilities of the three staff categories are considered as:

(i) Strategic level: Policy and Planning,

(ii) Tactical level: Planning and Implementation, and

(iii) Operational level: Implementation and Operation,

more detailed form of functions have been used to explore this aspect in the study as listed below:

- Policy/Strategy,
- Planning,
- Administration,
- Design/Develop,
- Coordination,
- Implementation,
- Supervision, and
- Operation.

Figure 5.15 presents the roles and responsibilities of all staff as a percentage of the total number (i.e.153). The results show significant involvement in all the functional areas, which signifies a considerable overlap among the three staff categories. The highest involvement is in the area of planning (68.6%), followed by coordination (65.4%), implementation (59.5%) and reporting (58.8%). The lowest involvement is related to supervision (40.5%) followed by administration as well as (41.2%) and operation (43.1%).

A better insight to the roles and responsibilities of transport sector actors could be obtained by analyzing the three staff categories, namely strategic level, tactical level and operational level separately, as presented in Figure 5.16 to Figure 5.18, respectively.

The above results for the individual staff categories too show involvement of all three staff categories in all functions, but with more involvements in the respective key functions. For examples, for strategic level staff, main involvements are in planning (87.8%), followed by policy/strategy (83.7%), administration (65.3%) and coordination (59.2%), while for those of

tactical level staff are planning (81.3%), followed by coordination (75.0%), implementation (68.8%) and design/development (58.3%). For the operational level staff the highest involvement is in reporting (85.7%), followed by coordination (62.5%), operation (58.9%) and implementation (57.1%). There is a significant involvements of the operational level staff in planning (41.1%) as well as supervision (35.7%). The involvements of the operational staff in policy/strategy and administration are the lowest with 8.9% and 12.5%, respectively.

Levels of cognitive and functional competencies

In order to accomplish the assigned roles and responsibilities effectively and efficiently, the transport sector actors require different competencies (knowledge and skills) at different levels such as policy making, planning, implementation and operation in variety of EE intervention programmes of the transport sector targeting improvements of system efficiency, trip-efficiency and vehicle efficiency. Assessing the relative levels of competencies in each of these aspects helps to identify the present status of the competencies as well as the gaps and areas/methods for competency building. The framework for this analysis is presented in Table 3.5 under the methodology section. The knowledge and skills are evaluated in five significant levels. Accordingly, the following criteria are used in this study to establish the five hierarchical levels for the competencies of the transport sector actors in relation to EE in transport:

(a) Knowledge Level

The knowledge represents cognitive competencies which could be broadly classified as information competency (the ability to access, acquire and process

Figure 5.15: Roles and responsibilities of all staff
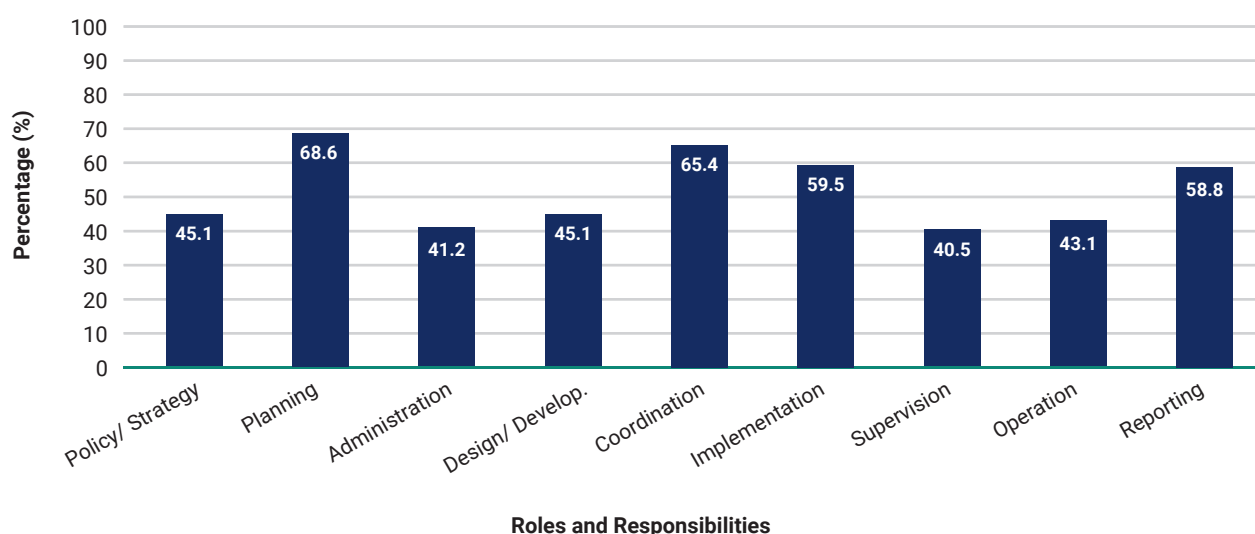
Figure 5.16: Roles and responsibilities of strategic level staff
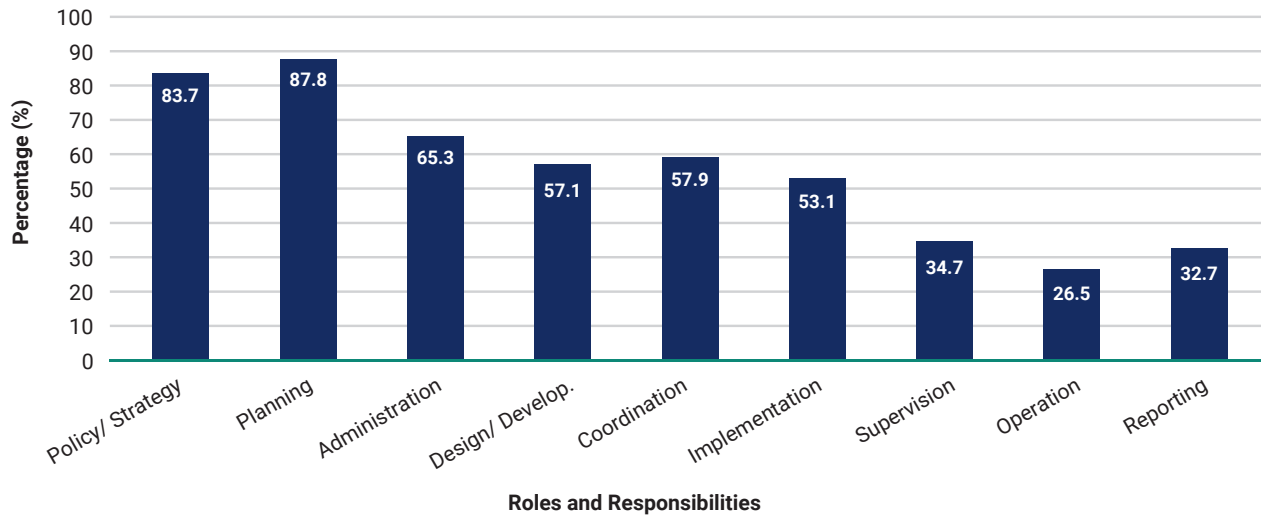
Figure 5.17: Roles and responsibilities of tactical level staff
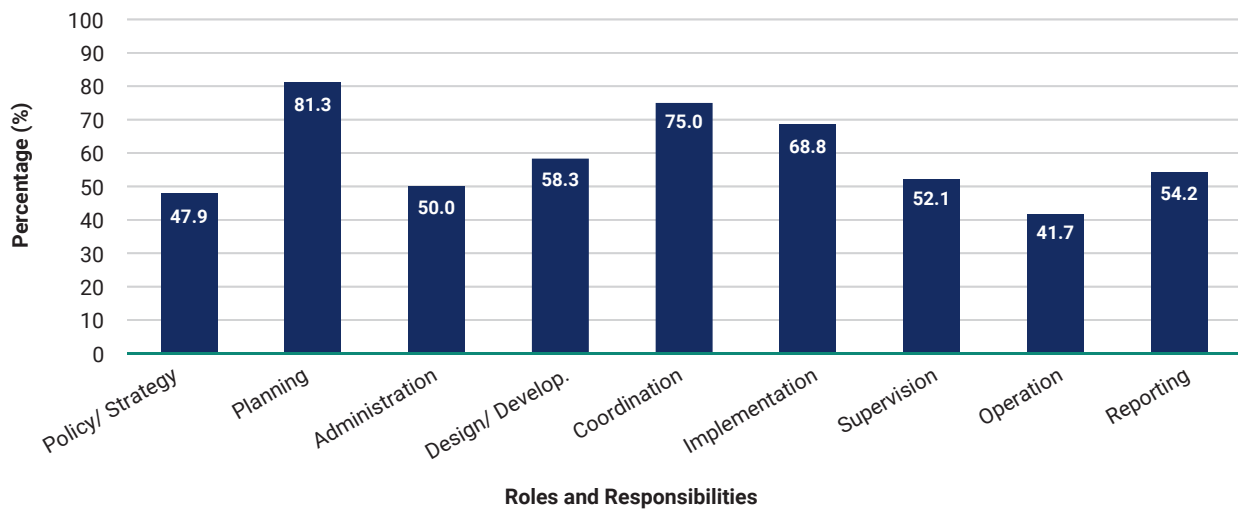
Figure 5.18: Roles and responsibilities of operational level staff
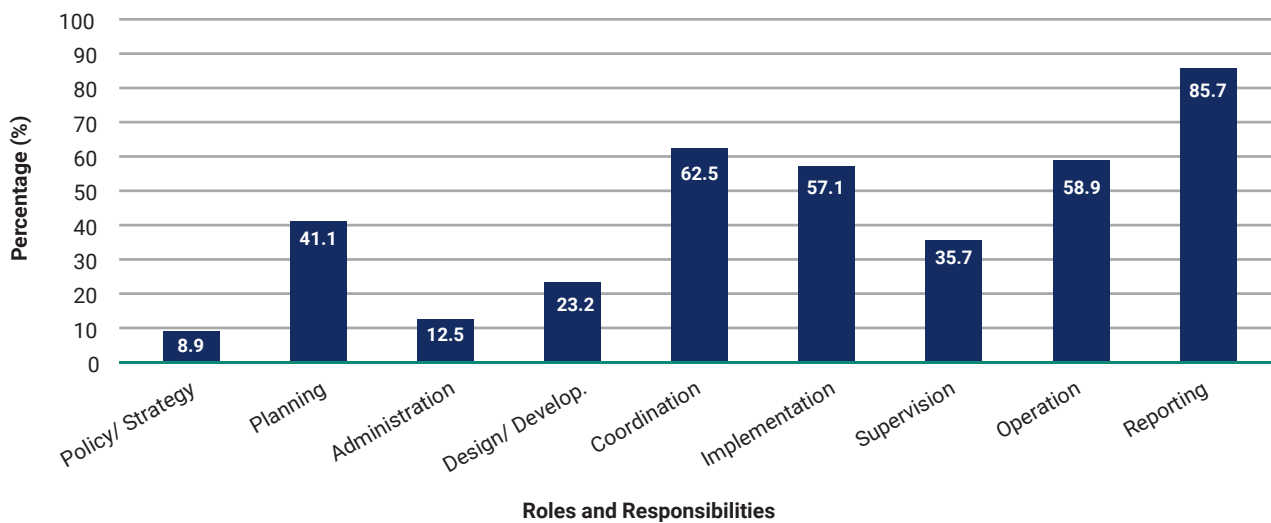
information), system thinking competency (the ability to recognize/understand relationships and to analyze complex systems) and critical thinking competency (the ability to question norms/practices; to reflect on self-perceptions/actions; and to take a position in the sustainability discourse). Five levels of significance in relation to this character are defined here as:

- *Expert* (E): demonstrated excellence in information management across multiple areas of transport; sound capacity to comprehend/analyze complex transport systems; proven capacity in testing norms/practices in several occasions, while reflecting on self-actions emphasizing sustainability.

- *Advanced* (A): proficient in information management in transport related areas; sound capacity to comprehend/analyze integrated transport systems; capable for testing of norms/practices, while reflecting on self-actions emphasizing sustainability.

- *Intermediate* (I): capable of information management in specific transport areas; understand the complexity of transport systems and relevant comprehensive solutions; evident desire for testing of norms/practices, while reflecting on self-actions with sense of sustainability.

- *Basic* (B): capable of managing basic information in specific transport areas; understand the complexity of transport systems and need for comprehensive solutions; understand the need for questioning norms/practices, while reflecting on self-actions with sense of sustainability.

- *None/Limited* (N): Very limited exposure to transport sector data/information; capable to understand only simple transport systems; limited experience to question norms/practices, and to reflect on self-perceptions/actions.

(b) Skills Level

The skills represent functional competencies which could be broadly classified as anticipatory competency (the ability to evaluate situations of multiple scenarios of transport systems), strategic competency (the ability to collectively design and implement interventions that foster sustainability) and complex problem solving competency (the ability to apply different problem-solving methodologies related to complex and diverse transport issues to develop comprehensive solution options). Five levels of significance in relation to this character are defined here as:

- *Expert* (E): demonstrated excellence in evaluating situations of multiple scenarios of transport systems; sound capacity to collectively design & implement interventions that foster sustainability; proven capacity to apply different problem-solving methodologies related to

complex and diverse transport issues in deriving comprehensive solution options.

- *Advanced* (A): proficient in evaluating situations of different scenarios of specific transport systems; capable of contributing to collective design & implementation of interventions that foster sustainability; capable of applying different problem-solving methodologies related to specific integrated transport issues in deriving appropriate solution options.

- *Intermediate* (I): capable of evaluating situations of different scenarios of specific transport systems; capable of contributing to specific areas in design & implementation of interventions that foster sustainability; capable of applying specific problem-solving methodologies related to particular transport issues in deriving appropriate solution options.

- *Basic* (B): capable of evaluating situations of specific scenarios of simple transport systems; understand specific areas in design & implementation of interventions that foster sustainability; capable of identifying specific problem-solving methodologies related to particular transport issues in deriving appropriate solution options.

- *None/Limited* (N): very limited exposure in evaluating situations of specific scenarios of transport systems; no experience in design & implementation of interventions that foster sustainability; limited familiarity on problem-solving methodologies related to particular transport issues.

The feedback is obtained from transport sector actors to establish their levels of competencies in performing EE improvements tasks in the main functional areas. Figure 5.19 and Figure 5.20 present the numerical results in matrix form for easy recognition of the competency levels, and gaps therein. Here, the gaps in competencies are identified by broadly categorizing the knowledge and skills together into two groups as High/Satisfactory (in light blue) and Low/Unsatisfactory (in gray). The high/satisfactory potential group is taken as the ones in the cells [E,E], [E,A], [E,I], [E,B], [A,E], [A,A], [A,I], [A,B], [I,E], [I,A], [I,I], [B,E] and [B,A].

In the above classification, more priority should be given to Low/Unsatisfactory groups in formulating and implementing education and capacity building programmes. Note that, broadly the policy making and planning functions represent the strategic level staff category, while planning and implementation functions represent tactical level and implementation and operation function represent operational level staff categories.

Figure 5.19: Competencies of the transport sector actors: Knowledge and skill levels for all functions (Each cell presents % number of the respondents)

Skill Levels		System Efficiency					Travel Efficiency					Vehicle Efficiency					Overall Efficiency					All Functions
	E	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	
	A	0.0	0.0	0.3	10.8	0.7	0.0	0.0	0.3	10.8	0.7	0.0	0.0	0.3	10.8	0.7	0.0	0.0	0.3	10.8	0.7	
	I	0.0	1.4	18.4	6.6	0.0	0.0	1.4	18.4	6.6	0.0	0.0	1.4	18.4	6.6	0.0	0.0	1.4	18.4	6.6	0.0	
	B	0.7	35.1	14.2	0.3	0.0	0.7	35.1	14.2	0.3	0.0	0.7	35.1	14.2	0.3	0.0	0.7	35.1	14.2	0.3	0.0	
	N	4.9	5.6	0.0	0.0	0.0	4.9	5.6	0.0	0.0	0.0	4.9	5.6	0.0	0.0	0.0	4.9	5.6	0.0	0.0	0.0	
		N	B	I	A	E	N	B	I	A	E	N	B	I	A	E	N	B	I	A	E	

Knowledge Levels

Figure 5.20: Competencies of the transport sector actors: Knowledge and skill levels for specific functions (Note: Each cell presents % number of the respondents)

		Policy making					Planning					Implementation					Operation					
	E	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.4	3.4	0.0	0.0	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.0	Overall Efficiency
	A	0.0	0.0	0.0	18.3	1.7	0.0	0.0	0.4	16.7	0.8	0.0	0.6	0.3	8.7	1.0	0.0	0.6	1.2	3.0	0.6	
	I	0.0	2.5	19.2	13.3	0.0	0.0	0.0	27.7	6.1	0.0	0.3	0.6	20.5	4.8	0.0	0.0	2.4	10.7	3.0	0.6	
	B	1.7	24.2	9.2	0.8	0.0	1.1	22.7	13.6	1.5	0.0	0.0	35.3	11.5	0.3	0.0	0.6	35.7	10.7	0.6	0.0	
	N	4.2	1.7	0.0	0.0	0.0	4.9	0.8	0.0	0.0	0.0	8.7	7.1	0.0	0.0	0.0	17.3	12.5	0.0	0.0	0.0	
	E	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	Vehicle Efficiency
	A	0.0	0.0	0.0	20.0	0.0	0.0	0.0	1.1	18.2	2.3	0.0	1.0	0.0	13.5	1.9	0.0	0.0	1.8	7.1	1.8	
	I	0.0	2.5	22.5	5.0	0.0	0.0	0.0	25.0	2.3	0.0	1.0	1.0	21.2	4.8	0.0	0.0	0.0	14.3	3.6	1.8	
	B	0.0	22.5	7.5	2.5	0.0	1.1	23.9	6.8	3.4	0.0	0.0	24.0	6.7	0.0	0.0	0.0	16.1	10.7	1.8	0.0	
	N	7.5	2.5	0.0	0.0	0.0	10.2	1.1	0.0	0.0	0.0	18.3	6.7	0.0	0.0	0.0	28.6	10.7	0.0	0.0	0.0	
	E	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	1.1	2.3	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	Travel Efficiency
	A	0.0	0.0	0.0	15.0	2.5	0.0	0.0	0.0	15.9	0.0	0.0	1.0	1.0	4.8	0.0	0.0	1.8	0.0	0.0	0.0	
	I	0.0	0.0	17.5	20.0	0.0	0.0	0.0	30.7	8.0	0.0	0.0	0.0	21.2	5.8	0.0	0.0	5.4	14.3	1.8	0.0	
	B	2.5	27.5	10.0	0.0	0.0	1.1	21.6	17.0	0.0	0.0	0.0	39.4	13.5	1.0	0.0	1.8	41.1	8.9	0.0	0.0	
	N	2.5	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	3.8	7.7	0.0	0.0	0.0	10.7	14.3	0.0	0.0	0.0	
	E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	System Efficiency
	A	0/0	0.0	0.0	20.0	2.5	0.0	0.0	0.0	15.9	0.0	0.0	0.0	0.0	7.7	1.0	0.0	0.0	1.8	1.8	0.0	
	I	0.0	5.0	17.5	15.0	0.0	0.0	0.0	27.3	8.0	0.0	0.0	1.0	19.2	3.8	0.0	0.0	1.8	3.6	3.6	0.0	
	B	2.5	22.5	10.0	0.0	0.0	1.1	22.7	17.0	1.1	0.0	0.0	42.3	14.4	0.0	0.0	0.0	50.0	12.5	0.0	0.0	
	N	2.5	2.5	0.0	0.0	0.0	2.3	1.1	0.0	0.0	0.0	3.8	6.7	0.0	0.0	0.0	12.5	12.5	0.0	0.0	0.0	
		N	B	I	A	E	N	B	I	A	E	N	B	I	A	E	N	B	I	A	E	

Knowledge Levels

The numerical values presented in Figure 5.19 and Figure 5.20 in matrix form could be used to estimate the percentage values for the two competency groups (High/Satisfactory and Low/Unsatisfactory) for each of the four function types (Policy making, Planning, Implementation and Operation) under each of the three

EE areas (System efficiency, Trip efficiency and Travel efficiency), and also the overall results, as presented in Figure 5.21 to Figure 5.24. Figure 5.21 presents the results for the overall EE efficiency (all the three EE areas together), while Figure 5.22 to Figure 5.24 present the competency status for the each of system efficiency, trip efficiency and vehicle efficiency areas, respectively.

The overall values of the competencies presented in Figure 5.21 signify the lack of adequate competencies across all functional areas. The overall satisfactory level is 42.5% for all functional areas, indicating the need for capacity development for majority of the staff. The satisfactory level of competencies for operation function is the lowest at 20.8%, while that of implementation function is 36.5%, which indicate the more critical staff category as operational that needs more emphasis in capacity building. The separate results for the three EE areas presented in Figure 5.22 to Figure 5.24 show similar features. The results presented in Figure 5.22 for system efficiency shows that the competencies are lower than those of overall EE, with a satisfactory level of 38.2% for all the functions. The lowest level of competencies is seen in operation function with only 10.7%. The relevant quantity for implementation function is 31.7%, which too is lower than that of overall EE.

Figure 5.21: Satisfactory levels of competencies of all staff categories in overall efficiency of the transport sector

Figure 5.22: Satisfactory levels of competencies of all staff categories in the system efficiency area of the transport sector
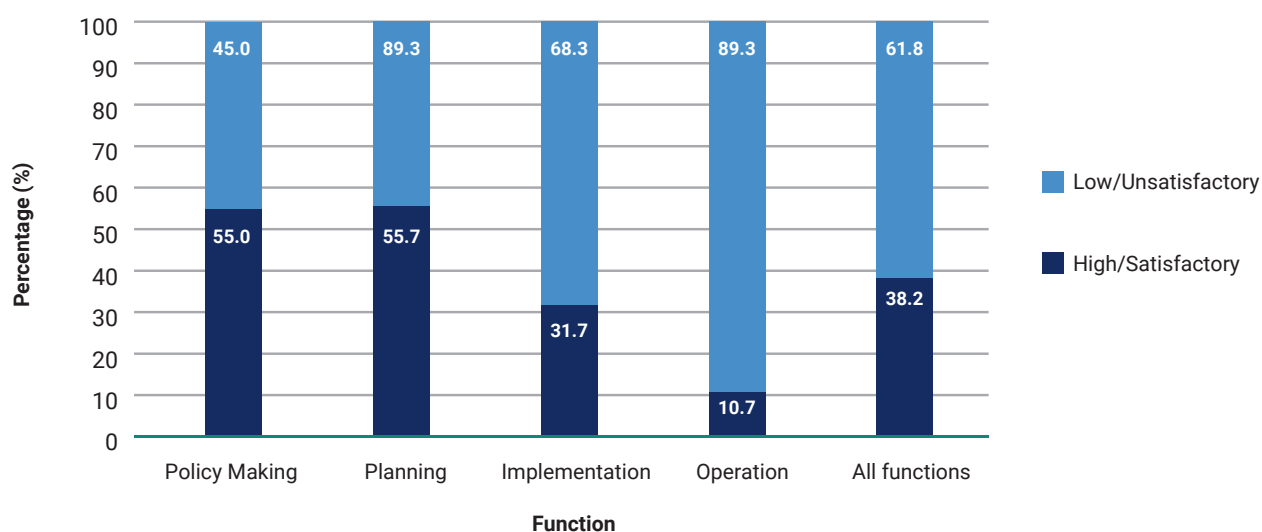
Figure 5.23: Satisfactory levels of competencies of all staff categories in the trip efficiency area of the transport sector
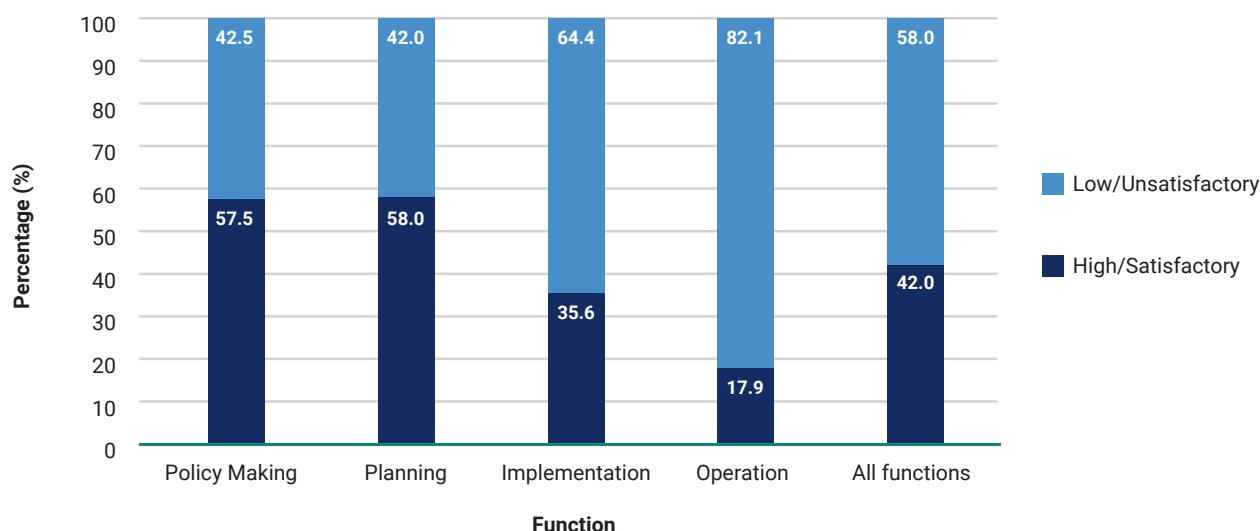
Figure 5.24: Satisfactory levels of competencies of all staff categories in the vehicle efficiency area of the transport sector
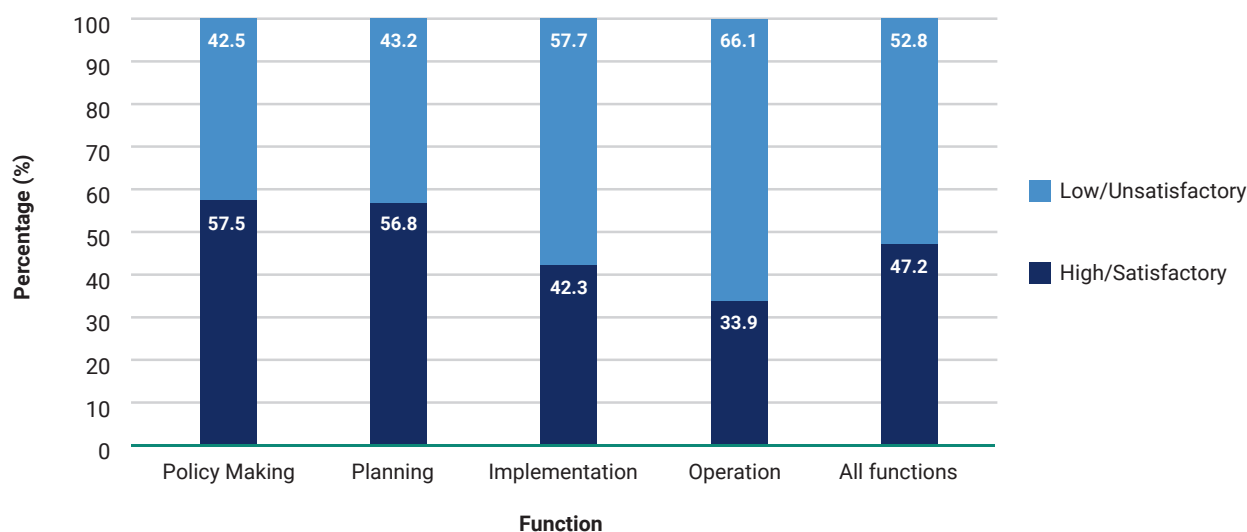
The performance in relation to trip efficiency presented in Figure 5.23 indicates that the satisfactory level of competencies in the all functional areas is 42.0%, which is marginally lower than that of overall EE. The satisfactory level of the competencies for operation and implementation functional areas show the lowest values with 17.9% and 35.6%, respectively. Both these values are lower than the relevant values for overall EE, but better than those of system efficiency area. The competencies in the vehicle efficiency area show superior performances (see Figure 5.24). Here, the satisfactory level is 47.2% for all the functional areas

and that for the operation function is 33.9%, the lowest among the different functional areas.

Note that the above analysis is based on the feedback from the transport sector actors on their competencies related to all the three EE areas. However, in general, a given transport sector agency may not be involved with all the three EE areas. For example, the roles and responsibilities of DMT are primarily on vehicles and therefore the competencies in vehicle efficiency are largely sufficient to perform their tasks successfully. Therefore, evaluation of the competencies in consideration of all the EE areas could lead to

erroneous results. Accordingly, the above estimates are repeated by considering response related to the EE area designated through the institutional mandates. Here, only the most relevant EE area is considered, even though the institutional mandate and activities conducted reflect more than one. The most relevant EE area identified for each institution is presented in Annex E. The results of these estimates are presented in matrix form in Figure 5.25 and Figure 5.26.

Figure 5.25: Competencies of the transport sector actors: Knowledge and skill levels for all functions relevant to the key EE area of the organization/profession

Skill Levels		Transport Efficiencies																				All Functions
		System Efficiency					Travel Efficiency					Vehicle Efficiency					Overall Efficiency					
	E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	5.1	0.0	0.0	0.0	0.0	3.1	
	A	0.0	0.0	0.0	12.2	0.0	0.0	0.0	1.3	10.0	1.3	0.0	0.0	0.8	25.4	4.2	0.0	0.0	0.7	17.0	2.1	
	I	0.0	3.3	14.4	10.0	0.0	0.0	2.5	18.8	7.5	0.0	0.0	0.8	31.4	5.1	0.8	0.0	2.1	22.6	7.3	0.3	
	B	0.0	26.7	12.2	0.0	0.0	0.0	38.8	13.8	1.3	0.0	0.0	10.2	10.2	2.5	0.0	0.0	23.3	11.8	1.4	0.0	
	N	10.0	11.1	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	4.5	3.8	0.0	0.0	0.0	
		N	B	I	A	E	N	B	I	A	E	N	B	I	A	E	N	B	I	A	E	
		Knowledge Levels																				

Figure 5.26: Competencies of the transport sector actors: Knowledge and skill levels for specific functions relevant to the key EE area of the organization/profession

Skill Levels		Functions																				
		Policy making					Planning					Implementation					Operation					
	E	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Overall Efficiency
	A	0.0	0.0	0.0	20.0	2.5	0.0	0.0	1.1	21.6	2.3	0.0	0.0	1.0	16.3	1.9	0.0	0.0	0.0	8.9	1.8	
	I	0.0	2.5	12.5	20.0	0.0	0.0	0.0	31.8	5.7	0.0	0.0	1.9	22.1	4.8	0.0	0.0	5.4	16.1	5.4	1.8	
	B	0.0	20.0	7.5	2.5	0.0	0.0	12.5	15.9	1.1	0.0	0.0	30.8	12.5	1.0	0.0	0.0	28.6	7.1	1.8	0.0	
	N	2.5	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	2.9	4.8	0.0	0.0	0.0	12.5	10.7	0.0	0.0	0.0	
	E	0.0	0.0	0.0	0.0	21.4	0.0	0.0	0.0	0.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Vehicle Efficiency
	A	0.0	0.0	0.0	28.6	0.0	0.0	0.0	2.9	28.6	5.7	0.0	0.0	0.0	26.7	4.4	0.0	0.0	0.0	16.7	4.2	
	I	0.0	0.0	21.4	7.1	0.0	0.0	0.0	34.3	2.9	0.0	0.0	2.2	31.1	4.4	0.0	0.0	0.0	33.3	8.3	4.2	
	B	0.0	0.0	7.1	7.1	0.0	0.0	5.7	5.7	2.9	0.0	0.0	15.6	13.3	0.0	0.0	0.0	12.5	12.5	4.2	0.0	
	N	7.1	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	
	E	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Travel Efficiency
	A	0.0	0.0	0.0	13.3	6.7	0.0	0.0	0.0	17.9	0.0	0.0	0.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	
	I	0.0	0.0	6.7	20.0	0.0	0.0	0.0	25.0	3.6	0.0	0.0	0.0	24.0	8.0	0.0	0.0	16.7	8.3	0.0	0.0	
	B	0.0	40.0	6.7	0.0	0.0	0.0	17.9	28.6	0.0	0.0	0.0	48.0	8.0	4.0	0.0	0.0	66.7	0.0	0.0	0.0	
	N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0	
	E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	System Efficiency
	A	0.0	0.0	0.0	18.2	0.0	0.0	0.0	0.0	16.0	0.0	0.0	0.0	0.0	11.8	0.0	0.0	0.0	0.0	5.0	0.0	
	I	0.0	9.1	9.1	36.4	0.0	0.0	0.0	36.0	12.0	0.0	0.0	2.9	8.8	2.9	0.0	0.0	5.0	0.0	5.0	0.0	
	B	0.0	18.2	9.1	0.0	0.0	0.0	16.0	16.0	0.0	0.0	0.0	38.2	14.7	0.0	0.0	0.0	25.0	5.0	0.0	0.0	
	N	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	5.9	14.7	0.0	0.0	0.0	30.0	25.0	0.0	0.0	0.0	
		N	B	I	A	E	N	B	I	A	E	N	B	I	A	E	N	B	I	A	E	
		Knowledge Levels																				

As earlier, the numerical values presented in Figure 5.25 and Figure 5.26 in matrix form are used to estimate the percentage values for the two competency groups for each of the four function types under each of the three EE areas, and also the overall results. These estimates are presented graphically in Figure 5.27 to Figure 5.30. Figure 5.27 presents the results for the overall EE efficiency (all the three EE areas together), while Figure 5.28 to Figure 5.30 present the competency status for the each of system efficiency, trip efficiency and vehicle efficiency areas, respectively.

The overall values of the significance levels of competencies presented in Figure 5.27 show significantly better performance for all the functions in all the EE areas compared with that presented in Figure 5.21 where the all the EE areas are considered irrespective of applicable key EE area for a given organization. The increase is from 42.5% to 54.5%, which is largely due to the vehicle efficiency area where

the increment is from 47.2% to 75.4%. Other two EE areas have shown marginal deviations.

The results for the each of the three EE areas presented in Figure 5.28 to Figure 5.30 show that there are considerable differences among the results of specific functional and EE areas, with the percentage changes ranging from -53.3% (decrease) +108.8% (increase), the two extreme values are for the cases of operation functional area in system efficiency and vehicle efficiency, respectively. The highest improvements are seen in all the functional areas related to vehicle efficiency (as illustrated in Figure 5.30), ranging from 49.1% to 108.8% of the percentage increase. The operation functional area shows the lowest performance for satisfactory level of competencies with 8.3% for trip efficiency and 10.0% for the system efficiency, both of which are lower than the corresponding values estimated earlier (i.e. 17.9% and 10.7%, respectively).

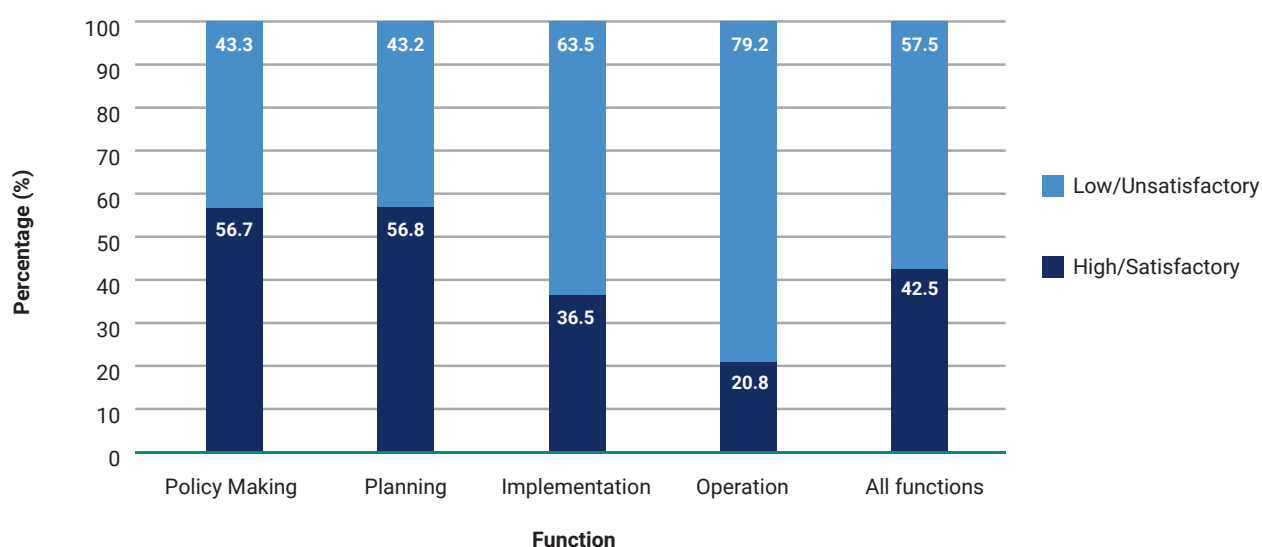**Figure 5.27: Satisfactory levels of competencies of all staff categories in overall EE of the transport sector relevant to key EE area of the organization/profession**
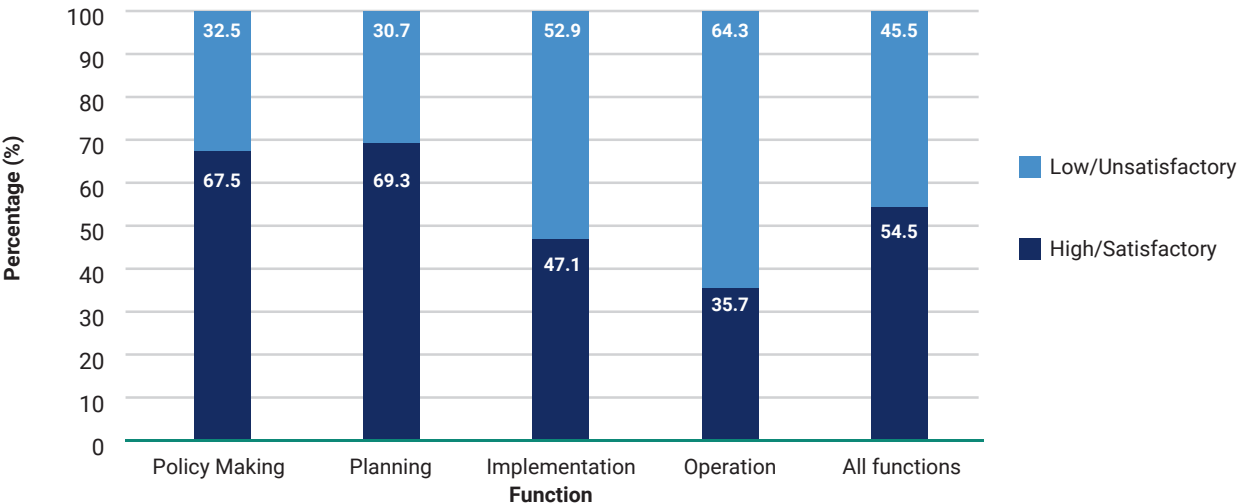
Figure 5.28: Satisfactory levels of competencies of all staff categories in organizations/ professions where the system efficiency is the key EE area of relevance
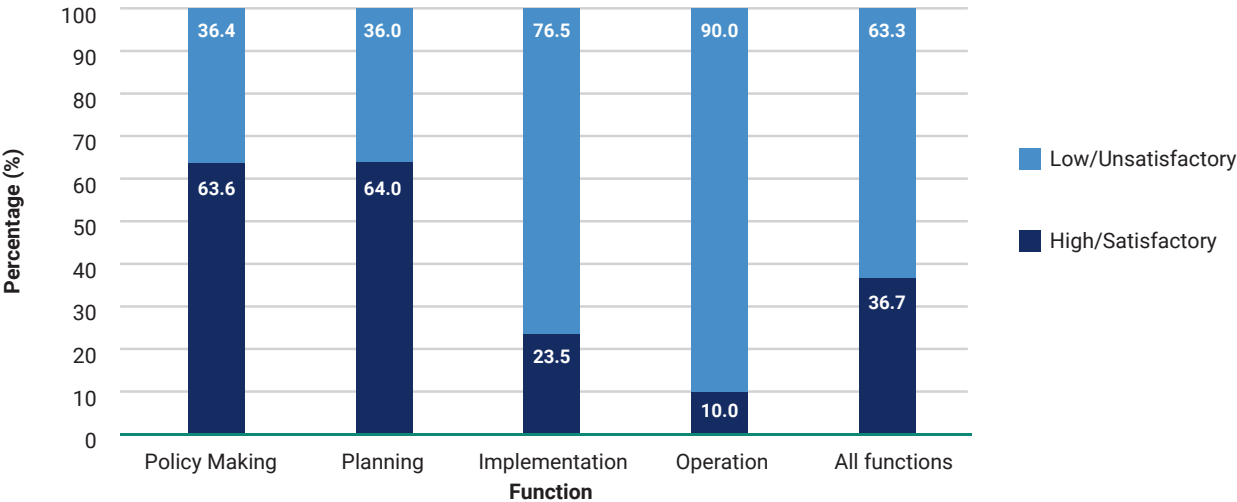
Figure 5.29: Satisfactory levels of competencies of all staff categories in organizations/ professions where the trip efficiency is the key EE area of relevance
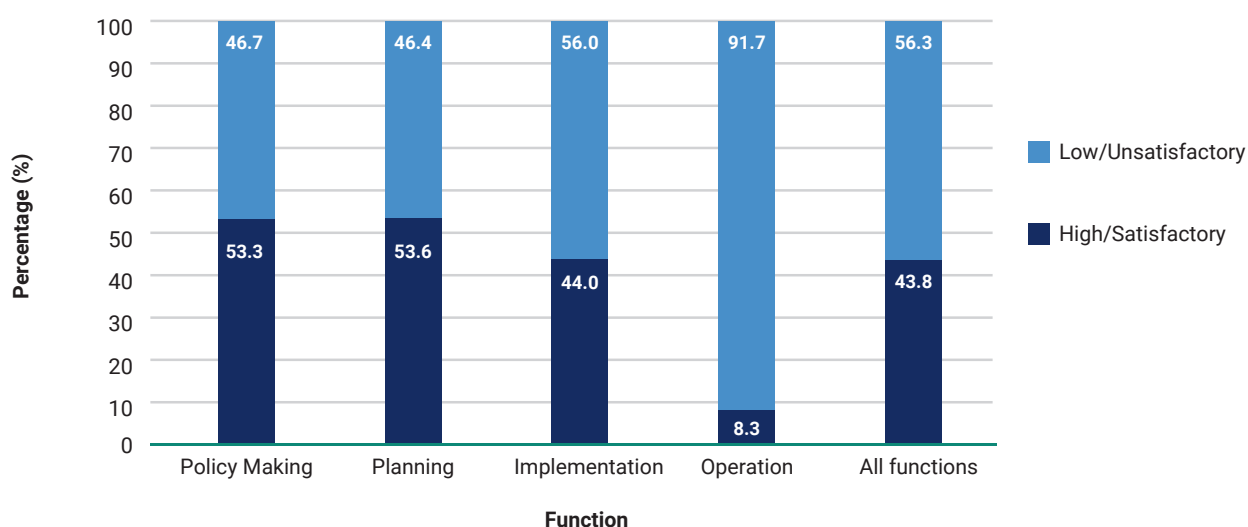
Figure 5.30: Satisfactory levels of competencies of all staff categories in organizations/ professions where the vehicle efficiency is the key EE area of relevance
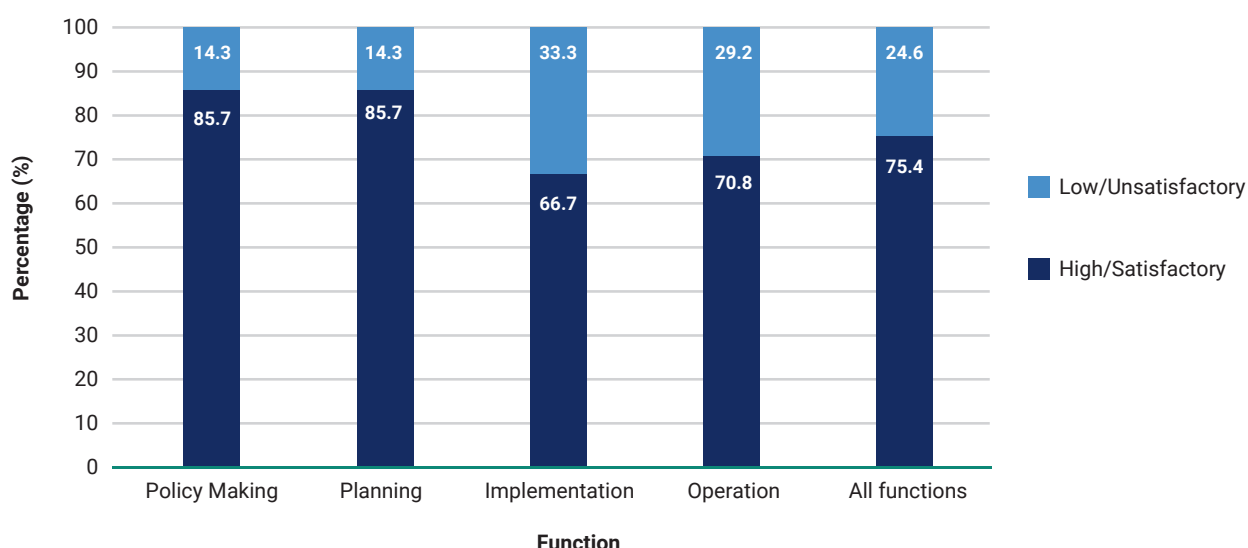
It is apparent from the above results that the lowest competency levels of the transport sector actors is in the system efficiency area, followed by trip efficiency. Accordingly, particular considerations should be given for system efficiency and trip efficiency areas in developing capacity building programmes. The competency levels in vehicle efficiency area are superior than the other two EE areas, but still the performance levels cannot be considered as adequate for effective implementation of EE project. In relation to functional areas, the operation followed by implementation show the weakest competencies, signifying the lack of competencies of operational staff in relation to EE project implementations in the transport sector. In overall, the competency gaps are clearly visible in

each of the functional categories in all the EE areas, which need to be addressed through a comprehensive awareness and education programmes for building of necessary cognitive and functional competencies incorporating combination of formal, informal and non-formal means of education at different levels. This aspect is deliberated in details in Section 6.

5.4.3 Feedback on Potential Interventions for Transport Sector EE Improvements

In addition to the competency levels, the feedback of the transport sector actors was obtained on their recommendations for the EE interventions in specific

components or sub-systems of the transport sector, with particular emphasis on Urban Transport Systems, covering the three EE areas considered in this study. A collated summary of the key recommendations made by the respondents is presented in Table 5.3. Note that the content present in the table excludes the recommendations given by the transport experts, which are elaborated in the next section.

Table 5.3: Recommendations of transport sector actors on EE interventions

Specific Component/ Sub-system	Type/Nature of intervention
(A) EE Area: System Efficiency (Avoid/Reduce)	
Need to travel	Introduce/encourage/regularize Transport Demand Management (TDM) concepts to reduce average number of trips per person (through policy/legislations, education, facilitation and information): - Telecommuting/work from home concepts - Introduce 1-day working from home concept for all institutes - Introduce compressed work week coupling with distant working practices - Education/capacity building on online facilities and technologies - Reduce school days (to 03 days/week, balance 02 days online) - Convert all government services/products to online - Promote government sector staff to work partly from home effectively - Promote identification of faults and services through decentralized systems - E-commerce (online shopping/purchasing/ordering and delivery facilities) and other online services (banking, transactions, utility payments) - Digital/virtual business interactions and services - Crowd sourcing of goods/services - Encourage digital gatherings, virtual meetings - Knowledge, attitude and behavioural management
	Establish and promote shared mobility services: - Car-pooling - Ridesharing - Introduce toll systems for urban travel by certain vehicles so that the trips shall be organized in an efficient manner of utility maximization by the individuals
System infrastructure	Training and capacity building to create competent workforce / professionals, particularly in government authorities / agencies for effective integrated land use planning / urban development.
	Integrated land use planning / urban development to reduce average length per trip - Create an efficient road network, connecting large and emerging cities, townships, economic centers and rural hubs while ensuring safety and equity - Smart cities/Compact cities/Walkable cities concepts - Promote transit-oriented development (TOD) - Urban route replanning - Provide and improve the connectivity - Design city centers and there infrastructure to facilitate all services under one roof concept / Limit such services to few in a centralized clustered area - Cluster the land use in a way that the travel distance for the commuters are greatly reduced - Shift institutes/activities away from city centers which are not necessarily functioned from there (Educational Institutes/ Hospitals, etc) - Construction of high-density commercial and residential complexes close to mass transit stations - Reduce the number of parking spaces available, thus deterring the use of personal vehicles - Improve infrastructure for better integration of different modes of transport - Allocating preferential road space to public transport and non-motorized modes.
	Introduce intelligent transport systems
	Shift government offices and industrial parks to semi urban areas
	Arrange grocery/essential item shops attached to transport hubs
	Integrated approach to establish cost effective & efficacious goods and services providing system
	Introduce infrastructure facilities such as e-platforms, cloud based, digitization, automation for online/remote/virtual/ work/services
	Establish information management system in view of reducing the need to travel

Specific Component/ Sub-system	Type/Nature of intervention
Demand characteristics	Introduce flexible office hours
	Decentralize government services / Relocate government offices in sub-urban areas
	Shorten supply chains and rely more on regional suppliers and regional nodes to avoid long-distance transport
	Deploy reusable transport containers to avoid additional transport for disposal
(B) EE Area: Trip Efficiency (Shift)	
Regulatory interventions	Introduce a mechanism to evaluate and characterize all transport modes (public, private) for the means of proper policy and regulatory interventions.
	Utilize more rational selection and prioritization of transport programmes and projects (with emphasis on sustainable development)
	Make priority the common transport systems and minimize the individual transport in policy making, planning and resource allocations
	Limit the use of inefficient transport modes in urban cities (e.g. 3W)
	Regulate/discourage single occupancy vehicles (through tax/fine systems)
	Regularize/discourage vehicle ownership
	Discourage use of road space (e.g.-high parking fees and highway tolls)
	Introduce time of use road taxation system for personal vehicles
	Introduce fines for single occupant vehicle in urban areas
	Introduce electronic congestion pricing systems together with lane classifications namely 2+ vehicles and 3+ vehicles occupancy (to promote high occupancy usage of vehicles)
	Reduce vehicle entering urban area through high parking fees
System infrastructure	Use more productive/efficient vehicle parking systems (underground / multi-story)
	Introduce mass and rapid transit systems: Light rail transit (LRT); Bus rapid transit (BRT); Monorail systems.
	Implementation of Subway system and high capacity railway system
	Introduce bus priority lane (BPL)
	Introduce urban metro systems
	Introduce the passengers to park private vehicle at the defined place and development of a system that allows luxury buses to enter the city (Park & Ride systems)
	Introducing GPS base system for public transport (mostly in railway Network)
	More priority / emphasis on development and maintenance of transport infrastructure
	Introduce more high capacity vehicles, high capacity lanes
Public Transport	Improve the quality & efficiency of public transport (Rail, Bus)
	Enhance the convenience and attractiveness of public transport
	Introduce low-floor buses and articulated buses for cities
	Upgrade trains to newer, more resource efficient models
	Increase capacity of public transport systems
	Introduce proper time table for the public transport
	Introduce combine timetables for private buses, government busses and trains

Specific Component/ Sub-system	Type/Nature of intervention
(C) EE Area: Vehicle Efficiency (Improve)	
All Vehicles	Implementation of carbon emission/fuel economy standards (Policy; regulatory)
	Introduce carbon tax for vehicle importation and operation to promote more energy efficient vehicle technologies and their operation.
	Link VET Programme to fuel economy / energy efficiency
	Regulations to ban inefficient vehicles from the market
	Retrofitting of low efficient old ICE engines
	Introduce vehicle scrappage programme to remove inefficient vehicles
	Provide tax concession for the more fuel efficient vehicles.
	Reduce import of less fuel efficient vehicles
Electric mobility / EVs	Promote electric mobility with clear and steady policy in the areas of vehicle and spare part manufacturing/imports, and environmental concerns (e.g., disposal/recycle of EV batteries).
	Promotion of hybrid/electric vehicles for (i) government organizations; (ii) urban public transport
	Promote conversion of low efficient ICE vehicles to electric
	More R&D on battery technology and local manufacturing
	Provide financial aid for companies that develop electric/hybrid vehicles domestically
	Promoting electric bicycles, electric tricycles and other EE transport modes
	Introducing Mini Cabs, motor bikes and other transport modes that work on renewable energy.
	Build a public transport network that focuses on utilizing renewable sources of energy.
	Electrification of public transport services: Railway Buses Urban shuttle services.
Electric vehicle charging infrastructure	Establish adequate electric vehicle charging station (EVCS) network throughout the country
	Implementation of EVCS by Electric Utility (CEB; LECO)
	Regulation of EV charging standards for Sri Lanka.
	Establish more electrical charging stations at gas stations to encourage people to buy electric vehicles
	Pilot projects on introducing Vehicle-to-Home (V2H), Vehicle-to-vehicle (V2V) concepts
	Promote solar PV based charging systems
	Introduce tax concessions and/or rebate for high energy efficient vehicles including EVs
Cleaner fuels	Promote and develop biofuels to reduce emissions and improve energy efficiency
	Switch in to new fuel options such as CNG
	Introduce fuel quality standards
	Modernized the local refinery plant to produce high quality fuel to improve the operational efficiency of vehicles and to facilitate importation of modern vehicles with high fuel economy capabilities.

Specific Component/ Sub-system	Type/Nature of intervention
Operational improvements	Optimize traffic control systems and manage traffic flows more efficiently (including through ICT. IoT, Intelligent vehicles etc.)
	Introduce certification and accreditation procedure to upgrade vehicle repair facilities/ garages
	Ensure proper and regular services and maintenance of vehicles
	Ensure high quality spare part industry
	Integrate VET programme with fitness certificate programme for all vehicles
	Upgrade VET programme with more stringent technical and regulatory conditions.
	Enforce type approval certification of new vehicles to prevent flow of substandard vehicles into the country
	Promote eco-driving / Build capacities of drivers for more energy-efficient driving styles / Conduct regular (and mandatory) trainings
	Ensure proficiency of the automobile engineering professionals.
	Develop automobile engineering training facilities
	Implement comprehensive Educational & Training Programmes to build knowledge and skills
	Proper operation and maintenance of bus fleet; - Quality spare parts; - Replacement of old buses with modern high efficient ones.
	Improve efficiency of locomotive engines
Road infrastructure	Proper maintenance, repair and reconstructions of road network
	Improve road surface roughness
	Limit or avoid other utility constructions affecting road networks (particularly major roads)
Other emerging/ futuristic technologies	Promote roof-top solar systems as a mean of charging electric vehicles
	De-carbonize the electricity grid to optimize the electric mobility
	Pilot fuel-cell and hydrogen technologies
	Make vehicle bodies more aerodynamic and the use of lighter materials reduces fuel consumption

The feedback presented by transport sector actors given in the above table exemplify the wide range of policy, regulatory, technological, infrastructure, capacity building, information related interventions that lead to EE improvements across all the sub-systems and components.

5.4.4 Recommendations by Transport Experts on Required Competency Levels

As briefed in Section 3.2.4, experts in the transport related sectors have been consulted to obtain their recommendations on the competency levels required for different staff categories for implementation of EE projects in the transport sector. In this case, the requirements are graded at four levels as High (H), Medium (M), Low (L) or None (N) form nine competencies (as defined in Table 3.4) of the three staff categories (Strategic, Tactical and Operational). The results of the recommended levels in percentage are presented in Figure 5.31 to Figure 5.34 for the all staff categories, strategic level staff, tactical level staff and operational level staff, respectively. In these figures, the nine competencies are designated by Information competency – INF, Systems thinking competency – SYT, Critical thinking competency – CRT, Anticipatory competency – ANT, Strategic competency – STR, Integrated problem-solving competency - IPS, Normative competency – NOM, Collaboration competency – COL and Self-awareness competency – SAW.

Figure 5.31: Recommended competency levels for all staff categories
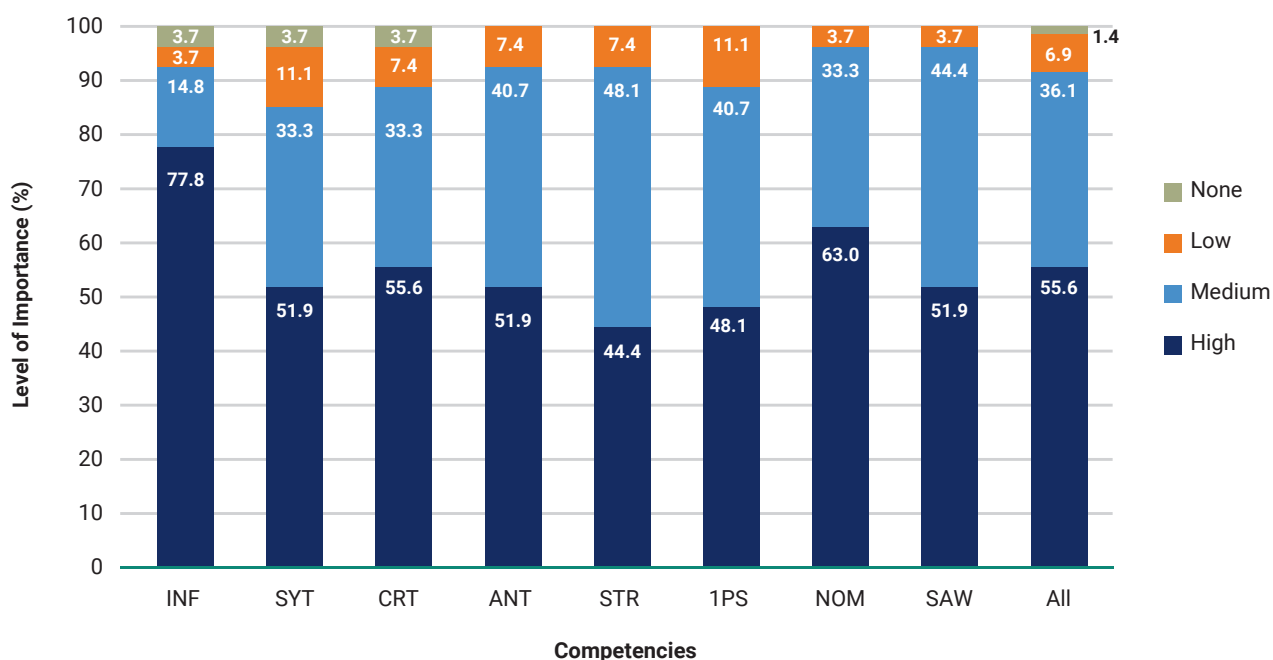
Figure 5.32: Recommended competency levels for strategic level staff
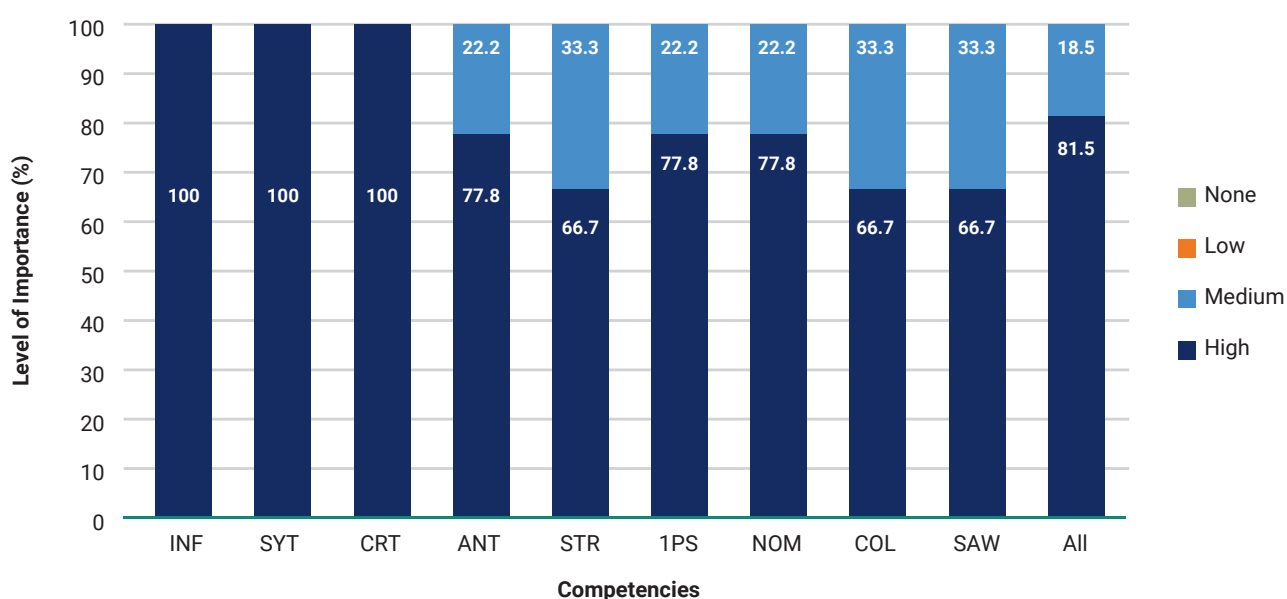
The results presented in Figure 5.31 signifies that for all staff categories, all nine competencies are primarily of high or medium level importance. In overall, 55.6% of the responses of the transport experts indicate level of importance as high, while 36.6% as medium, 6.6% as low and only 1.2% as none. When considering only the high level of importance, information competency (INF) in cognitive domain is emerged as the most significant one to be possessed with (77.8% responses). However, if both high and medium levels of importance are considered together, all the three attitudinal competencies, namely normative competency (NOM), collaboration competency (COL) and self-awareness competency (SAW) are emerged as the most crucial ones (96.3% responses). In case the of strategic level staff, as illustrated in Figure 5.32, the need of high level of competencies is more notable, with all the three cognitive competencies having 100% responses as high, and all the other six competencies (under methodical and attitudinal domains) having 100% responses as high or medium. In overall, 81.5% of the responses indicate level of importance as high, while balance 18.5% as medium.

Figure 5.33: Recommended competency levels for tactical level staff
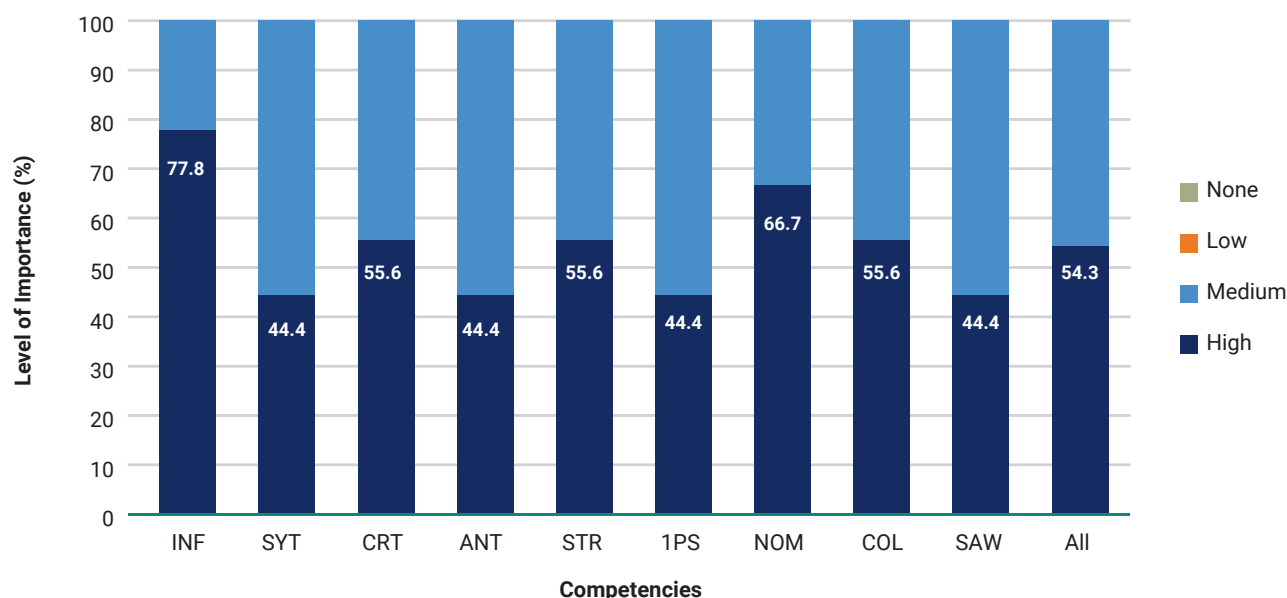
Figure 5.34: Recommended competency levels for operational level staff
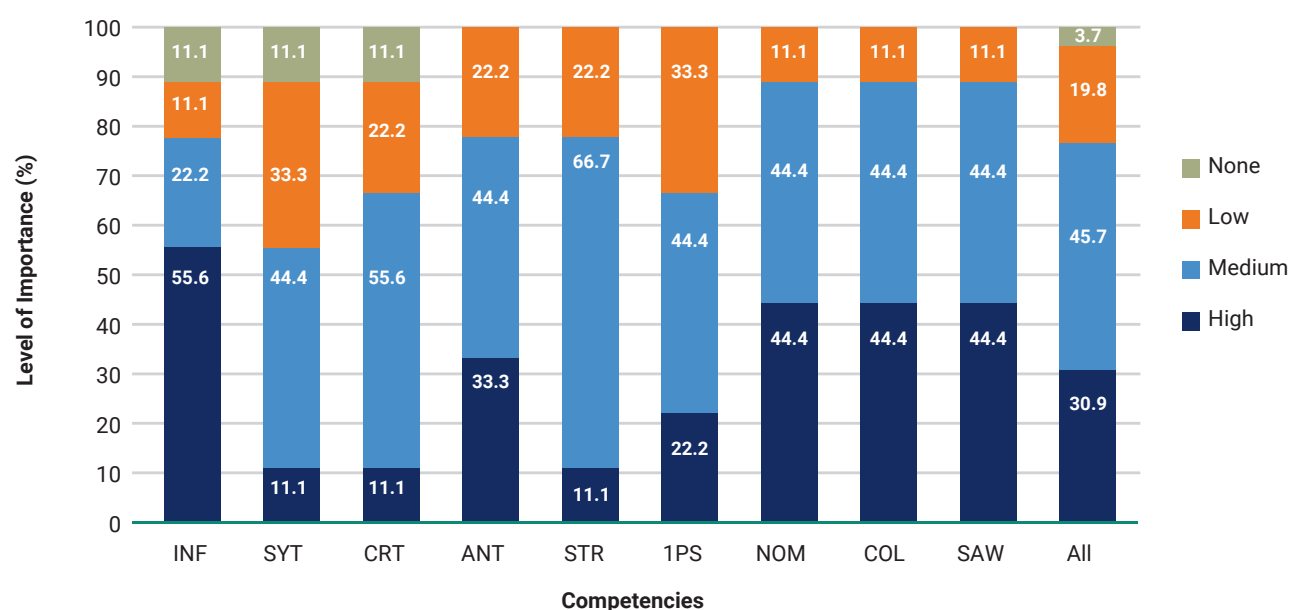
The results for the tactical level staff presented in Figure 5.33 exemplify the relatively lower level of competency requirements compared with the strategic level staff. However, in absolute terms, their competency requirements too are significant, with 100% responses as high or medium in all the nine competencies. In overall, 54.3% of the responses indicate level of importance as high, while balance 45.7% as medium. The least level of competency requirements is emerged as those for operational level staff, in comparison with others (see Figure 5.34). When considering both high and medium levels of importance together, all the three attitudinal competencies, namely normative competency, collaboration competency and self-

awareness competency are emerged as the most crucial ones (88.9% responses).

In overall, the recommendations of the transport sector experts imply that the successful development and implementation EE projects in the transport sector demand for competent staff in all the three categories of staff. Such competency building will not be able to attain through only informal and non-formal means of education, and more emphasis should be given in formal education modes such as technical/vocational diplomas and undergraduate/ postgraduate degree programmes to build relevant competencies.

5.4.5 Recommendations by Transport Experts on Type of Educational/Training Programmes

This section presents the results of the recommendations of transport sector experts on the type of educational and training programmes through which the required competencies presented in Section 5.4.4 above could be built. Eight different types of education were selected, as Technical Certificates (TEC), Technical Diplomas (TED), Undergraduate Degrees (UGD), Postgraduate Degrees – Taught courses (PGT), Postgraduate Degrees – Research (PGR), Continuous Professional Development Courses (CPD), Informal/Non-formal education (INF), and Occupational experiences (OCE). The priorities of these programmes are graded at four levels as High (H), Medium (M), Low (L) or None (N). The results of the recommended priority levels in percentage of

responses are presented in Figure 5.35 to Figure 5.38 for the all staff categories, strategic level staff, tactical level staff and operational level staff, respectively.

The results presented in Figure 5.35 for all staff categories imply that, when considering high priorities only, the most effective means of competency building is occupational experience (55.6% responses), followed by postgraduate research degrees (48.1% responses) and CPD programmes (44.4% responses). In this case, the informal/non-formal means of education is appeared as least important means of competency building (only 14.8% responses). If both high and medium priority levels considered together, CPD programmes become most crucial (85.1% responses), followed by occupational experience (81.5% responses), undergraduate degree programmes (77.8% responses) and technical diplomas (70.3% responses). Here too, the least priority is in informal/non-formal means of education (33.3% responses).

Figure 5.35: Prioritized educational programmes for all staff categories
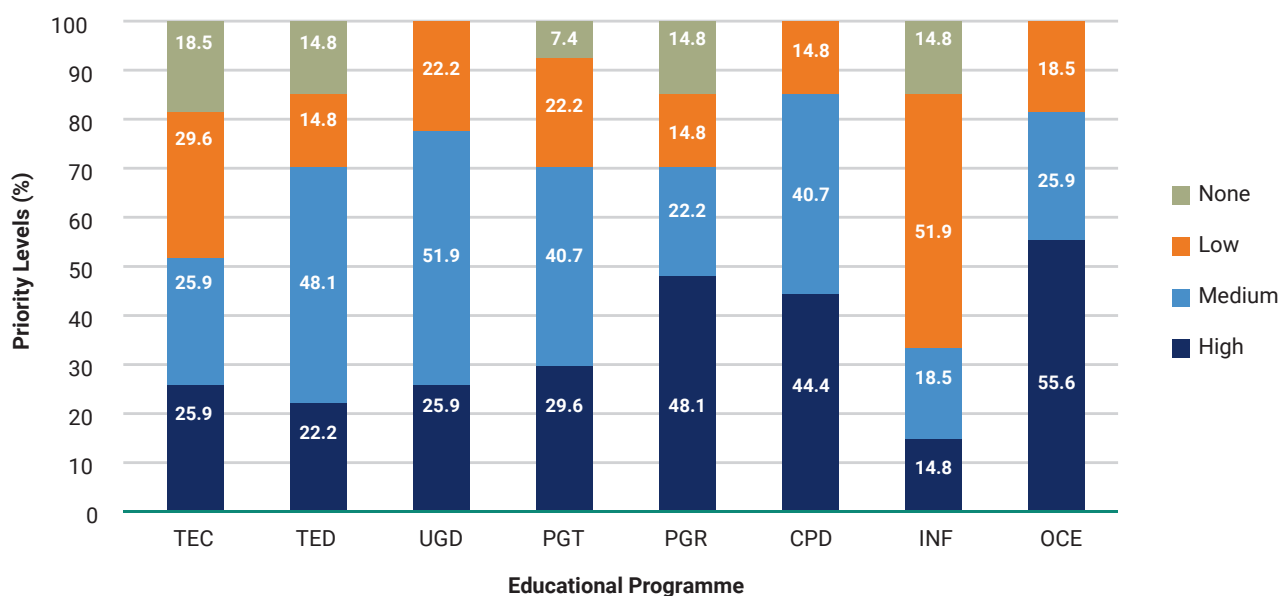
In the case of strategic level staff, as illustrated in Figure 5.36, the postgraduate research degrees and taught courses are ranked as most important modes of competency development based on high priority responses (with 66.7% and 55.6%, respectively). Occupational experience too is emerged as important means of competency development with 55.6% high priority responses. Here, the least priority means of education are turned out to be technical certificate and technical diploma with no high priority responses in the recommendations made by the transport sector experts. Informal/non-formal means of education too has lower ranking. When considering both high and medium priority levels together, undergraduate

degree programmes tops the list with 100% responses, followed by postgraduate research degrees, postgraduate taught courses and CPD programme, each having 88.9% responses. Here, informal/non-formal means of education is the least priority one with only 11.1% responses.

The results presented in Figure 5.37 for tactical level staff show that the most important means of competency building as postgraduate research degrees and occupational experience, both having high priority responses of 55.6%. Next one is CPD programmes with 33.3% high priority responses. Occupational experience too is emerged as important means of competency development with 55.6% high priority responses.

Here, the least priority one is the informal/non-formal means of education with no high priority responses. If both high and medium priority levels are considered together, both undergraduate degree programmes and CPD programmes become the most effective means of competency building with 100% responses each, followed by technical diplomas and occupational experience with 88.9% responses. In this case too, informal/non-formal means of education is the least priority one with only 33.3% responses.

In the case of operational level staff, the most important means of education are emerged as technical certificates, technical diplomas, CPD programmes and occupational experience, all with 55.6% responses with high level priority. If both high and medium priority levels are considered together, technical diplomas become the most effective means of competency building with 88.9% responses, followed by technical certificate and occupational experience, both having 77.8% responses.

Figure 5.36: Prioritized educational programmes for strategic level staff
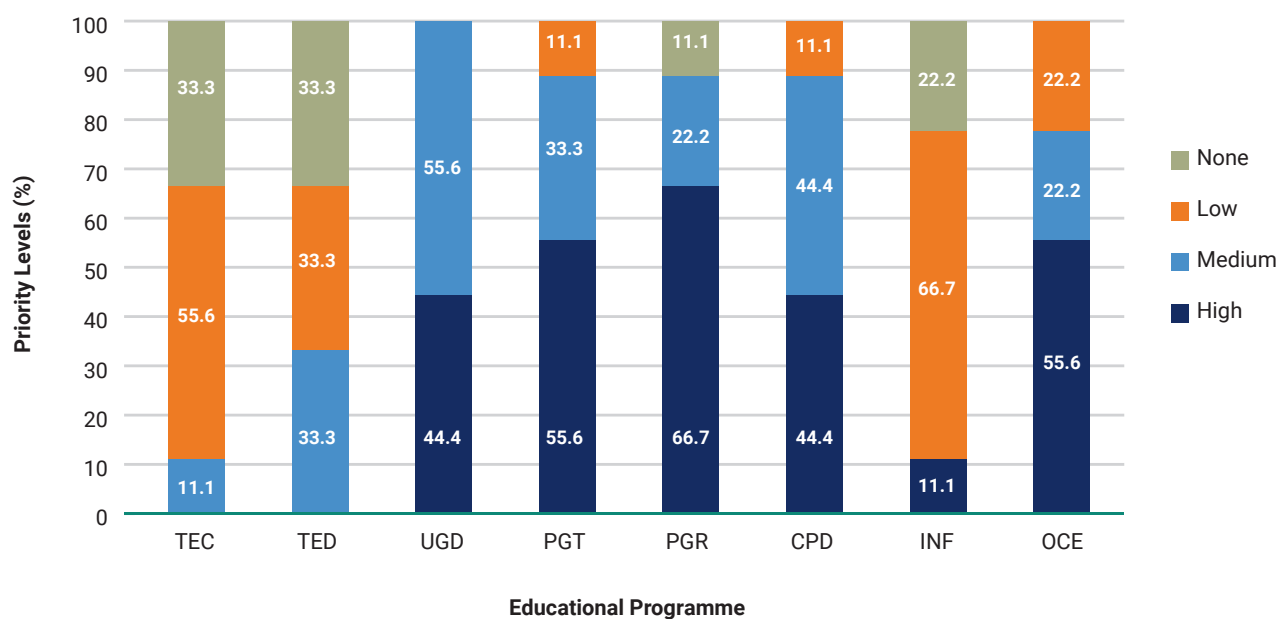
Figure 5.37: Prioritized educational programmes for tactical level staff
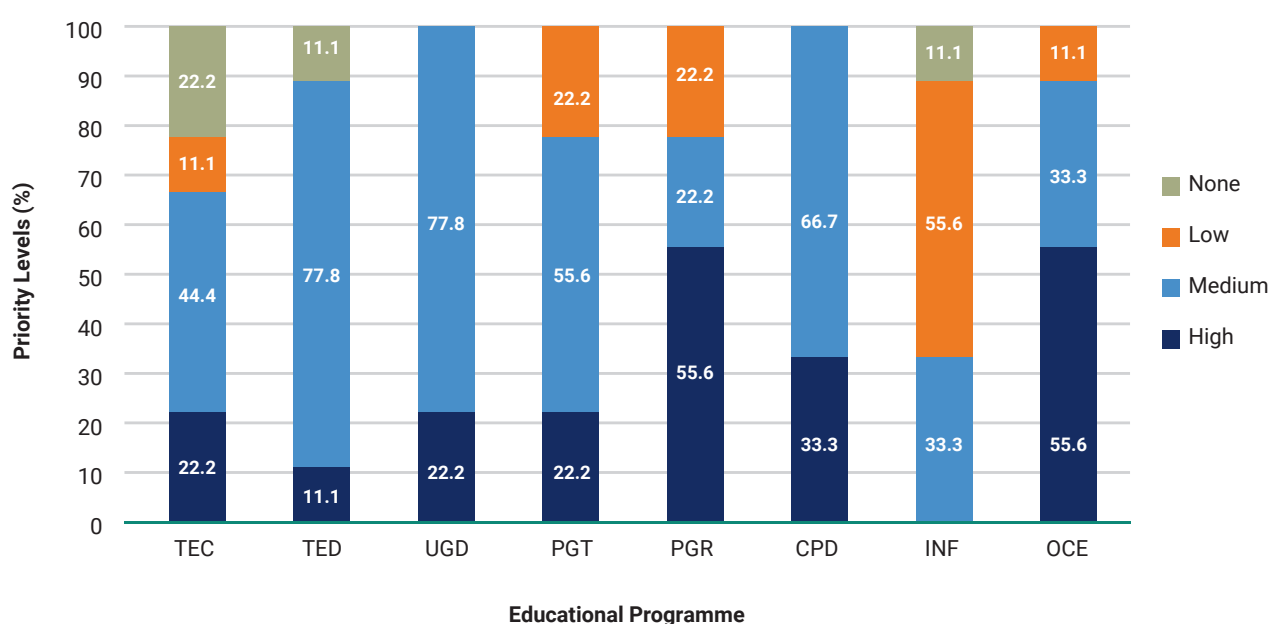
Figure 5.38: Prioritized educational programmes for operational level staff
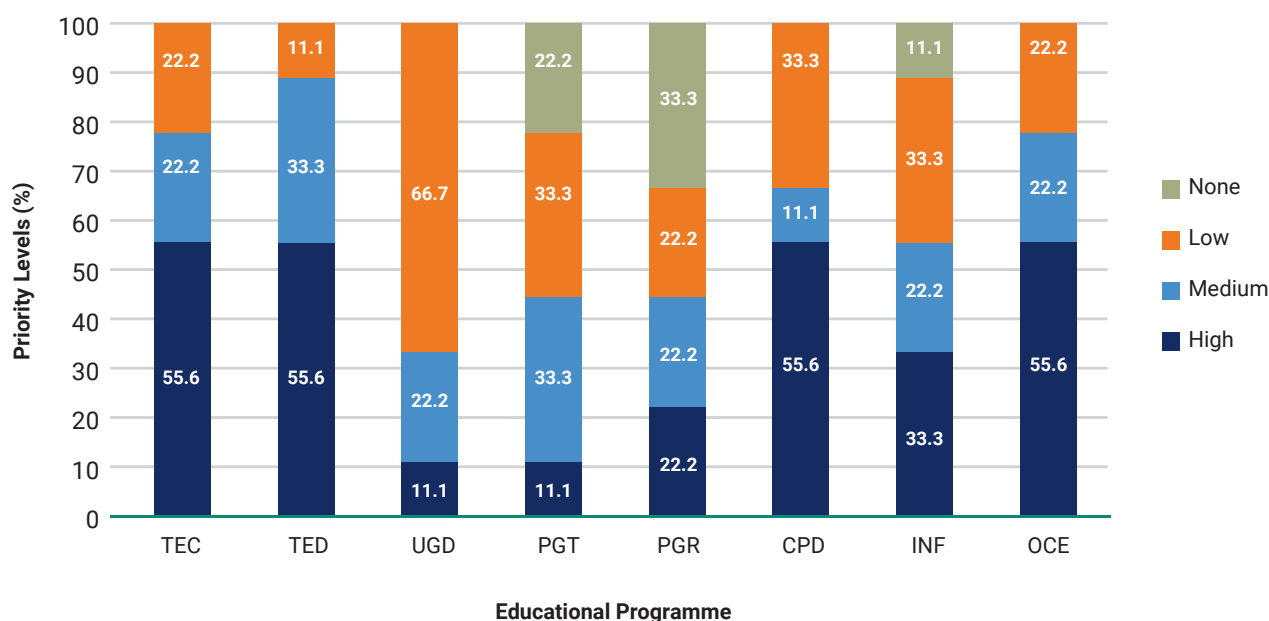
5.4.6 Recommendations by Transport Experts on Potential Interventions for Transport Sector EE Improvements

Further to the competency requirements and educational programmes, recommendations of transport experts were obtained on the EE interventions in specific components and sub-systems of the transport sector, with particular emphasis on Urban Transport Systems, covering the three EE areas considered in this study. The feedback obtained are summarized in Table 5.4. Note that similar feedback was obtained from transport sector actors, and presented in Table 5.3 in Section 5.4.3.

Table 5.4: Recommendations of transport sector experts on EE interventions

Specific Component/ Sub-system	Type/Nature of intervention
(A) EE Area: System Efficiency (Avoid/Reduce)	
Need to travel	Pursue Information and Communication solutions, such as integrated business models and e-commerce, through fiscal, regulatory and investment interventions, to minimizing unnecessary trips in order to reduce transport demand, and to spread demand peaks.
	Provide online meeting facilities to all institutions
	Increase vertical living spaces: Apartment buildings closer to central business district to avoid traveling by vehicles
	Issue government circular and regulation on using online platforms for meeting where possible
	Coordinated establishment of government offices to avoid officers travel
Reduce demand	Integrated land-use planning to minimize unnecessary trips and thereby reduce transport demand
	Decentralization of government services

Specific Component/ Sub-system	Type/Nature of intervention
(B) EE Area: Trip Efficiency (Shift)	
Public transport systems	Improve service quality, regulation and reliability of public transport services
	Expand the public transport network coverage with maximum service coordination and integration of available public transport systems to ensure seamless interchange among them
	Integrate public transport services with private vehicle use (e.g. Park and Ride) and para-transit services for first and last mile access.
	Reliable schedules and integrated networks
	Introduce cross subsidize public transport
	Subsidy for high occupancy public transport
	Integrated bus, train and private vehicle planning
	Increase quality of public transport for office staff
	Real-time accurate information about traffic conditions
Rail	Give priority for railway when competing public investments on infrastructure development
	Extend and develop railway as a network, connecting present suburban corridors with each other, so as to incentivize domestic and industrial transport needs to use the railway mode
	Introduce structural realignment to provide track and signaling infrastructure, regulatory and traffic management mechanisms, free of charge for train services.
	Implement well connected rail base public transport services systems which can easily adapt to demand variations and avoid traffic congestions
	Introduce LRT, Monorail
	Improve trains services on existing tracks
Bus	Reform bus service provision by State-owned and privately-owned sectors and pursue its regulation, adopting inter-alia, models such as "operator consolidation", "single operator-multiple owners", "inter-operator coordination", IT based communication and common revenue collection
	Improve quality of bus services through bus and terminal modernization, better operating systems including seamless electronic ticketing systems, information systems and other supporting infrastructure modernization
	Develop a "performance-oriented and quality-based competition" among bus passenger transport service providers.
	Set up Bus priority Lanes and BRT
	Revise fare policy to attract long distance travel and transfers between routes and discourage short distance travelers using long distance buses
	Revise bus route network to match the spatial demand
Inter-modal	Integrate and modernize inter-modal transport systems to improve reliability of services and user access to nodes, terminals and information.
	Adopt Information Technology appropriately for coordination, communication, ticketing, fares collection and inter-modal integration
NMT	Promote explicitly the use of non-motorized transport modes for short trips
	Set up cycle lanes and cycle parks / Provide adequate space for cycle parking and dedicated cycle lanes
	Provide bicycle parking facilities at schools, office etc. especially in rural environment
	Introduce mandatory regulation on cycle use and cycle park
	Improve internal/residential roads to accommodate bicycles and pedestrians and introduce traffic calming measures to discourage unnecessary vehicle travel
	Create awareness targeting an attitudinal shift on non-motorized modes

Specific Component/ Sub-system	Type/Nature of intervention
Alternative modes	Explore alternative ways of transportation, such as water-ways, particularly through rivers, canals and coastal shipping.
Transport infrastructure	Align road building program to develop high mobility transport connectivity among major regional centres, ports, airports.
	Develop road network to facilitate NMT, such as for cycling and for pedestrians, with their safety ensured.
	Improve pedestrian access to stops and terminals
	Improve intersection control mechanisms using advance adaptive traffic signals or use one-way arrangements where it is possible to reduce traffic congestion
	Proper coordination with Urban Planners
	Introduce information systems to plan trips efficiently
(C) EE Area: Vehicle Efficiency (Improve)	
Vehicle Technology	Promote and incentivize energy efficient and green motive power technologies.
	Keep improving adoption of EURO standards at importation
	Implement an incentive strategy to replace aging buses with more fuel efficient and comfortable buses
	Incentive scheme for replacing old vehicle to new one (Efficient one)
	Tax based on fuel efficiency
Electric mobility	Promote EVs
	Promote hybrid vehicles
Fuel	Promote and incentivize energy efficient fuel types
	Total Embargo for less than EURO 4 standards fuel
Operation	Ensure efficient and safe operation of vehicles through enforcement and compliance of quality standards and road-worthiness.
	Regular Testing for Vehicles older than 5 years, others on detection
	Increase awareness on vehicle service and maintenance, including changing oil and changing filters etc
	Reduce the taxes and prices of oil and air filters to encourage vehicle maintenance
	Training service station/garage staff regularly on vehicle maintenance
	Improve vehicle repair facilities/garages and spare part industry
	Restructure the VET program with more efficient approach removing weaknesses
	Nationwide driver training program and make regulation for requirement on driver training
Infrastructure	Take steps to improve quality standards of transport infrastructure to improve the operational efficiency of vehicles
Emerging / Advanced technologies	Promote natural gas busses
	Promote biogas buses
	Promote renewable hydrogen

The recommendations provided by the transport actors and the sector experts could be effectively used to identify areas for EE efficiency improvements in the transport sector.

Section 06: Stakeholder Analysis – The Education Sector Actors

6.1 Introduction

As in case of transport sector actors, the data collection is performed through the distribution of the questionnaires among the staff identified in the selected educational institutions involved with education and training programmes for transport sector actors. The methodology for this activity is provided in Section 3.2. The primary mode of data collection is the self-completion questionnaires, while physical meetings for individuals, smaller groups and seminars for larger groups are conducted, when ever possible. Two physical workshops/meetings were conducted for universities, one at the University of Peradeniya, Kandy in Central province and the other at the University of Ruhuna, Galle in Southern Province, covering multiple stakeholders and educational programmes. Another two physical workshops/meetings were conducted at two individual private sector organizations, who are involved with the SLVET programme, having in-house training programmes. The feedback from other educational institutes in all the sectors (tertiary/university, technical/vocational and continuous professional development) were taken through distribution of the questionnaire and online interviews. Further to the above, feedback from education sector specialists were obtain for critical review of the programmes and curricula, and also for professional opinions and recommendations related to the scope of the study.

This section provides the details of the respondents and the results of the stakeholder analysis in the education sector involved with competency building of transport sector actors.

6.2 Stakeholder Institutions: Educationalists

As per the framework presented in Table 3.1 of Section 3.2.2, the stakeholder institutions in the educational sector were selected for the analysis, as listed in Table 6.1. Altogether there are 31 institutions and 50 programmes identified for the consultation.

Table 6.1: Stakeholder institutions selected form the education sector

Sector	Institute	Faculty	Department/Programme
University & Tertiary – National Government	University of Moratuwa (UoM)	Engineering	Civil Engineering
			Mechanical Engineering
			Transport & Logistic Management
			Industrial Training Division
		Architecture	Town & Country Planning
	University of Peradeniya (UoP)	Engineering	Civil Engineering
			Mechanical Engineering
			Chemical & Process Engineering
	Sabaragamuwa University of Sri Lanka (SUSL)	Technology	Engineering Technology
	University of Jaffna (UoJ)	Engineering	Civil Engineering
		Technology	Automobile Technology
			Construction Technology
	University of Ruhuna (UoR)	Engineering	Civil & Environment Eng.
			Mechanical & Manufacturing Engineering
		Technology	Bio-systems Technology
			Engineering Technology
		Agriculture	Green Technology
			Agricultural Resource Management & Technology
	University of Colombo (UoC)	Science	Zoology and Environment Sciences
	Uva Wellassa University of Sri Lanka (UWU)	Technological Studies	Engineering Technology
	Wayamba University of Sri Lanka (WUSL)	Technology	Mechanical & Manufacturing Technology
	University of Sri Jayawardenapura (USJP)	Science	Forestry and Environmental Science
	University of Kelaniya (UoK)	Science	Environmental Conservation and Management
	South Eastern University (SEU)	Engineering	Mechanical Engineering
	Open University of Sri Lanka (OUSL)	Engineering Technology	Mechanical Engineering
	Kotelawala Defense University (KDU)	Engineering	Mechanical Engineering
		Management, Social Sciences & Humanities	Logistics Management
University & Tertiary – Private	Sri Lanka Institute of Information Technology (SLIIT)	Engineering	Mechanical Engineering
			Civil Engineering
	National School of Business Management (NSBM)	Engineering	Mechatronic Engineering
	Colombo International Nautical and Engineering College (CINEC)	Management & Social Sciences	Supply Chain Management

Sector	Institute	Faculty	Department/Programme
Technical & Vocational - National Government	University of Vocational Technology (UoVT)	Engineering Technology	Building Services Technology
			Manufacturing Technology
			Mechatronics Technology
			Construction Technology & Resource Management
	Institute of Technology University of Moratuwa (ITUM)	-	Mechanical Engineering Technology
			Civil Engineering Technology
	Ceylon-German Technical Training Institute (CGTTI)	-	Automobile Mechanic
	Automobile Engineering Training Institute (AETI)	-	Automobile Mechanic
	University College of Kuliyapitiya (UCK)	-	Automobile Technology
	Sri Lanka Institute of Advanced Technological Education (SLIAT)	-	Mechanical Engineering
Technical & Vocational - Private	David Pieris Motor Company (Pvt) Ltd (DPMC)	Training Division	Auto mechanic training
	Toyota Lanka (Private) Limited (TOYOTA)	Training Division	Auto mechanic training
	Diesel & Motor Engineering (DIMO) Academy for Technical Skills (DATS)	-	Automobile Technology training
	CleanCo Lanka Limited (CleanCo)	Training Division	Automobile technology training
	Laugfs Eco Sri Limited (EcoSri)	Training Division	Automobile technology training
Professional & Non-university Tertiary Education	Sri Lanka Institute of Development Administration (SLIDA)	-	Training Programmes on Environment Management
	Sri Lanka Energy Managers Association (SLEMA)	-	Training Programmes on Resource Management
	Institute of Automotive Engineers of Sri Lanka (IAESL)	-	Training Programmes on Automobile Technologies
	National Cleaner Production Centre (NCPC)	-	Training Programmes on Resource Management

6.3 Staff of the Educational Sector Institutions Selected for the Consultation

For the consultation, one or more number of educationalists from each institute were identified, in accordance with the methodology presented in Section 3.2.3. The sample is selected to cover the two categories educationalists as curriculum developers and lecturers, though in many instances both are done by same staff member. Thus, in the data collection and analysis, they are treated in the same group (i.e. the same questions), but allowing the responses to highlight the two levels. The number of staff responded to the survey under in each institute and department is presented in Table 6.2 (University = 54; Technical = 20; Other bodies = 7). The number of education specialists contributed to the study too is indicated. Accordingly, the total number of respondents is 90. The details of the educational specialist and the staff of education institutes contributed to the survey are given in Annex K and Annex L, respectively.

Table 6.2: Categories and number of educationalists selected for consultation

Education Institution	Department / Programme	No. of Respondents
UoM	Civil Engineering	04
	Mechanical Engineering	04
	Transport & Logistic Management	02
	Industrial Training	02
	Town & Country Planning	02
UoP	Civil Engineering	01
	Mechanical Engineering	02
	Chemical & Process Engineering	02
SUSL	Engineering Technology	01
UoJ	Civil Engineering	01
	Automobile Technology	02
	Construction Technology	01
UoR	Civil & Environment Engineering	02
	Mechanical & Manufacturing Engineering	03
	Bio-systems Technology	01
	Engineering Technology	01
	Green Technology	04
	Agricultural Resource Management & Technology	01
UoC	Zoology and Environment Sciences	01
UWU	Engineering Technology	01
WUSL	Mechanical & Manufacturing Technology	02
USJP	Forestry and Environmental Science	02
UoK	Environmental Conservation and Management	01
SEU	Mechanical Engineering	02
OUSL	Mechanical Engineering	01
KDU	Mechanical Engineering	01
	Logistics Management	01
SLIIT	Mechanical Engineering	03
	Civil Engineering	01
NSBM	Mechatronic Engineering	01
CINEC	Supply Chain Management	01
UoVT	Engineering Technology	02
ITUM	Mechanical Engineering Technology	01
	Civil Engineering Technology	01
CGTTI	Automobile Mechanic	01
AETI	Automobile Mechanic	02
UCK	Automobile Technology	01
SLIAT	Mechanical Engineering	01
DPMC	Auto mechanic training	05
TOYOTA	Auto mechanic training	01

DATS	Automobile Technology training	01
CleanCo	Automobile technology training	03
EcoSri	Automobile technology training	01
SLIDA	Resource Management	01
SLEMA	Energy Management	03
IAESL	Automobile technology training	01
NCPC	Resource Management	02
Sub-Total		81
Education Specialists		09
Total Responded		90

6.4 Stakeholder Analysis – Educationalists

6.4.1 Potential for impact upon EE in the transport sector by the educationalist

As presented in Section 3.3, the potential of educationalists to impact on competency building for EE in transport is evaluated by two set of criteria, namely (i) based on the level of opportunity, as determined by the type of the module offered, and level of involvement in the curriculum development and delivery, and (ii) based on their expertise, as determined by the levels of awareness and proficiency. A set of significant levels for each indicators is set, as described below:

(a) Level of Opportunity

The level of opportunity is determined by two attributes, namely the significance of the module/lesson offered in the study programme and the degree of involvement of the staff member in the curriculum development and delivery. Firstly, three levels of significance of the subject/module of concern within the programme are defined as:

- *Compulsory/Core subject* (C) is deemed essential/compulsory and shall take by a learner for the successful completion of the programme.

- *Elective subject* (E) is one chosen by a learner from a set of subjects specified for particular focus area/sub-specialization within the programme. Usually, elective subjects provide a depth of knowledge in a chosen subject area and the choice is more restrictive.

- *Optional subject* (O) is one chosen by a learner from a wider range of subjects, with limited or no restrictions for the choice. Usually, these subjects cover complementary/ supplementary topics of the main study area.

Secondly, three levels of significance based on the responsibility and engagement in either curriculum development and/or delivery or both of the subject/module of concern are defined as:

- *Direct/Main involvement* (D) in which the educationalist is the key resource person or in-charge of the curriculum development or delivery of the programme.

- *Some/Partial involvement* (S) in which the educationalist provides supportive role in the curriculum development or delivery of the programme.

- *Minor/Little involvement* (L) in which the educationalist does not involved with the curriculum development or delivery, but provides inputs or feedback to improve them.

(b) Level of Expertise

This is depicted through two aspects as awareness and proficiency, each with three levels of significance. For the awareness on EE in the transport sector, the three levels defined are:

- *Well informed* (W)- up to date, extensive information on the subject is acquired/accessible.

- *Fairly informed* (F)- general trends & basic information on the subject is acquired/ accessible.

- *Vaguely informed* (V)- related information is rarely pursued and limited acquisition.

For the proficiency in EE in the transport sector, the three levels defined are:

- *Highly proficient* (H)- well practiced, versatile knowledge; recognized as a sector expert.

- *Fairly proficient* (F)- adequate knowledge, common engagement; recognized as a sector player.

- *Slightly proficient* (S)- basic knowledge, development stage of skills, newcomer to the sector.

The feedback of the respondents on the above attributes is presented in Annex M. The results of the stakeholder analysis based on the above criteria, indicators and level of significance are presented in the following sub-sections.

Levels of Opportunities

Figure 6.1 presents the mapping of the levels of significance of the module/lesson offered and the degree of involvement of the staff members of all the institutes consulted, in which each cell presents % number of the respondents (total of 81). Here the education specialists are not included. The overall opportunity of educationalists to impact on EE in transport through competency building is identified by broadly categorizing the significance level of the modules and the level of involvement together into two groups as High/significant (in light blue) and Low/insufficient (in dark blue). The high/ significant potential group is taken as the ones in the cells [C,D], [C,S], [E,D] and [E,S]. The results show that, among those consulted, the percentage of staff having opportunities to contribute significantly to EE improvements in the transport sector through the competency building is about 87.7%. The notable result in this analysis is that 65.4% of the staff are directly involved with offering compulsory modules having at least some relevance to transport systems in the respective study/ training programmes.

The above results show that the present curricula of the educational programmes provide opportunities for the introduction of EE related lessons appropriately for the future interventions in the related competency developments in tertiary/university, technical/ vocational and continuous professional development programmes.

Levels of Expertise

As above, stakeholder analysis could be performed based on the awareness and proficiency levels to derive the level of expertise of the educationalists in delivering educational programmes for competency building of transport sector actors (present and future employees). Here, the education specialists too are taken for the analysis (i.e. 90 respondents in total). The results are presented in Figure 6.2. As in the previous case, the high/significant potential group is taken as the ones in the cells [W,H], [W,F], [F,H] and [F,F]. The results show that, among those consulted, the percentage of staff having expertise to contribute significantly to build competencies required for implementation of EE projects in the transport sector is about 85.6%. Though the total is closer to the previous analysis, the significant variation could be noted in the distribution of the individual cells, particularly the central cell that represents 35.6% of the staff (compared with 8.6% in the previous attribute.

In overall, the above Stage 1 analysis of the educationalists signifies the significantly high potential for implementing interventions in the educational programmes for competency building in EE in the transport sector in the tertiary/ university, technical/ vocational and continuous professional development sectors of education in the country.

6.4.2 Detailed assessment of education sector actors and educational programmes

The detailed assessment of education sector actors (educationalists and education specialists) and educational programmes related to competency building in EE of the transport sector is performed based on the following aspects:

- Academic qualifications
- Professional qualifications
- Modes of education/training specific to transport

Figure 6.1: Levels of opportunity for educationalists

		Optional	Elective	Compulsory
Involvement	Direct/Major	0.0%	2.5%	65.4%
	Some/Partial	1.2%	8.6%	11.1%
	Minor/Little/None	7.4%	1.2%	2.5%
		Significance of the module		

Opportunity for Impact on Competency building in EE

■ High Opportunity
■ Low Opportunity

Figure 6.2: Levels of expertise of the educationalists

Proficiency		Vaguely/None	Fairly	Well-informed
	High	0.0%	1.1%	30.0%
	Fair	1.1%	35.6%	18.9%
	Low /None	4.4%	7.8%	1.1%
		Vaguely/None	Fairly	Well-informed
			Awareness	

Potential for Impact on EE through Competency building

- High Potential
- Low Potential

- Type of transport and/or EE related subjects offered (in case of educationalists)
- Specific education / training related to competency based education / curriculum development (in case of education specialists)
- Roles & responsibilities in the employment / profession
- Details of the study programmes offered including targeted competencies (in case of educationalists)

In addition to the above, feedback was also obtained from educationalists on recommendations for the implementation of EE projects, in specific components or sub-systems of the transport sector covering the three EE areas, namely system efficiency, travel efficiency or vehicle efficiency, which are discussed in Section 6.4.3. Further recommendations were obtained from educational specialists on the competency levels in each of the nine competency types and the scope/depth of study under each category of EE area for different educational programmes, details of which are presented in Section 6.4.4.

The feedbacks on the above aspects obtained from educationalists and education specialists are summarized in Annex N and Annex M. The results of the analysis of the feedback are presented in the following sub-sections.

Academic qualifications

The distribution of highest academic qualifications of the education sector actors (both educationalists and education specialists), categorized as Postgraduate, Undergraduate, and Diploma is shown in Figure 6.3-(a), as percentage of the total respondents (i.e. 90). The majority of 80.0% has postgraduate level qualifications, followed by undergraduate (12.2%) and diploma (7.8%). Further, as shown in Figure 6.3-(b), about 61% of the respondents have professional qualifications (such as

memberships in professional bodies), which indicate the preference for further professional developments (beyond the academic qualifications) even for education sector actors.

(a) Highest academic qualification

(b) Possessing of professional qualification

Modes of awareness and education on transport

Figure 6.4 presents the distribution of specific modes/means used by the educationalist for acquiring awareness and education related to EE in transport. Note that a given respondent has used more than one mode, in general, to acquire education and awareness in EE of transport. Further, though the percentages are calculated based on the total number of educationalists consulted (i.e. 81), all respondents may not have the opportunity to get awareness and education in all modes, particularly the formal education modes of technical, undergraduate and postgraduate due to their educational pathways taken. It is apparent by the above analysis that the main mode or means of acquiring awareness and education on the subject of transport is through seminars and workshops (67.9%), followed by undergraduate (45.7%) and research (39.5%). The contribution from the school education is the lowest at 9.9%. The other modes (occupational, postgraduate, specific training, technical, and non-formal) have similar contribution of around one-third of the respondents each.

As highlighted at the beginning of the previous paragraph, all the respondents may not have equal opportunity to follow the formal education modes of technical, undergraduate and postgraduate level and the results presented in Figure 6.4 related to these three modes should be interpreted in conjunction with the results presented in Figure 6.3-(a) on highest academic qualifications. Accordingly, as 63 of educationalists (out of 81) have postgraduate qualifications, and 29 respondents indicate the mode of education is

Figure 6.3: Highest academic qualifications and professional qualifications
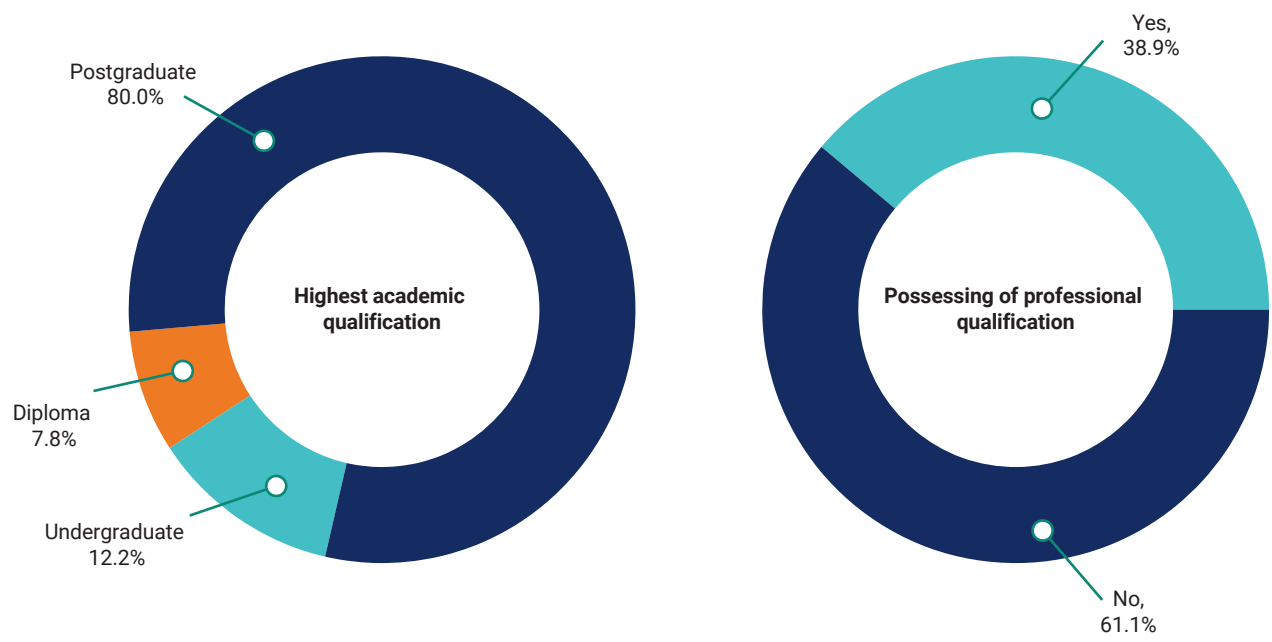
Figure 6.4: Modes of acquiring awareness and education on transport by educationalists
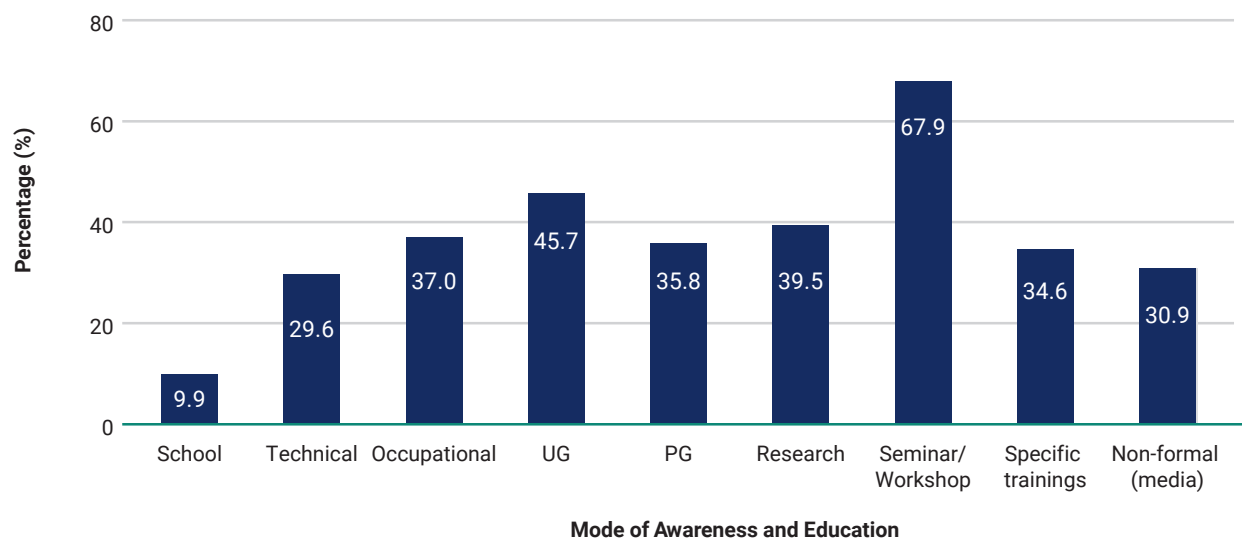
postgraduate, the transport related subject is covered in about 46% of the postgraduate level educational programmes followed by them. Further, with the assumption that all the postgraduate degree holders have undergraduate degree qualifications too, it could be estimated that the transport related subject is covered in about 50% of the undergraduate level courses. In case of respondents having technical/ diploma level of education, all of them have acquired the knowledge and education on transport during the relevant programmes.

A similar feedback for the education specialists was obtained on the modes of specific education/training through which the expertise on competency based education is acquired, and the results are presented in Figure 6.5. It is apparent that the expertise or proficiency in competency based education is acquired through a range of involvements, but particular prominence is seen for seminars/workshops (77.8%), followed by research (55.6%) and non-formal means of education (55.6%). One-third of the respondent has followed short courses (<3 months).

Figure 6.5: Types of competency based education received by education specialists

Mode of Competency Based Education
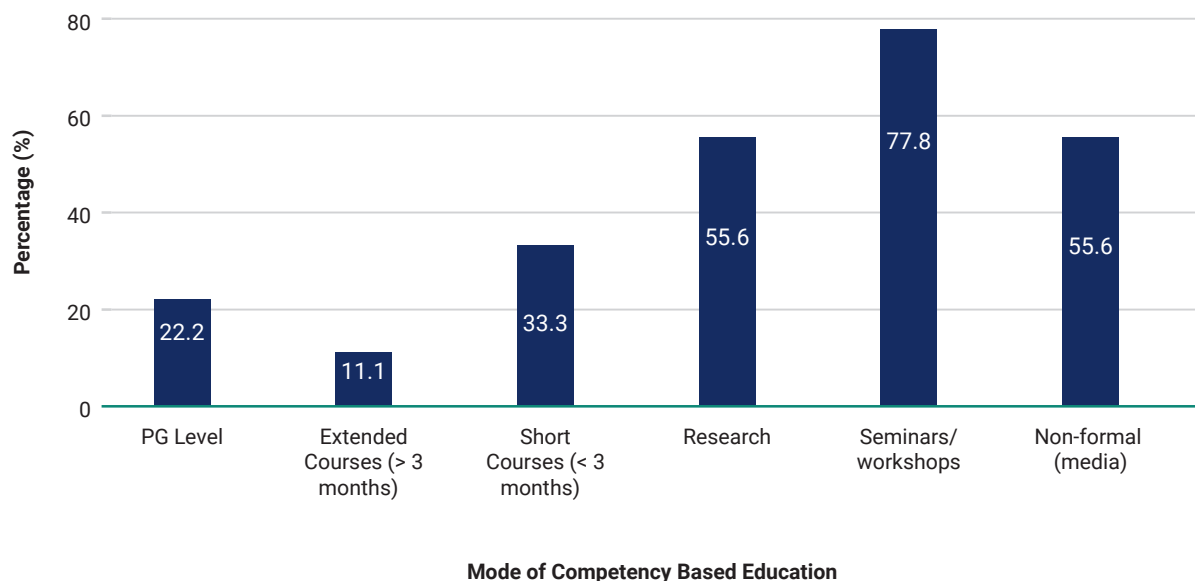
The above results highlight the important role of continuous educational modes (beyond formal education) for proficiency building in educational sector actors in general.

Educational programmes where transport related subjects are offered

The feedback of the educationalists was obtained on the level of educations where the transport related subjects are offered by them within their institutions. In this analysis, following four levels of educational programmes are considered:

- PG level
- UG level
- Diploma level
- Short courses /Training.

The result of the analysis is presented in Figure 6.6. The largest number of subjects related to transport sector is at the undergraduate level (65.4%) followed by short courses/training programmes (34.6%), postgraduate level (25.9%) and diploma level (24.7%). It should be noted that the above percentages are calculated based on the total number of respondents (i.e. 81), but all the respondents may not have equal opportunities to contribute to all the four levels of educations, particularly the postgraduate, undergraduate and diploma levels due to their academic qualifications and the employment. Thus the results presented in Figure 6.6 for these three levels of education should be interpreted cautiously. For example, postgraduate and undergraduate courses are offered only in universities (except UoVT, where technical degree programmes are

offered). Accordingly, if the number of educationalists consulted in universities (including UoVT) are considered (i.e. 54 + 2 = 56), the percentages related to undergraduate and postgraduate levels will increase to 94.6% and 37.5%, respectively.

It is apparent from the above results that the interventions for improvements in competency building of the transport sector actors would be most effective if the educational programmes offered in universities have primary focus.

Roles & responsibilities

The roles and responsibilities of the educationalists are categorized under the following six functions: (i) Curriculum development, (ii) Educational material development, (iii) Teaching & labs, (iv) Research & Industry project, (v) Consultancy, and (vi) Administration. Figure 6.7 presents the roles and responsibilities of educationalists as a percentage of the total number (i.e. 81).

The results show significant involvements in all the functional areas directly related to the development and delivery of educational/training programmes. The highest involvement is in the area of teaching & laboratory lessons (87.7%), followed by Educational material development (85.2%), and curriculum development (74.1%). Though relatively lower, other involvements too have significance in absolute terms, as research & industry project - 56.8%, administration - 53.1% and consultancy -40.7%.

In the case of education specialists, the roles & responsibilities are not identical to the above, and therefore catabolized into the following six functions:

Figure 6.6: Educational programmes where transport related subjects are offered

Figure 6.6: Educational programmes where transport related subjects are offered

Figure 6.7: Roles and responsibilities of educationalists
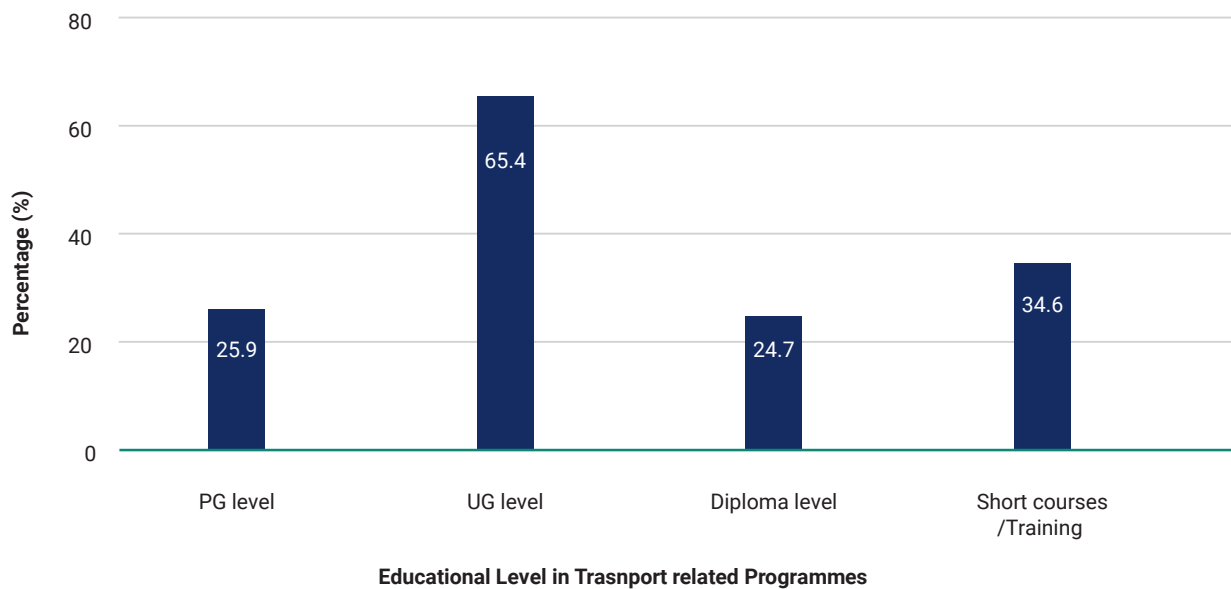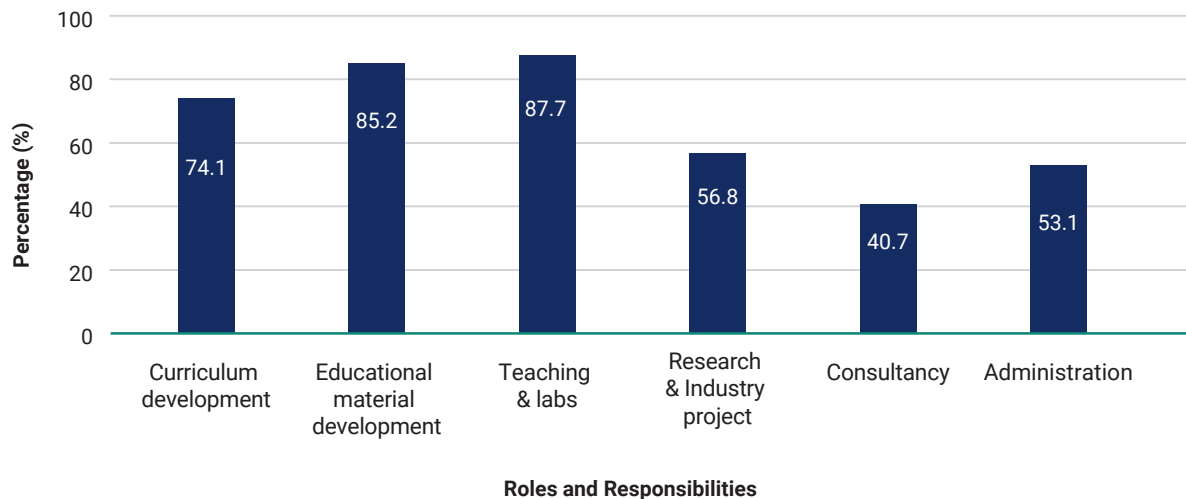
Figure 6.7: Roles and responsibilities of educationalists

Policy and strategies, Curriculum review/moderation, Curriculum development, Educational material development, Teaching & labs and Administration. Figure 6.8 presents the results as a percentage of the total number (i.e. 9). The results show significant involvements in all the functional areas (77.8% to 88.9%), thus signifying the important roles play by the educational specialists in the sector development, and in turn the potential contributions to any interventions proposed in this study.

Details of the study programmes offered

The consultation of the educationalists is also targeted to obtain detail and more specific information on the

study programmes offered by them, covering the following aspects:

- Number of credits / teaching hrs
- Topics on EE, particularly related to transport
- Related LOs
- Related POs
- Targeted Competencies.

As the educationalists consulted represent a much diverse group at different levels of education and wide variety of disciplines/specializations, this stage of the analysis done in collective manner under the three main groups of the educational institutes, namely Tertiary/

Figure 6.8: Roles and responsibilities of education specialists
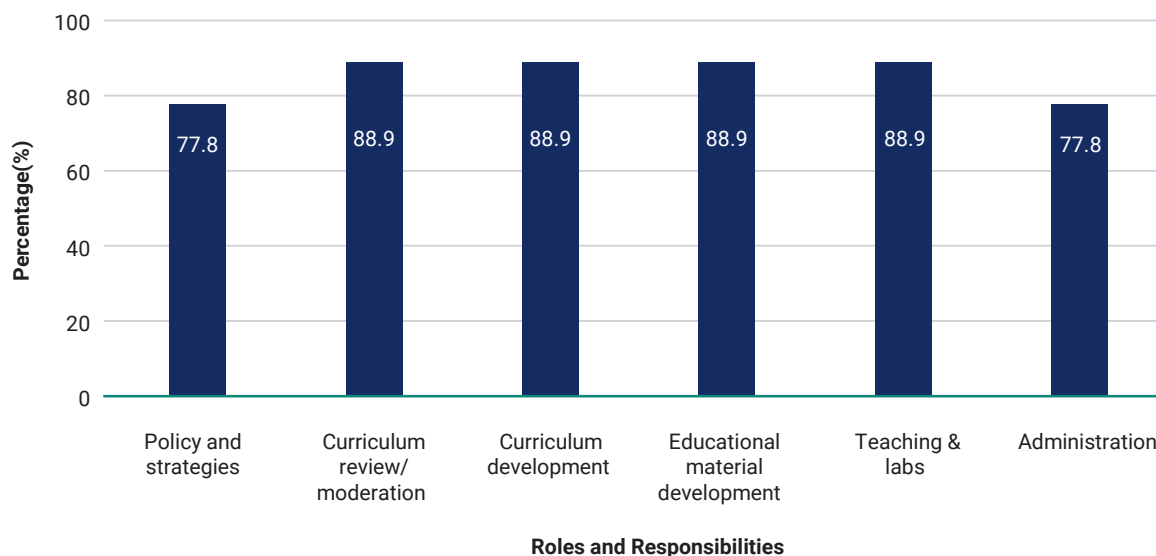
University, Technical/Vocational and Professional Bodies/Training providers. Basic introduction to these three categories of education is given in Section 4.1. Further, as revealed in Section 4.4.5, the common and unified qualification framework for higher education and training that recognizes the outcomes achieved after formal secondary education in Sri Lanka established through SLQF and NVQF provides the basis for evaluating the different courses/educational programmes and index them against the overall curriculum framework of EE education. Therefore, prior to the detailed assessment of the programmes offered under the three groups of institutions, it is imperative to recognize the base of the common framework, as reflected in the learning outcomes of the qualification holders. In particular, the SLQF describes the credit requirements for each qualification level as well as intended learning outcomes, which are to be considered by the educational and training institutions in designing a particular subject or a module, courses and programmes [38].

In SLQF, the learning outcomes are defined as statements that describe what learners should know, understand and can demonstrate upon the completion of a course or study programme, and stated in two parts termed as attributes of the qualification holders and the level descriptor. Attributes are a set of general statements of the wider abilities that the typical student is expected to have developed by the end of the course or study programme (which is similar to the learning objectives), while the level descriptor is a set of specific outcome statements, achievement of which is assessed and which a student should be able to demonstrate for the fulfilment of requirements of the qualification, signifying the specific broad abilities that the graduate should be capable of, for award of

the qualification. Further, for each qualification, the generic outcomes and attributes indicate the expected capabilities from qualification holders defined in terms of the four main domains of learning: knowledge; skills; attitudes; and mind-set and paradigm, characterized as the K-SAM model: (i) Knowledge, (ii) Skills, (iii) Attitudes, and (iv) Mind-set. The learning outcomes identified by the Ministry of Higher Education as of national importance have been customized in SLQF as level descriptors. The categorization of the learning outcomes according to the K-SAM model is given in Table 6.3.

The curriculum and assessments to provide all students with the opportunity to achieve, and to demonstrate the achievement of the intended outcomes stated under respective level descriptors too are fundamental to the SLQF. Accordingly, the formulation and use of student-centred teaching and learning methods targeting the respective learning outcomes become imperative for curriculum development and delivery. Table 6.4 presents some of the commonly used methods recommended for the respective learning outcomes.

In line with the basic framework given above, the attributes of qualification holder in each of the twelve SLQF levels are established. The details of these attributes for the main educational levels covered in this study at technical/vocational (diploma and higher diploma courses) and tertiary/university (undergraduate and postgraduate courses), are presented in Annex O. It could be noted that, CCs proposed in the present study for the overall EE education programme, as given in Table 4.4 in Section 4.4.3, are in agreement with the attributes of the qualification holders defined in SLQF. In fact the overall

Table 6.3: The comparability of the levels in SLQF and NVQF [38]

Categories of Learning Outcomes	Core area of K-SAM
1. Subject / Theoretical Knowledge	Knowledge
2. Practical Knowledge and Application	
3. Communication	Skills
4. Teamwork and Leadership	
5. Creativity and Problem Solving	
6. Managerial and Entrepreneurship	
7. Information Usage and Management	
8. Networking and Social Skills	
9. Adaptability and Flexibility	
10. Attitudes, Values and Professionalism	Attitudes, Values, Professionalism and Vision for life
11. Vision for Life	
12. Updating Self / Lifelong Learning Mind	Mind-set and Paradigm

Table 6.4: Commonly used student-centred teaching and learning methods [38]

Categories of Learning Outcomes	Teaching and Learning Methods
1. Subject / Theoretical Knowledge	Independent learning activities, interactive lectures, team-based learning, and other small group activities
2. Practical Knowledge and Application	Problem-based learning, team-based learning, inquiry-based learning, practical classes, laboratory sessions, role play
3. Communication	Student presentations, role play, debates, dramas
4. Teamwork and Leadership	Group projects, industrial training, small group learning; e.g. problem-based learning, games
5. Creativity and Problem Solving	Assignments, projects, small group learning activities; e.g. problem-based learning
6. Managerial and Entrepreneurship	Group projects, industrial training, small group learning; e.g. problem-based learning, games, simulated training, industrial (workplace-based) training
7. Information Usage and Management	Assignments, presentations, projects, case studies
8. Networking and Social Skills	Student presentations, role-play, debates, dramas
9. Adaptability and Flexibility	Group projects, industrial training, small group learning; e.g. problem-based learning, role plays, portfolios
10. Attitudes, Values and Professionalism	Group projects, industrial training, small group learning; e.g. problem-based learning, role play, portfolios
11. Vision for Life	Portfolios, reflective practice
12. Updating Self / Lifelong Learning Mind	Portfolios, reflective practice

curriculum development framework illustrated in Figure 4.4 based on CCs, POs, SCs and LOs too follows the underlining principles of the SLQF framework. This allows the educationalists to incorporate any changes required to enhance the competency building on EE in transport promptly and efficiently.

The development of study programmes and their curricula is also governed by discipline and/or field specific requirements set frothed by local and international professional bodies. For example, in the case of engineering disciplines, the curricula follow the International Engineering Alliance (IEA) Graduate Attributes and Professional Competencies (GAPC) profiles, which define the expected outcomes for engineering education programsmes and competencies for independent engineering practices. There are three professional tracks

covered in this international framework defined as Engineer, Engineering technologist and Engineering technician, and there are three international accreditation agreements for the three tracks, namely (i) Washington Accord for 4+ years Professional Engineer programmes, (ii) Sydney Accord for 3+ years Engineering Technologist programmes, and (iii) Dublin Accord 2+ years Engineering Associate programmes. The focal point for the implementation of these accords in Sri Lanka is Institute of Engineers Sri Lanka (IESL). The manual prepared by IESL prescribes the criteria and procedures for accrediting an engineering education programme [54].

A majority of the study programmes in engineering universities covered in this study have been accredited by IESL. The details of the modules gathered exemplify this status. It is evident that the said modules are principally structured in accordance with the IESL accreditation manual. In particular, the study programmes are guided by the main constituents of the accreditation requirement, including the attributes of an engineering graduate and programme outcomes. The IESL manual defines the pogramme outcomes are as statements that describe what students are expected to know and be able to perform or attain by the time of graduation. These relate to the skills, knowledge, and behaviour that students acquire through the programme, which is the same as K-SAM model used in SLQF. Following are the programme outcomes given in IESL manual [54]:

(i) ability to apply knowledge of basic science and engineering fundamentals;

(ii) ability to communicate effectively, not only with engineers but also with the community at large;

(iii) in-depth technical competence in at least one engineering discipline;

(iv) ability to undertake problem identification, formulation and solution;

(v) ability to utilize a systems approach to design and operational performance;

(vi) ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;

(vii) understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;

(viii) understanding of the principles of sustainable design and development;

(ix) understanding of professional and ethical responsibilities and commitment to them; and

(x) expectation of the need to undertake lifelong learning, and capacity to do so.

Similarly, the attributes specified for an engineering graduates in IESL accreditation manual bear a resemblance to learning outcomes of SLQF (see Table 6.5).

It is evident from Table 6.5 that the CCs proposed in the present study as one of the key elements of the overall framework of the curriculum development are closely resembled with the generic attributes of an engineering graduate, Though the above comparison is done for a particular specialization (i.e engineering), similar behavior could by found in other programmes too.

With the above background and the contexts, the detailed analysis of the feedback of the educational sector actors was performed, and the main findings are presented in the following sub-sections.

(a) Tertiary/University Institutions

Altogether there were 16 institutions (51.6%), 31 educational programmes (62.0%) and 54 educationalists (66.7%) in this group, thus representing the largest. The main study areas/disciplines covered in this group, together with number of programmes and number of respondents are presented in Table 6.6.

In the university sector, about half of the programmes and number of respondents are from engineering disciplines. The balance is taken mainly by engineering technology and science disciplines having similar contributions.

(b) Technical/Vocational Institutions

Under the technical/vocational category, there were 11 institutions (35.5%), 15 educational programmes (50.0%) and 20 educationalists/trainers (24.7%). The main study areas/disciplines covered in this group, together with number of programmes and number of respondents are presented in Table 6.7. The results indicate that the main discipline/area of study in technical/vocational education is automobile related. In fact, all the five private sector training providers have their primary functions in the automobile area (i.e. either vehicle importers or vehicle emission testing companies), and the training programmes offered are for the in-house staff (except for DATS that provides automobile diplomas).

(c) Professional bodies

Finally, there were few professional bodies who provide CPD programmes in the areas related to energy, environment, development, etc., but covering transport sector as an application area, except for IAESL, which is the professional body of automobile sector professionals and experts. Number of institutions, programmes and respondents consulted were 04 (12.9%), 04 (8.0%) and 07 (8.6%), respectively (see Table 6.8).

Table 6.5: Attributes of an engineering graduate [54]

The Generic Attributes of an Engineering Graduate	
Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**Problem Analysis**: Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
Design/ development of solutions: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	**Investigation**: Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations	**The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
Project Management and Finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Environment and Sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.	**Lifelong learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadcast context of technological change.

Table 6.6: Main disciplines and programmes in tertiary/university institutions

Main Field/Discipline	Number of programmes		Number of respondents	
	No.	%	No.	%
Engineering (Mechanical/Manufacturing, Civil, Environment, Chemical, Mechatronics, Industrial Training)	15	48.4	30	55.6
Engineering Technology (Mechanical, Civil/Construction, Automobile, Bio-systems)	07	22.6	09	16.7
Science (Environment, Agriculture, Green technology)	05	16.1	09	16.7
Management (Transport & Logistic, Supply chain)	03	9.7	04	7.4
Architecture (Town & Country Planning)	01	3.2	02	3.7
Total	31	-	54	-

Table 6.7: Main disciplines and programmes in technical/vocational institutions

Main Field/Discipline	Number of programmes		Number of respondents	
	No.	%	No.	%
Automobile Engineering/Technology	08	53.3	15	75.0
Mechanical/Manufacturing Technology	03	20.0	02	10.0
Civil/Construction Technology	02	13.3	02	10.0
Other	02	13.3	01	5.0
Total	**15**	-	**20**	-

Table 6.8: Main disciplines and programmes offered by professional bodies

Main Field/Discipline	Number of programmes		Number of respondents	
	No.	%	No.	%
Automobile Engineering/Technology	01	25.0	01	14.3
Energy Management	01	25.0	03	42.9
Resource Management	01	25.0	02	28.6
Environment Management	01	25.0	01	14.3
Total	04	-	07	-

(d) Type of EE area

The feedback of the educationalists was obtain on the EE area in the transport sector that is mostly linked to the curriculum/lessons of the study/training module offered. The results are presented graphically in Figure 6.9, where the percentages given are based on the total number of educationalists consulted (i.e. 81).

The results signify that main EE area in the transport sector considered in the educational programmes in the country is vehicle efficiency (51.9%), followed by system efficiency (24.7%), The coverage of travel efficiency aspects is relatively low, having only 11.1%. There were considerable number of programmes (12.3%) that do not highlight EE in transport, though the modules have lessons on transport. When considering the importance of all the aspects of EE within transport sector, more importance should be given to trip efficiency as well as system efficiency areas in the competency building progarammes.

(e) LOs and POs

Another aspects investigated in the present study related to the LOs and POs having bearing on EE. The results given in Figure 6.10 signify that LOs specified have more relevancy (65.4%) to EE, than POs (53.1%). While the information presented in Figure 6.10 provides some overall understanding on the relevancy of LOs and POs on transport EE quantitatively, the more in-depth analysis of the statements of LOs and POs suggests the need for improvements, in most of the cases, so that the lessons, delivery and evaluation methods are more

Figure 6.9: Key EE areas covered in educational/training programmes

Vehicle Efficiency 51.9%

None/Not Clear 12.3%

System Efficiency 24.7%

Travel Efficiency 11.1%
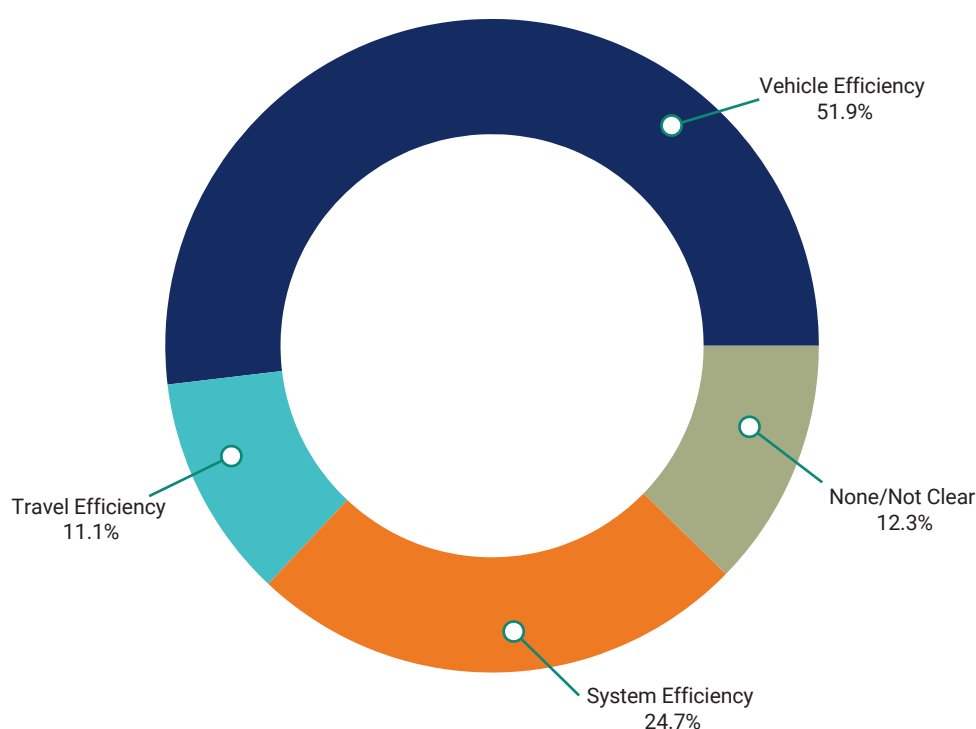
evidently interlinked to CCs and POs, as detailed in the proposed curriculum development framework and also the national (and international) competency building frameworks (such as SLQF and TVQF).

(f) Competencies

The level of emphasis given in the subject module for the three main areas of competencies, namely cognitive, functional and attitudinal, is also examined through the feedback, findings of which are shown in Figure 6.11. It can be seen that the highest level of emphasis is given on cognitive, followed by functional, while lowest is on attitudinal competenices.

When considering the complexity of the transport sector and importance of EE therein, the critical role of attitudinal competencies of the transport sector actors is apparent. Therefore, the enhancement of the attitudinal competencies within transport related education becomes a priority, which needs to look into not only curriculum development but also the method of delivery as this area of competency needs much different approach to other areas and conventional methods.

6.4.3 Recommendations by Education Specialists on Competency Levels for Energy Efficiency Education

As described earlier, in addition to the educationalists, a selected group of specialists in the engineering and technical education sectors was consulted for recommendations on the main aspects covered in this study. This section presents the findings on the recommendations of education specialists on competency levels required for EE education in the transport, in each of the five qualification/education level covered in this study, namely, technical certificate,

Figure 6.10: LOs and POs of the educational/training programmes
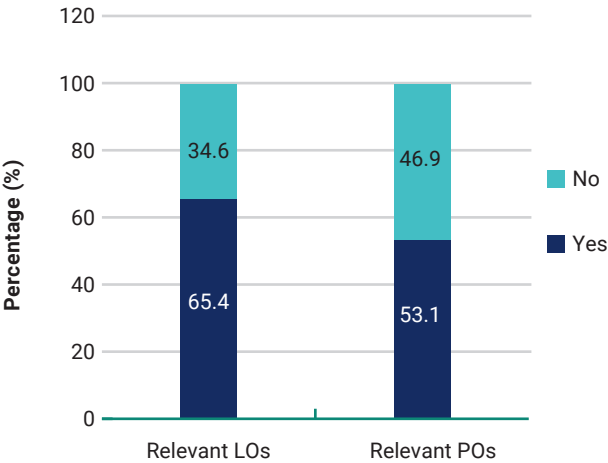
Figure 6.11: Emphasis given on competencies in the educational/training programmes
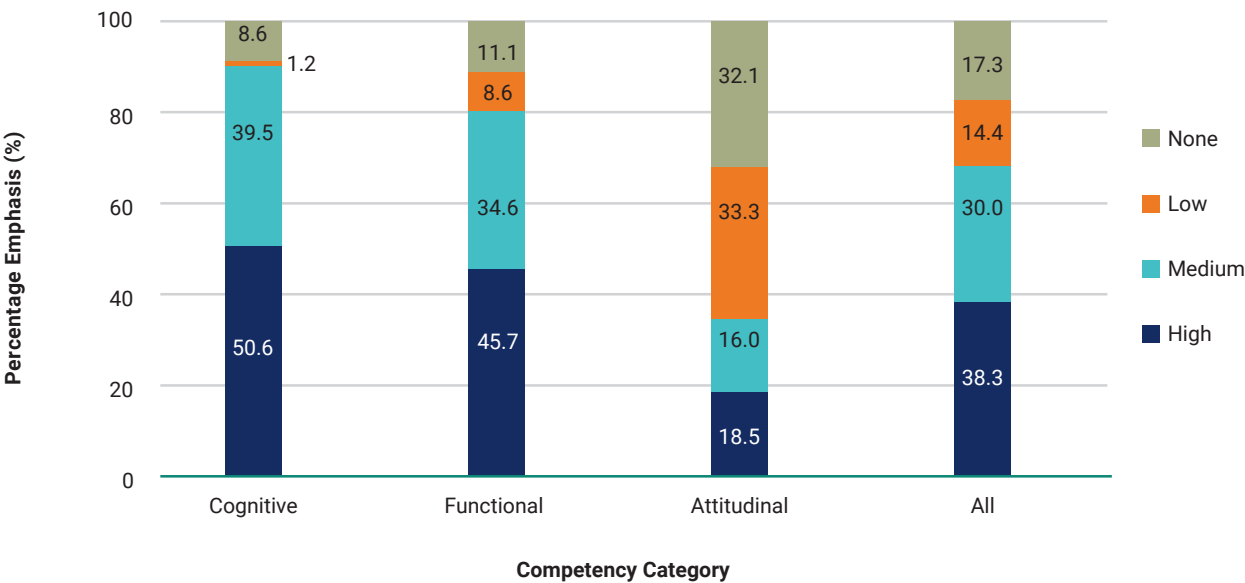
technical diploma, undergraduate degree, postgraduate degree and CPD. The competencies considered in the assessment were more comprehensive than those studies under educationalists presented in the previous section, having three more specific competencies under each of the main category of cognitive, functional and attitudinal competencies. This leads to a total of nine (09) competencies. These competencies, as applicable to the EE in transport, are described in Table 4.4 of Section 4.4.3. The results related to each of the five sectors of education are presented in Figure 6.12 to Figure 6.16. The results represent each of the nine competency areas as well as the overall competency, derived through simple average (thus equal weights).

Figure 6.12 presents the findings for the technical certificate level programmes. It is evident from the above results that the main emphasis is given by the education specialist to build attitudinal competency area for the technical certificate level, followed by cognitive area.

Figure 6.13 illustrates the findings for the technical diploma level programmes. In this case too, the prominence is given to attitudinal competency area, followed by cognitive competencies. However, the emphasis given for competency building in technical diploma is higher in all the three competency categories than those of technical certificate courses presented in Figure 6.12.

Figure 6.12: Emphasis on competencies in the technical certificate programmes
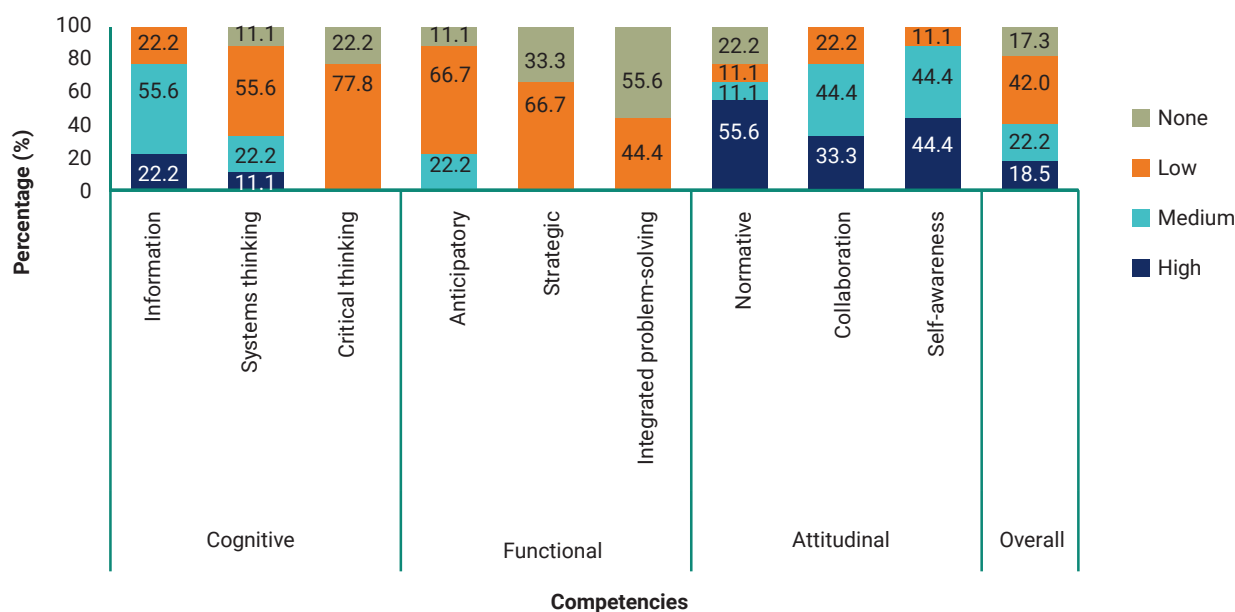
Figure 6.13: Emphasis on competencies in the technical diploma programmes
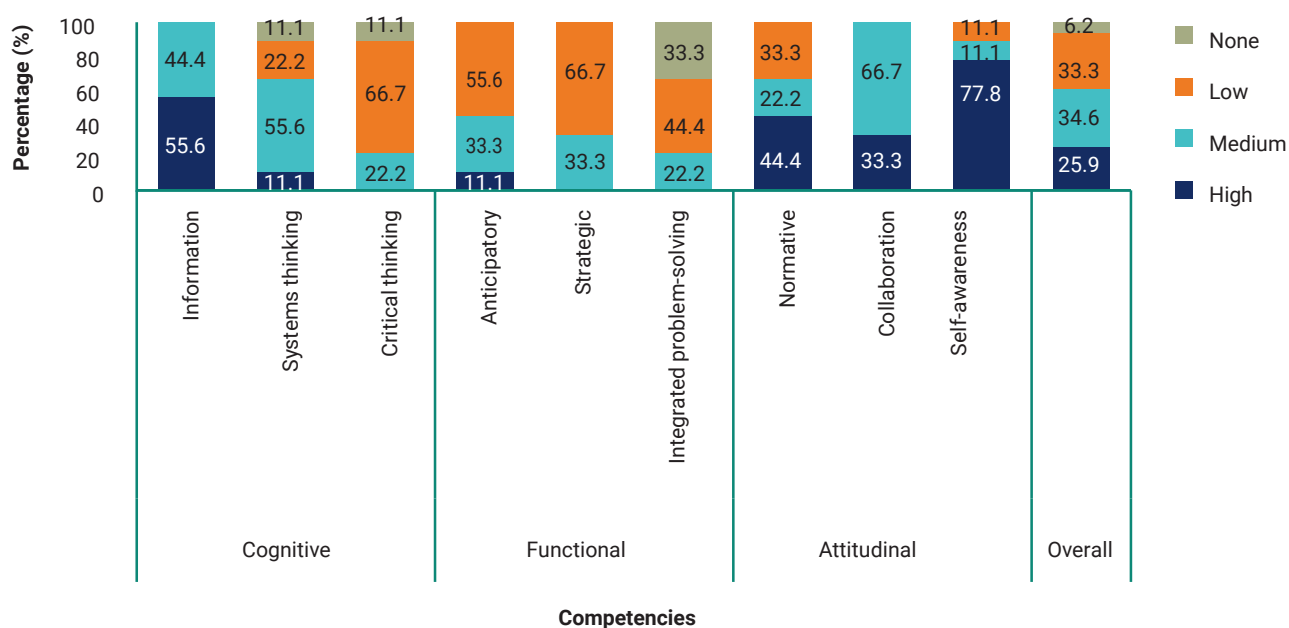
The results for the undergraduate degree level programmes are presented in Figure 6.14 illustrates the findings for the technical diploma level programmes. As with the two technical level educations presented above, the emphasis is given more to attitudinal competency area, followed by cognitive competencies. However, much more importance is given in all the competency areas than technical education. Thus, undergraduate degree programmes could be considered as a main intervention area for competency building of transport sector actors.

The next education sector considered in the analysis is postgraduate degree programmes (taught courses),

as presented in Figure 6.15. In this case, almost all the competency areas are emerged as highly important, which leads to the conclusion that the postgraduate degree level courses is crucial for competency building of transport sector actors. This finding could be attributed to the complex nature of the challenges in the EE project implementation in the transport sector, thus requiring in-depth understanding and skills for the transport sector actors. Collectively, undergraduate and postgraduate study programme could provide the major impact on the competency building of transport sector actors, and thus tertiary/universities sector emerged as the key education provider.

Figure 6.14: Emphasis on competencies in the undergraduate degree programmes
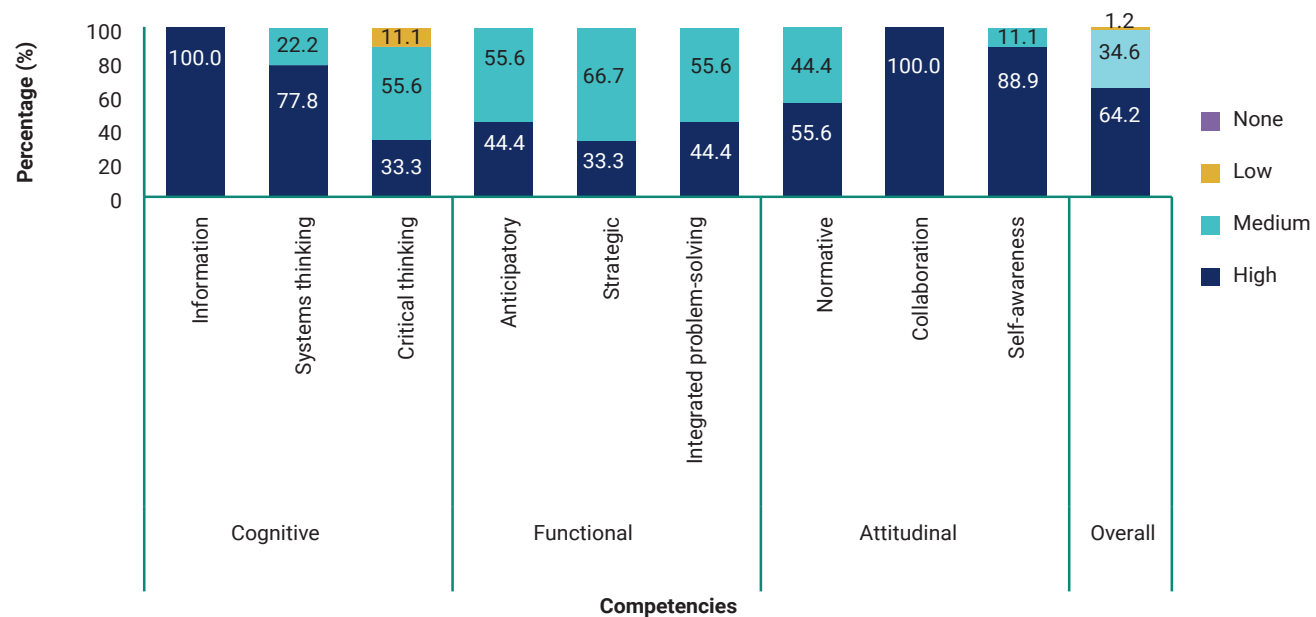
Figure 6.15: Emphasis on competencies in the postgraduate degree programmes
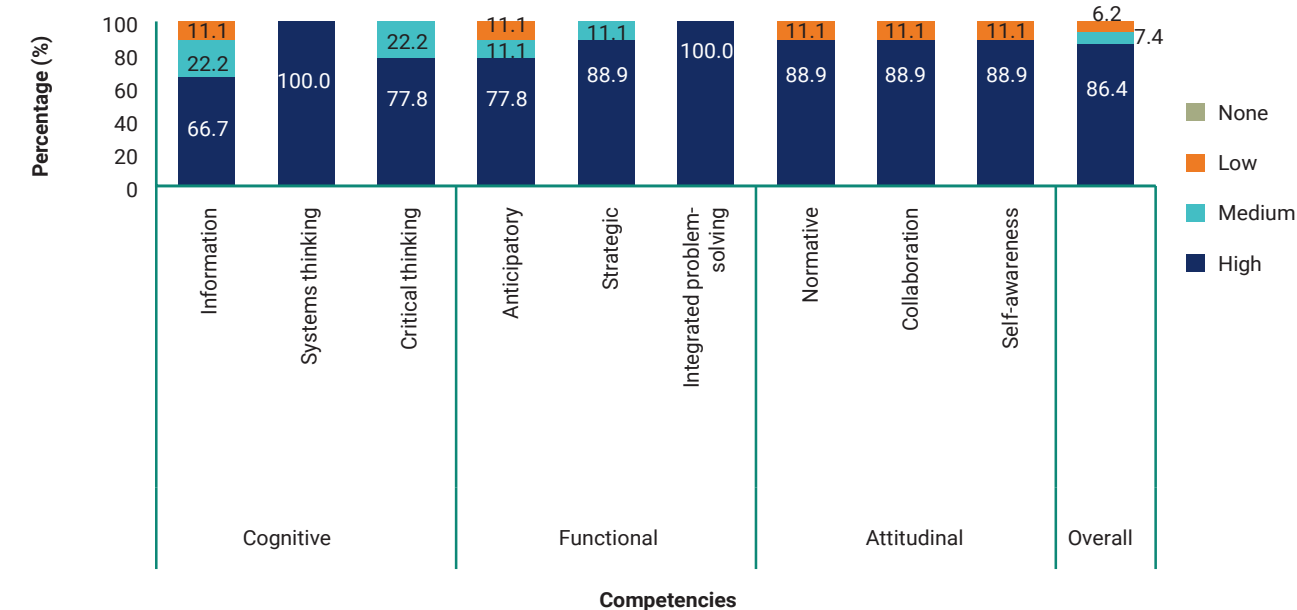
Figure 6.16: Emphasis on competencies in the professional programmes
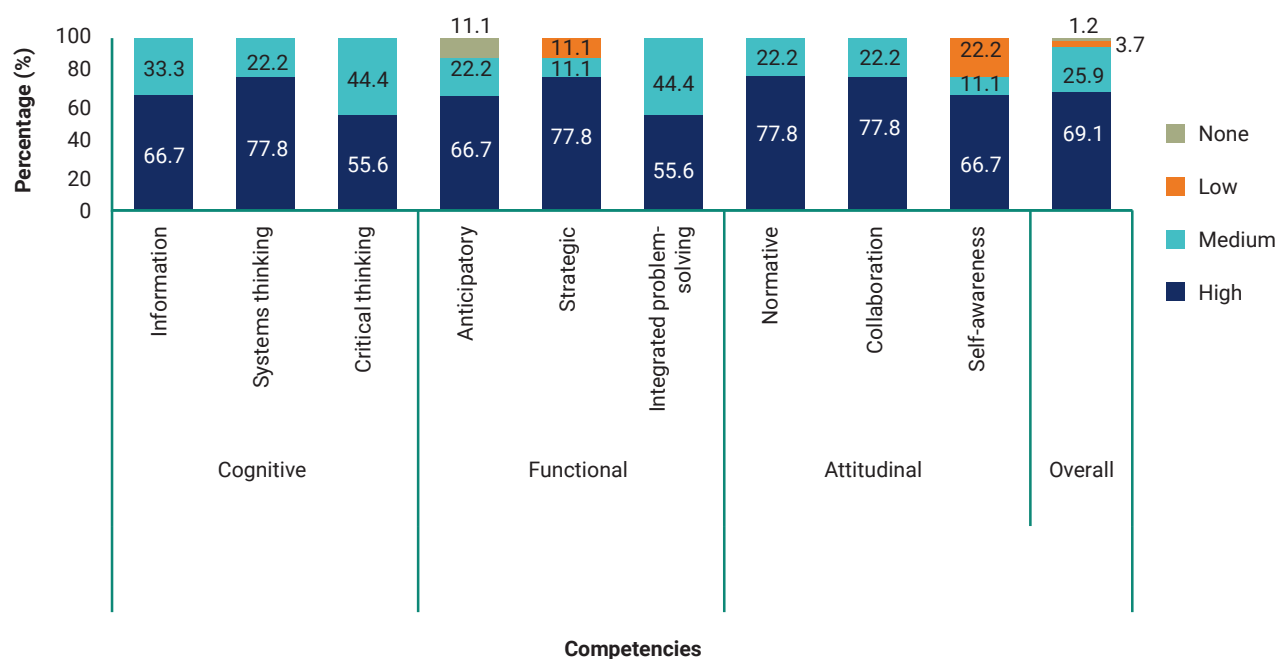
Figure 6.17: Emphasis on overall competency in the all educational programmes
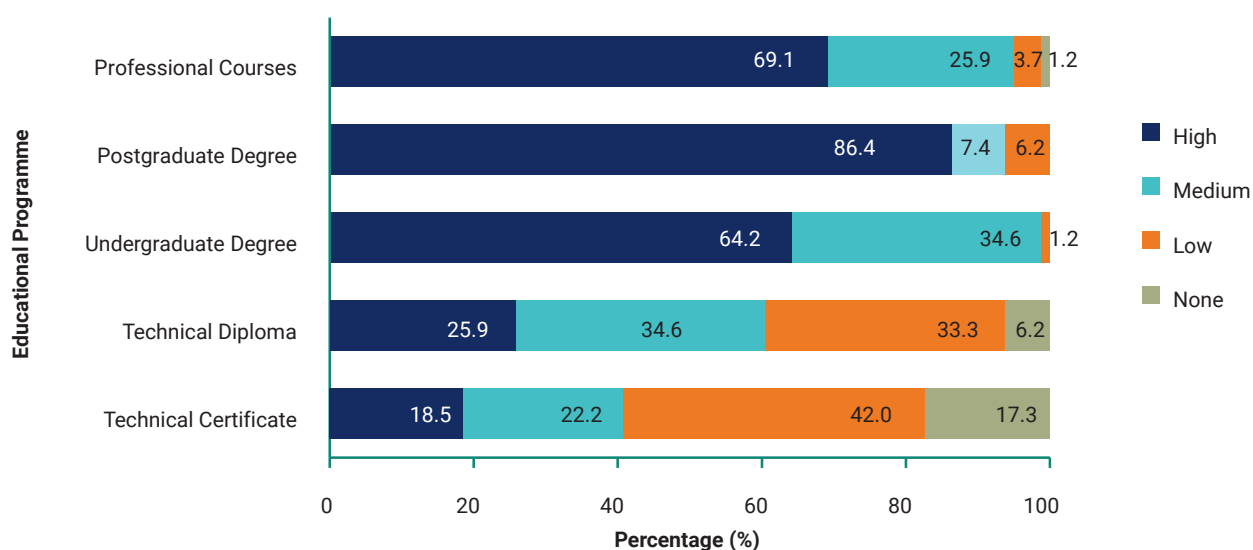
Finally, the results for the professional courses are presented in Figure 6.16. In this case too, significantly high emphasis is given for all the competency areas.

The results presented above for the five different educational programme levels could by presented together by considering the overall competency levels for a comparison of relative importance, as presented in Figure 6.17. As identified earlier, the importance of undergraduate degrees, postgraduate degrees (taught courses) and professions courses is clearly visible.

6.4.4 Recommendations by Education Specialists on Scope/Depth of Study under each Energy Efficiency Area

The other important contribution made by the education specialist for the present study is related to the recommendations made on scope/depth of study under each EE area in the transport sector (system efficiency, trip efficiency and vehicle efficiency) in the five levels of educations (technical certificate, technical diploma, undergraduate degree, postgraduate degree

and CPD). The results related to each of the five sectors of education are presented in Figure 6.18 to Figure 6.22. The results represent each of the three EE areas as well as the overall EE, derived through simple average (thus equal weights).

Figure 6.18 presents the findings for the technical certificate level programmes. It is evident from the above results that the main emphasis is given by the education specialist to include vehicle efficiency areas, in comparison with system efficiency and trip efficiency areas, for the technical certificate level courses.

The results for the technical diploma level programmes are presented in Figure 6.19. In this case, all the three

EE areas are given higher prominence than for the technical certificate level courses, but with more emphasis in trip efficiency.

Figure 6.20 illustrates the findings for the undergraduate degree level programmes. In this case, much more importance is given in all the competency areas than the two technical education categories given above, where vehicle efficiency area is given even higher emphasis. Thus, as with the competencies, undergraduate degree programmes could be considered as a main intervention sector for competency building in all the EE areas of transport sector actors.

Figure 6.18: Emphasis for EE areas in the technical certificate programmes
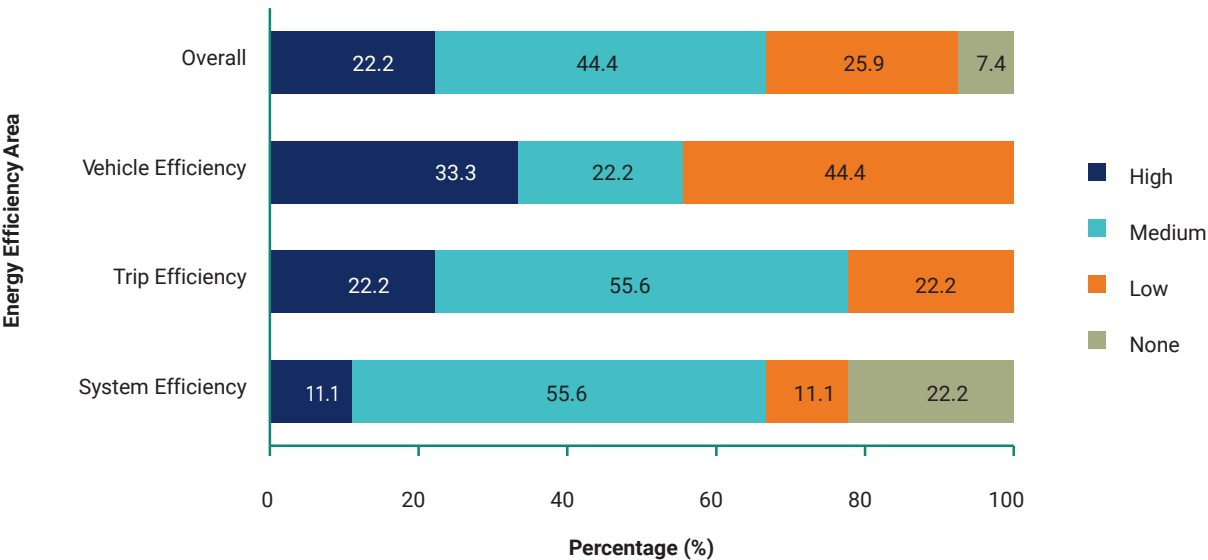
Figure 6.19: Emphasis for EE areas in the technical diploma programmes
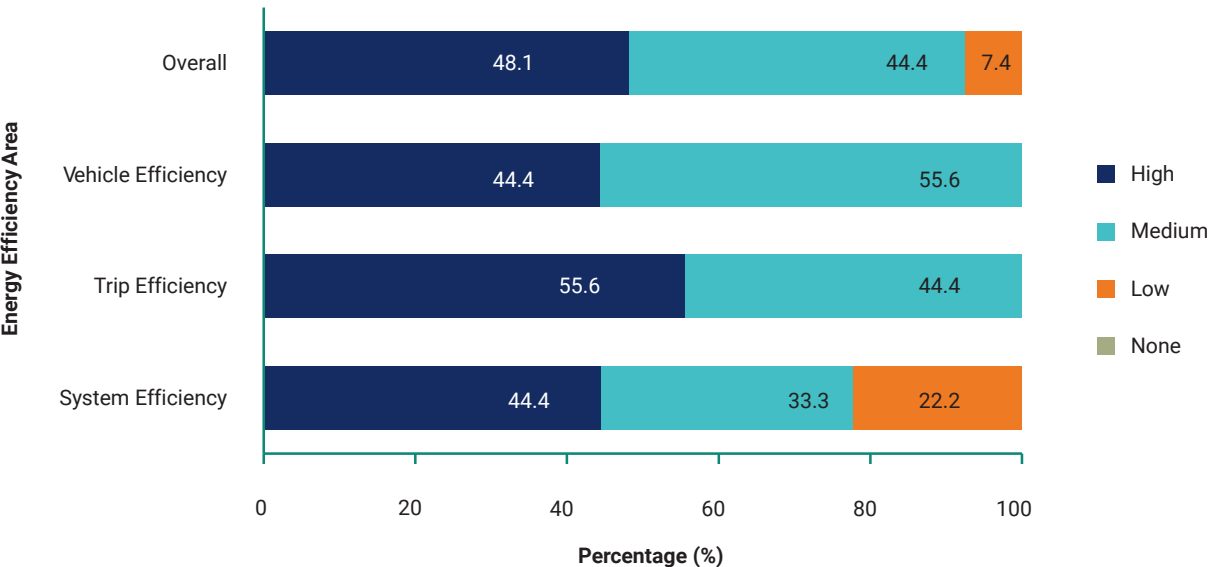
Figure 6.20: Emphasis for EE areas in the undergraduate degree programmes
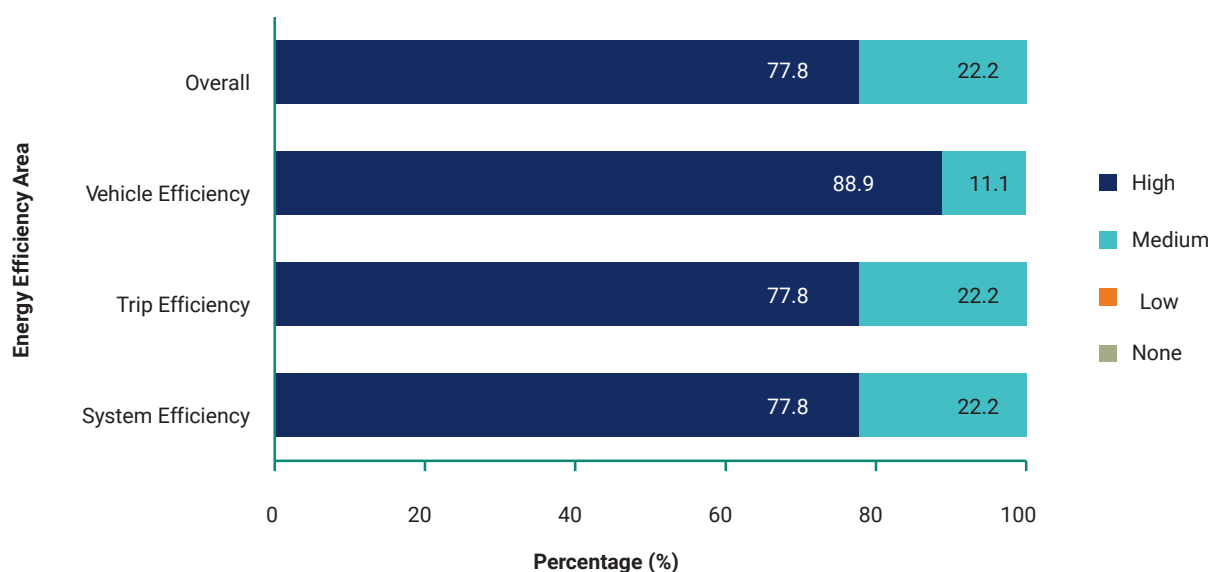
Figure 6.21: Emphasis for EE areas in the postgraduate degree programmes
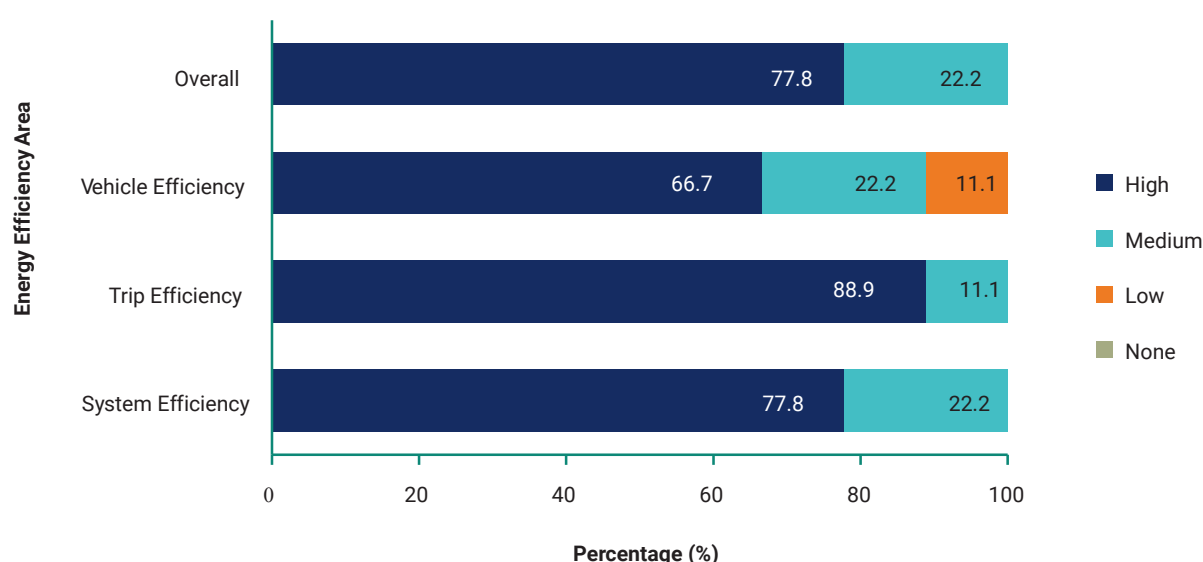
The results for the postgraduate degree programmes (taught courses), as presented in Figure 6.21. In this case, almost all the EE areas are emerged as highly important, though slightly lower than those with undergraduate degree programmes. This leads to the conclusion that both the undergraduate and postgraduate degree level courses would play a main role in competency building all the EE areas of the transport sector.

Finally, the results for the professional courses are presented in Figure 6.22. For this sector of education, more prominence is given for system efficiency, followed by trip efficiency.

In overall, the professional courses are given more importance than the technical/vocational level programmes, but less importance than the undergraduate and postgraduate degree programmes. The comparative analysis of all the educational programme levels in overall EE is illustrated in Figure 6.23.

In conclusion, it is apparent that the undergraduate and postgraduate degree programmes, thus the tertiary/university sector institutions emerged as the front-runner for the competency building of the transport sector actors in all the EE areas.

Figure 6.22: Emphasis for EE areas in the professional courses
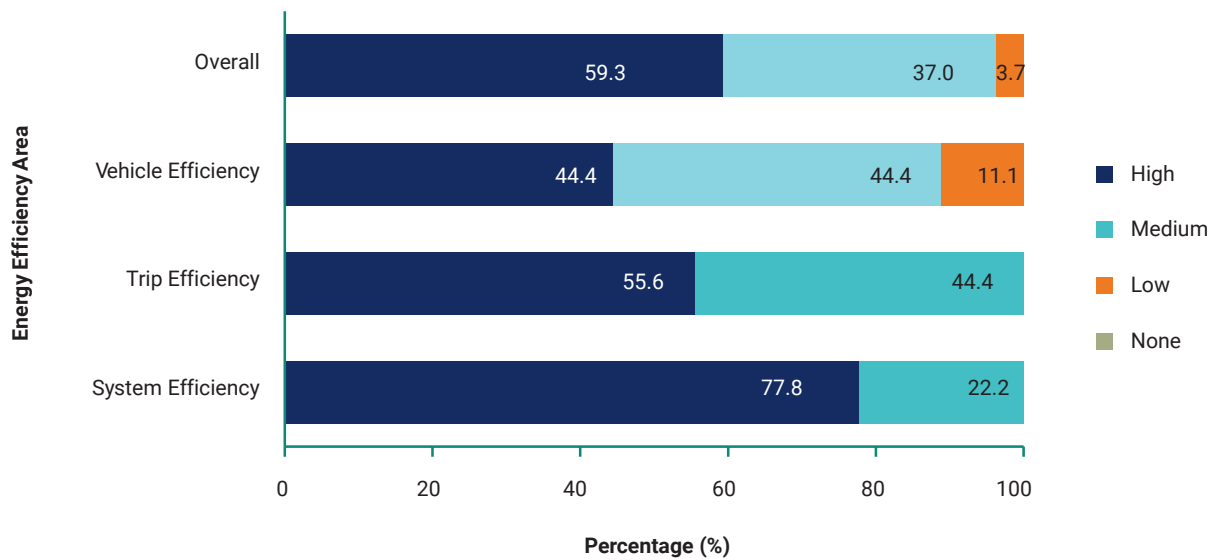
Figure 6.23: Emphasis for overall EE in the all levels of educational programmes
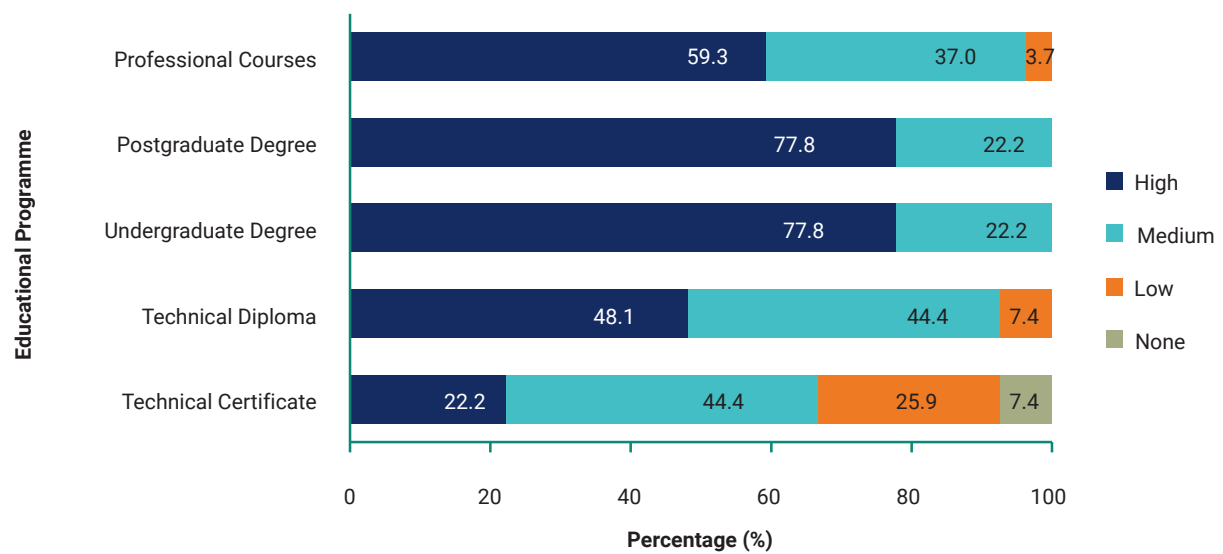
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Annex A: Assessment for GFEI Revised Targets on Fuel Economy and GHG Emissions [10]

A.1 APPROACH

The revised targets were based on a comprehensive assessment conducted by the International Council on Clean Transportation (ICCT), in close coordination with the International Energy Agency (IEA) and with input from all GFEI partners. They incorporate the latest technological developments and provide a more robust characterization of on-road global transportation decarbonization potential by 2050. Potential efficiency improvements are evaluated separately for internal combustion engine (ICE) technology alone and ICE technology in combination with vehicle electrification.

A.2 KEY FINDINGS

The assessment reaffirms the previous targets set by GFEI for new LDVs and HDTs in 2030 and 2035 respectively, establish more stringent 2050 targets for new LDVs and HDTs, establish targets for two and three wheelers and buses in 2035 and 2050, and compile these targets into a vision for achieving major reductions in GHG emissions from the transportation sector by 2050. Vehicle class-specific and fleet-wide targets and findings are as follows:

LDVs

The previous target of doubling fuel economy of new LDVs globally by 2030 (relative to 2005) is affirmed, which is possible through continued improvements in ICE efficiency plus the introduction of electric LDVs, and extend this target to a 50% reduction in new passenger vehicle per-kilometer CO_2 emissions by 2030. The new target established for LDVs is per-kilometer CO_2 emissions reduction of 90% for 2050 (relative to 2005). Following specific interventions and sub-targets are required to achieve this overall target:

- ICE fuel consumption needs to improve by an average of 2.1% per year from 2020 to 2050,

- Global sales fraction of electric LDVs needs to increase to 35% of sales in 2030 and 86% of sales in 2050,

- Carbon intensity of the global electricity grid needs to decrease by at least 90% between 2020 and 2050.

HDTs

The previous target of 35% reduction of per-kilometer fuel consumption from new heavy duty trucks by 2035 (relative to 2005) is affirmed, which is possible through continued improvements in ICE efficiency plus the introduction of electric heavy duty trucks, and extend this target to a 35% reduction in new heavy duty truck per-kilometer CO_2 emissions by 2035. The new target established for HDTs is per-kilometer CO_2 emissions reduction of 70% for 2050 (relative to 2005). Following specific interventions and sub-targets are required to achieve this overall target:

- ICE fuel consumption needs to improve by an average of 1.7% per year from 2020 to 2050,

- Global sales fraction of electric HDTs needs to increase to 19% of sales in 2030 and 66% of sales in 2050,

- Carbon intensity of the global electricity grid needs to decrease by at least 90% between 2020 and 2050.

Two and Three Wheelers

The first-ever targets are set for two and three wheelers, namely reduction of per-kilometer CO_2 emissions by 80% by 2035 and 95% by 2050 (both relative to 2005). Following specific interventions and sub-targets are required to achieve these overall targets:

- FE of ICE powered two and three wheelers needs to improve by an average of 1.4% per year from 2020 to 2050,

- Global sales fraction of electric two and three wheelers needs to increase to 74% of sales in 2030 and 100% of sales in 2050,

- Carbon intensity of the global electricity grid needs to decrease by at least 90% between 2020 and 2050.

Transit Buses

The first-ever targets are set for transit buses, as reduction of per-kilometer CO_2 emissions by 65% by 2035 and 95% by 2050 (both relative to 2005). Following specific interventions and sub-targets are required to achieve these overall targets:

- FE of ICE powered buses needs to improve by an average of 2.0% per year from 2020 to 2050,

- Global sales fraction of electric buses needs to increase to 37% of sales in 2030 and 93% of sales in 2050,

- Carbon intensity of the global electricity grid needs to decrease by at least 90% between 2020 and 2050.

Decolonization of the Transport Sector

In addition to the vehicle class-specific targets presented above, GFEI recognizes the importance of supporting government actions and policies that bring the transportation sector into compliance with the Paris Climate Agreement. Based on the assessment, following conclusions are made:

- Continued improvements in vehicle efficiency plus aggressive introduction of electric vehicles combined with decarbonization of the electricity grid can achieve a 55-70% reduction in fleet wide well-to-wheel CO_2 emissions by 2050 with combustion engine efficiency responsible for 50-65% of the overall reductions (from a 2005 baseline).

- By 2050, per-kilometer CO_2 reduction targets for new vehicles of greater than 90% can be established for the LDVs, two wheelers, three wheelers and buses, assuming aggressive development of markets for electric vehicles and aggressive decarbonization of the electricity grid. The corresponding reduction for new HDTs is lower at 70% due to the greater challenge of electrifying vehicle (EV) operations in the sector.

- Decarbonizing the electricity grid becomes increasingly important during post 2035 as EV sales approach or exceed 90% in all but the HDT sector. Grid CO_2 intensity becomes the dominant influence on the CO_2 impacts of these EVs, driving CO_2 reductions from about 55% (relative to an ICE vehicle) for today's global average grid characteristics to 90-100% under an aggressive grid decarbonization scenario.

- On a fleet-wide basis, growth in the population and annual usage rates of on-road vehicles results in significant growth in total vehicle kilometers of travel (VKT), which offsets the net fleet-wide CO_2 emission reduction achievable though efficiency technology and electrification. This analysis does not investigate measures to constrain such growth. The total VKT is estimated to increase by a factor of 3.2 between 2005 and 2050.

- The estimated fleet-wide well-to-wheel CO_2 emissions reduction target is 2.2 Gt in 2050, which represents a 65% reduction from the 2005 baseline. This target is set at an ambitious level to comply with the Paris Climate Agreement commitment to limit the global average temperature increase to "well below" 2 °C.

- The estimated reduction of CO_2 emissions due to compliance with the proposed GFEI new vehicle standards is about 1.9 Gt. This is less than what is required to achieve the targeted 65% reduction from 2005 emissions by 2050 given above. In effect, the reaffirmed and newly established targets for new vehicles deliver 46% of the required reduction in fleet-wide emissions by 2050 (under the most aggressive electricity grid CO_2 intensity scenario analyzed).

- The present assessment looks at efficiency and emissions only through 2050, at which time EV sales are projected to approach a 100% market share for all road transport sectors except HDTs. If this analysis were to continue beyond 2050, there would be additional CO_2 emission reductions due to the increasing share of travel associated with EV operation. It is expected that CO_2 emission reductions to nearly double from 30% to over 55%, from a 2005 baseline, when 100% EV market share for all sectors (other than HDTs) is combined with an aggressively decarbonized electricity grid.

- There is a need for additional policies to further reduce road transport emissions. However, the required magnitude of such reductions is dependent on the timing of EV market saturation. Such policies can include those targeting VKT reduction, congestion mitigation, vehicle class shifting, incentives for the purchase and utilization of more fuel-efficient vehicles, and incentives designed to accelerate the transition to a zero emission fleet more quickly. Conversely, due to complications associated with operating characteristics, the analysis assumes that ICE vehicles will retain a significant sales share in the HDT sector through at least 2050. This, combined with significant growth in VKT of HDTs between 2005 and 2050, serves to constrain emissions reductions for both the HDT sector and for the on-road transportation sector as a whole.

- Although it is not possible to foresee the EV future with certainty, it is possible to ground longer-term projections in near-term estimates. For LDVs, this analysis assumes global EV sales of 22% by 2025 and 35% by 2030. Automaker announcements indicate global sales of 15 million EVs by 2025, which represents a sales share of 14% in a global market of 107 million annual sales. Existing government commitments indicate a demand for 22 million EVs by 2030. This represents a 19% sales share on a global basis. Thus, both automakers and regulators will have to build on their commitments to meet the EV trajectory envisioned.

Annex B: Formats of the Questionnaires

B.1   Questionnaire for Transport Sector Actors

B.2   Questionnaire for Educationalists

B.3   Questionnaire for Transport Experts

B.4   Questionnaire for Education Specialists.

B.5   Interview Question Sheet for Transport Sector Actors

B.6   Interview Question Sheet for Educationalists

B.1:   ASSESSMENT OF SKILLS AND KNOWLEDGE GAP IN ENERGY EFFICIENCY WITHIN THE TRANSPORT SECTOR IN SRI LANKA

Questionnaire to Obtain Data on the Employment and Competency Levels & Requirements

Stakeholder Category: Transport Sector Actors

Please refer the Guidance Note annexed before responding

Stage 1: Basic Information for Relevancy (Refer the Section B of the Guidance Note)

Institution/Agency							
Position; Division/Department							
(A) Interest & Influence in transport related activities (particularly urban) – Pls tick							
Interest	Primary		Secondary		Minor		No	
Influence	High		Moderate		Low		None	
(B) Awareness & Competency on energy efficiency in transport sector. Pls tick							
Awareness	Sound		Fair		Low		None	
Competency	High		Fair		Low		None	

Stage 2: Detailed Information for Assessment (Refer the Section C of the Guidance Note)

1. Educational Background							
		Degree		Institute		Field / Specialization	
Academic Qualifications	Postgraduate degree						
	Bachelor's degree						
	Diploma						
Professional Qualifications							
Specific education related to transport (Pls tick)	School		Technical		Occupational		
	Undergraduate		Postgraduate		Research		
	Seminars/workshops		Specific trainings		Non-formal (media)		

2. Present Employment

Job title/Position			Years of Experience	
Management Level (Pls tick)*	Strategic		Tactical		Operational	
Roles & Responsibilities (Pls tick)	Policy/Strategy		Planning		Administration	
	Design/Develop		Coordination		Implementation	
	Supervision		Operation		Reporting	

* If the management level is "Strategic", pls respond only to Part (A) of Section 3 and Section 4.
If the management level is "Tactical" or "Operational", pls respond only to Part (B) of Section 3 and Section 4

3. Cognitive Competencies (Knowledge)   - Please answer either (A) or (B) as relevant

(A) Strategic Level

Energy efficiency intervention areas of the urban transport systems		Knowledge level (pls tick)				
		None	Basic	Intermediate	Advanced	Expert
Reduce/avoid travel or the need to travel	Policy Making					
	Planning					
Shift to more energy efficient modes	Policy Making					
	Planning					
Vehicle technology & Operational characteristics	Policy Making					
	Planning					

(B) Tactical & Operational Levels

Energy efficiency intervention areas of the urban transport systems		Knowledge level (pls tick)				
		None	Basic	Intermediate	Advanced	Expert
Reduce/avoid travel or the need to travel	Planning					
	Implementation					
	Operation					
Shift to more energy efficient modes	Planning					
	Implementation					
	Operation					
Vehicle technology & Operational characteristics	Planning					
	Implementation					
	Operation					

4. Functional Competencies (Skills) - Please answer either (A) or (B) as relevant

(A) Strategic Level

Energy efficiency intervention areas of the urban transport systems		Skill level (pls tick)				
		None	Basic	Intermediate	Advanced	Expert
Reduce/avoid travel or the need to travel	Policy Making					
	Planning					
Shift to more energy efficient modes	Policy Making					
	Planning					
Vehicle technology & Operational characteristics	Policy Making					
	Planning					

(B) Tactical & Operational Levels						
Energy efficiency intervention areas of the urban transport systems		Skill level (pls tick)				
		None	Basic	Intermediate	Advanced	Expert
Reduce/avoid travel or the need to travel	Planning					
	Implementation					
	Operation					
Shift to more energy efficient modes	Planning					
	Implementation					
	Operation					
Vehicle technology & Operational characteristics	Planning					
	Implementation					
	Operation					

5. Implementation of Energy Efficiency (EE) Projects in the Transport Sector

Please provide your recommendation, if any, on different component of the transport sector (particularly Urban Transport Systems) where EE project can be implemented

EE Area	Specific Component/Sub-system of the Transport Sector*	Type/Nature of intervention**
Reduce/avoid travel or the need to travel		
Shift to more energy efficient modes		
Vehicle technology & Operational characteristics		

* These could include either type of main transport modes such as public transport (buses), personal vehicles (2W, 3W, 4Ws), non-motorized transport, etc. and also could be further divided geographically (rural, urban, semi-urban) or by technology (ICE, Hybrid, EVs), or by fuel type, or by operator (government, private companies, individual private operators) or by functions (long-distance / intercity, short distance, intermodal transport, school buses, government vehicle fleet) or support systems (such as vehicle repair facilities/garages, spare part industry, information management systems, transport infrastructure, fuel supply/distribution system).

** These could include generic or specific policy, legislations, regulatory, facilitations, technological, infrastructure, fuel, information, knowledge / capacity building, etc. that could lead to direct or indirect improvements in system efficiency, travel efficiency or vehicle efficiency.

IMPORTANT:

Please go through the information provided in the Guidance Note in the next pages, before completing the above questionnaire.

Guidance Note for the Questionnaire – Transport Sector Actors

(A) The Energy Efficiency in Transport System

Although the energy efficiency (EE) has a simple and direct meaning technically, analysis of overall EE of a transport system is a complex topic, particularly in the urban environment, and needs holistic approach to comprehend the interconnectedness and interactions among different factors and elements when proposing interventions. The main framework for such strategic action is commonly referred to as Avoid/Reduce-Shift-Improve (A-S-I) approach, which means:

- Avoiding/reducing inefficient or unnecessary travel or transport, where appropriate, e.g. by improved and integrated urban planning with access to public transit development, compact city form, transport demand management, less complex and extended supply chains, economic instruments, and ICT to reduce travel such as e-communication options;

- Shifting travel/transport to improve trip efficiency by most efficient or environmentally friendly mode (such as public transport, non-motorized transport) or combination of modes capable of meeting the travel/transport needs through relevant land use planning, infrastructure development and economic instruments; and/or shifting to off-peak travel;

- Improving the energy & environmental performance of transport through technological, operational, regulatory (fuel economy, emissions, fuel quality/cleaner fuels), economic, and/or infrastructure improvements to make transport vehicles and equipment and the provision of transport more energy efficient and less carbon intensive.

The above three elements result in improvement of the overall performance in the transport sector in relation to EE in three basic facets, namely system efficiency, travel (or trip) efficiency and vehicle efficiency, respectively. The interrelation between the three facets in the EE of transport system with A-S-I approach is illustrated in Figure A.1, which facilitates the identification of the activities and programme for implementation under each intervention area. This in turn provide a sound basis to establish competency requirements (knowledge & skills) for relevant actors in the transport sector together with knowledge areas/subject matters.

(B) The Hierarchical Levels for Potential Impacts by Transport Sector Actors on EE in Transport (Reference to Stage 1 of the Questionnaire)

The potential of transport sector actors to impact on EE in transport depends partly on their interest (or attentiveness) and influence (or power) related to the affairs in the employment and partly on their expertise (awareness & competency) to accomplish the responsibilities and tasks. Assessing the relative levels of each of these aspects helps to select the most appropriate players among relevant stakeholder

Figure A.1: The overall energy efficiency concept in a transport system

institutions in the transport sector to be consulted for obtaining feedbacks. Accordingly, the following criteria are used in this study to establish the hierarchical levels for the potential impact by transport sector actors on EE in transport.

(a) Level of Influence

The influence characterizes the power of the transport sector actor to impact upon actions of others. Three levels of significance in relation to this character are defined here as:

- *High influence* - having characters/attributes such as direct authority, higher management level, well-connectivity (strong contacts) and prominent professional respect.

- *Moderate influence* - having characters/ attributes such as some specific authority, middle management level, some-connectivity (certain contacts) and evident professional respect.

- *Little influence* - having character/attributes such as low/no specific authority, middle or low management level, limited contacts and early stage of professional development.

(b) Level of Interest

The interest portrays the relevancy and focus of the employment of the transport sector actor on the area of concern, which in turn signifies the potential to support and facilitate relevant interventions. Three levels of significance in relation to this character are defined here as:

- *Primary interest* – directly related to the roles & responsibilities of the employment.

- *Secondary interest* – no direct relevance to the roles & responsibilities employment, but frequent contributions are made under team activities and/or specific tasks.

- *Little/no interest* – Little/no relevance to the roles & responsibilities employment, and contributions made under team activities and/or specific tasks are occasional/none.

(c) Level of Expertise

This is depicted through two aspects as awareness and competency (knowledge and skills), each with three levels of significance as:

- *Sound awareness* - up to date, wide-ranging information on the subject is acquired/accessible.

- *Fair awareness* - general trends & basic information on the subject is acquired/accessible.

- *Low/no awareness* - related information is rarely/not pursued and limited/no acquisition.

- *Highly competent* - well practiced, versatile knowledge; recognized as a sector expert.

- *Fairly competent* - adequate knowledge, practiced through common engagements; recognized as a sector player.

- *Low/ competent* - basic knowledge, development stage of skills, newcomer to the sector.

(C) The Hierarchical Levels for Competencies of Transport Sector Actors on EE in Transport (Reference to Stage 2 of the Questionnaire)

In order to accomplish the assigned roles and responsibilities effectively and efficiently, the transport sector actors require different competencies (knowledge and skills) at different levels such as planning, implementation and operation in variety of EE intervention programmes of the transport sector targeting improvements of system efficiency, trip-efficiency and vehicle efficiency. Assessing the relative levels of competencies in each of these aspects helps to identify the present status of the competencies as well as the gaps and areas/methods for competency building. Accordingly, the following criteria are used in this study to establish the hierarchical levels for the competencies of the transport sector actors in relation to EE in transport.

(a) Knowledge Level

The knowledge represents cognitive competencies which could be broadly classified as information competency (the ability to access, acquire and process information), system thinking competency (the ability to recognize/understand relationships and to analyze complex systems) and critical thinking competency (the ability to question norms/practices; to reflect on self-perceptions/actions; and to take a position in the sustainability discourse). Five levels of significance in relation to this character are defined here as:

- *Expert* – demonstrated excellence in information management across multiple areas of transport; sound capacity to comprehend/analyze complex transport systems; proven capacity in testing norms/practices in several occasions, while reflecting on self-actions emphasizing sustainability.

- *Advanced* - proficient in information management in transport related areas; sound capacity to comprehend/analyze integrated transport systems; capable for testing of norms/practices, while reflecting on self-actions emphasizing sustainability.

- *Intermediate* – capable of information management in specific transport areas; understand the complexity of transport systems and relevant

comprehensive solutions; evident desire for testing of norms/practices, while reflecting on self-actions with sense of sustainability.

- *Basic* – capable of managing basic information in specific transport areas; understand the complexity of transport systems and need for comprehensive solutions; understand the need for questioning norms/practices, while reflecting on self-actions with sense of sustainability.

- *None/Limited* – Very limited exposure to transport sector data/information; capable to understand only simple transport systems; limited experience to question norms/practices, and to reflect on self-perceptions/actions.

(b) Skills Level

The skills represent functional competencies which could be broadly classified as anticipatory competency (the ability to evaluate situations of multiple scenarios of transport systems), strategic competency (the ability to collectively design and implement interventions that foster sustainability) and complex problem solving competency (the ability to apply different problem-solving methodologies related to complex and diverse transport issues to develop comprehensive solution options). Five levels of significance in relation to this character are defined here as:

- *Expert* – demonstrated excellence in evaluate situations of multiple scenarios of transport systems; sound capacity to collectively design & implement interventions that foster sustainability; proven capacity to apply different problem-solving methodologies related to complex and diverse transport issues in developing comprehensive solution options.

- *Advanced* - proficient in evaluate situations of different scenarios of specific transport systems; capable of contributing to collective design & implementation of interventions that foster sustainability; capable of applying different problem-solving methodologies related to specific integrated transport issues in developing appropriate solution options.

- *Intermediate* – capable of evaluating situations of different scenarios of specific transport systems; capable of contributing to specific areas in design & implementation of interventions that foster sustainability; capable of applying specific problem-solving methodologies related to particular transport issues in developing appropriate solution options.

- *Basic* – capable of evaluating situations of specific scenarios of simple transport systems; understand specific areas in design & implementation of interventions that foster sustainability; capable of identifying specific problem-solving methodologies related to particular transport issues in developing appropriate solution options.

- *None/Limited* – Very limited exposure in evaluating situations of specific scenarios of transport systems; No experience in design & implementation of interventions that foster sustainability; Limited familiarity on problem-solving methodologies related to particular transport issues.

B.2: ASSESSMENT OF SKILLS AND KNOWLEDGE GAP IN ENERGY EFFICIENCY (EE) WITHIN THE TRANSPORT SECTOR IN SRI LANKA

Questionnaire to Obtain Data on the Employment and Competency Levels & Requirements

Stakeholder Category: Educationalists

Please refer the Guidance Note annexed before responding

Stage 1: Basic Information for Relevancy (Refer the Section B of the Guidance Note)

Institution	
Faculty/Department/Division	
Job Title/Position	

(A) Main Subject Module (Transport/Energy Efficiency related) involved with. Pls tick					
Type of Module	Core/Compulsory		Elective		Optional	
Involvement	Direct/Major		Some/Partial		Minor/Little	

(B) Awareness & Proficiency on Energy Efficiency in the Transport Sector. Pls tick					
Awareness	Well-informed		Fairly		Vaguely		Not aware	
Proficiency	High		Fair		Low/Slight		None	

Stage 2: Detailed Information for Assessment

1. Educational Background				
		Degree	Institute	Field / Specialization
Academic Qualifications	Postgraduate degree			
	Bachelor's degree			
	Diploma			
Professional Qualifications/Memberships				
Specific education /training related to transport (Pls tick)	School		Technical		Occupational	
	Undergraduate		Postgraduate		Research	
	Seminars/workshops		Specific trainings		Non-formal (media)	

2. Teaching Background				
Teaching positions held			Years of teaching experience	
Transport and/or EE related subjects offered	Postgraduate level			
	Undergraduate level			
	Diploma level			
	Short courses/Training			
Roles & Responsibilities	Curriculum development		Educational material development	
	Teaching & labs		Research & Industry project	
	Consultancy		Administration	

3. Study Programme Details – Existing (Fill the available information, if applicable)					
(A) Postgraduate Degree/Diploma					
Title of the course/programme					
Module title (transport/EE related)					
Number of credits / teaching hrs					
Topics on EE, particularly in transport					
Related Learning Objectives (LOs)*					
Related Programme Outcomes (POs)*					
Targeted Competencies**	Knowledge		Skills		Attitudes/Values	
EE Areas that could be included for improvement					
Potential method/s of introduction. Pls tick	Lecture		Lab. work		Project/Assignment	
(B) Undergraduate Degree					
Title of the course/programme					
Module title (transport/EE related)					
Number of credits / teaching hrs					
Topics on EE, particularly in transport					
Related Learning Objectives (LOs)*					
Related Programme Outcomes (POs)*					
Targeted Competencies**	Knowledge		Skills		Attitudes/Values	
EE Areas that could be included for improvement					
Potential method/s of introduction. Pls tick	Lecture		Lab. work		Project/Assignment	
(C) Short Courses					
Title of the course/programme					
Module title (transport/EE related)					
Number of credits / teaching hrs					
Topics on EE, particularly in transport					
Related Learning Objectives (LOs)*					
Related Programme Outcomes (POs)*					
Targeted Competencies**	Knowledge		Skills		Attitudes/Values	
EE Areas that could be included for improvement					
Potential method/s of introduction. Pls tick	Lecture		Lab. work		Project/Assignment	
(D) Training Programmes/Workshops/Seminars					
Title of the course/programme					
Module title (transport/EE related)					
Number of credits / teaching hrs					
Topics on EE, particularly in transport					
Related Learning Objectives (LOs)*					
Related Programme Outcomes (POs)*					
Targeted Competencies**	Knowledge		Skills		Attitudes/Values	
EE Areas that could be included for improvement					
Potential method/s of introduction. Pls tick	Lecture		Lab work		Project/Assignment	

* For LOs and POs, you may provide web-link or reference to the curriculum document/s
**For Competencies, you may indicate the emphasis under each area of "Knowledge", "Skills" and "Attitudes" as High (H), Medium (M) or Low (L) or None (N).

4. Study Programme Details – New / Proposed / Recommended (If Applicable)								
Type of study programme. Pls tick	PG level		UG level		Diploma		Short courses	
Title of the course/ programme								
Module title (transport/EE related)								
Number of credits / teaching hrs								
Type of the module (Pls Tick)	Core/Compulsory				Elective		Optional	
Topics on EE, particularly in transport								
Related Learning Objectives (LOs)								
Related Programme Outcomes (POs)								
Targeted Competencies. Pls denote as H – High, M – Medium, L – Low, N - None	Knowledge		Skills		Attitudes/Values			
Potential method/s of introduction. Pls tick	New module in existing course			In a new course				

5. Implementation of Energy Efficiency (EE) Projects in the Transport Sector		
Please provide your recommendation, if any, on different component of the transport sector (particularly Urban Transport Systems) where EE topics could be included in the curricula.		
EE Area	Specific Component/Sub-system of the Transport Sector*	Lesson topic/s**
Reduce/avoid travel or the need to travel		
Shift to more energy efficient modes		
Vehicle technology & Operational characteristics		

* These could include either type of main transport modes such as public transport (buses), personal vehicles (2W, 3W, 4Ws), non-motorized transport, etc. and also could be further divided geographically (rural, urban, semi-urban) or by technology (ICE, Hybrid, EVs), or by fuel type, or by operator (government, private companies, individual private operators) or by functions (long-distance / intercity, short distance, intermodal transport, school buses, government vehicle fleet) or support systems (such as vehicle repair facilities/garages, spare part industry, information management systems, transport infrastructure, fuel supply/distribution system).

** These could include generic or specific policy, legislations, regulatory, facilitations, technological, infrastructure, fuel, information, knowledge / capacity building, etc. that could lead to direct or indirect improvements in system efficiency, travel efficiency or vehicle efficiency.

IMPORTANT:

Please go through the information provided in the Guidance Note in the next pages, before completing the above questionnaire.

Guidance Note for the Questionnaire – Education Sector Actors

(A) The Energy Efficiency in Transport System

Although the energy efficiency (EE) has a simple and direct meaning technically, analysis of overall EE of a transport system is a complex topic, particularly in the urban environment, and needs holistic approach to comprehend the interconnectedness and interactions among different factors and elements when proposing interventions. The main framework for such strategic action is commonly referred to as Avoid/Reduce-Shift-Improve (A-S-I) approach, which means:

- Avoiding/reducing inefficient or unnecessary travel or transport, where appropriate, e.g. by improved and integrated urban planning with access to public transit development, compact city form, transport demand management, less complex and extended supply chains, economic instruments, and ICT to reduce travel such as e-communication options;

- Shifting travel/transport to improve trip efficiency by most efficient or environmentally friendly mode (such as public transport, non-motorized transport) or combination of modes capable of meeting the travel/transport needs through relevant land use planning, infrastructure development and economic instruments; and/or shifting to off-peak travel;

- Improving the energy & environmental performance of transport through technological, operational,

regulatory (fuel economy, emissions, fuel quality/cleaner fuels), economic, and/or infrastructure improvements to make transport vehicles and equipment and the provision of transport more energy efficient and less carbon intensive.

The above three elements result in improvement of the overall performance in the transport sector in relation to EE in three basic facets, namely system efficiency, travel (or trip) efficiency and vehicle efficiency, respectively. The interrelation between the three facets in the EE of transport system with A-S-I approach is illustrated in Figure A.1, which facilitates the identification of the activities and programme for implementation under each intervention area. This in turn provide a sound basis to establish subject areas, required knowledge & skills, competencies, and thus the curricula in related educational and capacity building programmes.

(B) The Hierarchical Levels for the Potential Impacts by Education Sector Actors on EE in Transport (Reference to Stage 1 of the Questionnaire)

The educationalist's ability to impact on capacity building of learners (target group) in any educational or training programme depends on the level of involvement in the curriculum development and delivery, the emphasis of the particular subject module/lesson within the programme, as well as the level of expertise (or proficiency) on the related subject matters/topics. Assessing the relative levels

Figure A.1: The overall energy efficiency concept in a transport system

Energy Efficiency of Transport Systems

System Efficiency	Travel Efficiency	Vehicle Efficiency
Organize land use, social and economic activities in such a way that the need for transport and the use of fossil fuels is reduced	Make use of energy-efficient modes like public transport and non-motorized modes to reduce energy consumption per trip	Consuming as little energy as possible per vehicle-km by using advanced technologies and cleaner fuels and by optimizing vehicle operation
Reduce or avoid travel or the need to travel	Shift to more energy efficient modes	Improve the efficiency through vehicle technology
AVOID/REDUCE	SHIFT	IMPROVE

of each helps to select the most appropriate players among relevant education and training providers to be consulted for obtaining feedbacks. Thus, the following criteria are used in the present study to establish the hierarchical levels for the potential impacts of education sector actors on competency building on EE in transport.

(a) Type of Module/Lesson

Three levels of significance of the subject/module of concern within the programme as:

- *Core subject* is deemed essential/compulsory and shall take by a learner for the successful completion of the programme.

- *Elective subject* is one chosen by a learner from a set of subjects specified for particular focus area/ sub-specialization within the programme. Usually, elective subjects provide a depth of knowledge in a chosen subject area and the choice is more restrictive.

- *Optional subject* is one chosen by a learner from a wider range of subjects, with limited or no restrictions for the choice. Usually, these subjects cover complementary/ supplementary topics of the main study area.

(b) Level of Involvement

Three levels of significance based on the responsibility and engagement in either curriculum development or delivery of the subject/module of concern as:

- *Direct/Main involvement* in which the educationalist is the key resource person or in-charge of the curriculum development or delivery of the programme.

- *Some/Partial involvement* in which the educationalist provides supportive role in the curriculum development or delivery of the programme.

- *Minor/Little involvement* in which the educationalist does not involved with the curriculum development or delivery, but provides inputs or feedback to improve them.

(c) Level of Expertise

This is depicted through two aspects as awareness and proficiency, each with three levels of significance as:

- *Well informed* - up to date, extensive information on the subject is acquired/accessible.

- *Fairly informed* - general trends & basic information on the subject is acquired/accessible.

- *Vaguely informed* - related information is rarely pursued and limited acquisition.

- *Highly proficient* - well practiced, versatile knowledge; recognized as a sector expert.

- *Fairly proficient* – adequate knowledge, common engagement; recognized as a sector player.

- *Slightly proficient* – basic knowledge, development stage of skills, newcomer to the sector.

B.3: ASSESSMENT OF SKILLS AND KNOWLEDGE GAP IN ENERGY EFFICIENCY WITHIN THE TRANSPORT SECTOR IN SRI LANKA

Questionnaire to Obtain Data on the Competency Levels & Requirements

Stakeholder Category: Transport Sector Actors – Transport Expert

Please refer the Guidance Note annexed before responding

Stage 1: Basic Information for Relevancy (Refer the Section B of the Guidance Note)

Institution/Agency							
Position; Division/Department							
(A) Interest & Influence in transport related activities (particularly urban). Pls tick							
Interest	Primary		Secondary		Minor		No	
Influence	High		Moderate		Low		None	
(B) Awareness & Competency on energy efficiency in transport sector. Pls tick							
Awareness	Sound		Fair		Low		None	
Competency	High		Fair		Low		None	

Stage 2: Detailed Information on Relevancy

1. Educational Background								
Academic Qualifications		Degree		Area of Specialization		Whether transport is a topic/ lessons covered (Y/N)		
	Postgraduate degree							
	Bachelor's degree							
	Diploma							
Professional Qualifications / Memberships of Professional bodies								
Specific education /training related to transport (Pls tick)	School			Technical			Occupational	
	Undergraduate			Postgraduate			Research	
	Seminars/workshops			Specific trainings			Non-formal (media)	
2. Employment / Affiliation								
Present job title/ Position						Years of Experience in Transport Sector		
Key positions held in the transport sector								
Roles & Responsibilities assumed in the transport sector so far (Pls tick)	Policy/Strategy		Planning			Administration		
	Design/Develop		Coordination			Implementation		
	Supervision		Operation			Reporting		

Stage 3: Feedback on Competency Levels and Education/Training (Refer the Section C of the Guidance Note for the description of competencies)

3.1 Recommendation on Competency Levels required for different staff categories for Implementation of Energy Efficiency Projects in the Transport sector.

Pls denote the emphasis level as High (H), Medium (M), Low (L) or None (N) for each staff category

Competencies		Staff Category		
		Strategic Level	Tactical Level	Operational Level
Cognitive	Information			
	Systems thinking			
	Critical thinking			
Functional	Anticipatory			
	Strategic			
	Integrated problem-solving			
Attitudinal	Normative			
	Collaboration			
	Self-awareness			

3.2 Recommendation on type of educational/training programmes through which the above competencies could be best acquired for each category of staff.

Pls denote the priority level as High (H), Medium (M), Low (L) or None (N).

Educational/Training Programme	Staff Category		
	Strategic Level	Tactical Level	Operational Level
Technical Certificate			
Technical Diploma			
Undergraduate Degree			
Postgraduate Degree (taught)			
Postgraduate Degree (research)			
Professional Courses			
Informal/Non-formal education			
Occupational experiences			

Stage 4: Feedback on Recommendation for Implementation of EE Projects in Transport Sector

5. Implementation of Energy Efficiency (EE) Projects in the Transport Sector		
Please provide your recommendation on different component of the transport sector (particularly Urban Transport Systems) where EE project can be/should be implemented		
EE Area	**Specific Component/Sub-system of the Transport Sector**	**Type/Nature of intervention**
System Efficiency Reduce/avoid travel or the need to travel (by organizing land use, social and economic activities in such a way that the need for transport and the use of fossil fuels is reduced)		

Trip Efficiency Shift to more energy efficient modes (by making use of resource-efficient modes like public transport and non-motorized modes to reduce resource consumption per trip)		
Vehicle Efficiency Vehicle technology & Operational characteristics (by using advanced technologies & cleaner fuels and by optimizing vehicle operation to consume as little resources as possible per vehicle-km)		

IMPORTANT:

Please go through the information provided in the Guidance Note in the next pages, before completing the above questionnaire.

Guidance Note for the Questionnaire – Transport Sector Actors

(A) The Energy Efficiency in Transport System

Although the energy efficiency (EE) has a simple and direct meaning technically, analysis of overall EE of a transport system is a complex topic, particularly in the urban environment, and needs holistic approach to comprehend the interconnectedness and interactions among different factors and elements when proposing interventions. The main framework for such strategic action is commonly referred to as Avoid/Reduce-Shift-Improve (A-S-I) approach, which means:

- Avoiding/reducing inefficient or unnecessary travel or transport, where appropriate, e.g. by improved and integrated urban planning with access to public transit development, compact city form, transport demand management, less complex and extended supply chains, economic instruments, and ICT to reduce travel such as e-communication options;

- Shifting travel/transport to improve trip efficiency by most efficient or environmentally friendly mode (such as public transport, non-motorized transport) or combination of modes capable of meeting the travel/transport needs through relevant land use planning, infrastructure development and economic instruments; and/or shifting to off-peak travel;

- Improving the energy & environmental performance of transport through technological, operational,

regulatory (fuel economy, emissions, fuel quality/cleaner fuels), economic, and/or infrastructure improvements to make transport vehicles and equipment and the provision of transport more energy efficient and less carbon intensive.

The above three elements result in improvement of the overall performance in the transport sector in relation to EE in three basic facets, namely system efficiency, travel (or trip) efficiency and vehicle efficiency, respectively. The interrelation between the three facets in the EE of transport system with A-S-I approach is illustrated in Figure A.1, which facilitates the identification of the activities and programme for implementation under each intervention area. This in turn provide a sound basis to establish competency requirements (knowledge & skills) for relevant actors in the transport sector together with knowledge areas/subject matters.

(B) The Hierarchical Levels for Potential Impacts by Transport Sector Actors on EE in Transport (Reference to Stage 1 of the Questionnaire)

The potential of transport sector actors to impact on EE in transport depends partly on their interest (or attentiveness) and influence (or power) related to the affairs in the employment and partly on their expertise (awareness & competency) to accomplish the responsibilities and tasks. Assessing the relative levels of each of these aspects helps to select the most appropriate players among relevant stakeholder

Figure A.1: The overall energy efficiency concept in a transport system

institutions in the transport sector to be consulted for obtaining feedbacks. Accordingly, the following criteria are used in this study to establish the hierarchical levels for the potential impact by transport sector actors on EE in transport.

(a) Level of Influence

The influence characterizes the power of the transport sector actor to impact upon actions of others. Three levels of significance in relation to this character are defined here as:

- *High influence* - having characters/attributes such as direct authority, higher management level, well-connectivity (strong contacts) and prominent professional respect.

- *Moderate influence* - having characters/attributes such as some specific authority, middle management level, some-connectivity (certain contacts) and evident professional respect.

- *Little influence* - having character/attributes such as low/no specific authority, middle or low management level, limited contacts and early stage of professional development.

(b) Level of Interest

The interest portrays the relevancy and focus of the employment of the transport sector actor on the area of concern, which in turn signifies the potential to support and facilitate relevant interventions. Three levels of significance in relation to this character are defined here as:

- *Primary interest* – directly related to the roles & responsibilities of the employment.

- *Secondary interest* – no direct relevance to the roles & responsibilities employment, but frequent contributions are made under team activities and/or specific tasks.

- *Little/no interest* – Little/no relevance to the roles & responsibilities employment, and contributions made under team activities and/or specific tasks are occasional/none.

(c) Level of Expertise

This is depicted through two aspects as awareness and competency (knowledge and skills), each with three levels of significance as:

- *Sound awareness* - up to date, wide-ranging information on the subject is acquired/accessible.

- *Fair awareness* - general trends & basic information on the subject is acquired/accessible.

- *Low/no awareness* - related information is rarely/not pursued and limited/no acquisition.

- *Highly competent* - well practiced, versatile knowledge; recognized as a sector expert.

- *Fairly competent* - adequate knowledge, practiced through common engagements; recognized as a sector player.

- *Slightly competent* - basic knowledge, development stage of skills, newcomer to the sector.

(C) Core Competencies for Implementation of Energy Efficiency Projects in the Transport Sector

Cognitive Competencies (Knowledge)
1. **Information competency**: The ability to access, acquire and process information on topics of energy efficiency (EE) in transport sector (covering the three areas of system efficiency, trip efficiency and vehicle efficiency in line with the Avoid/Reduce-Shift-Improve concept).
2. **Systems thinking competency**: The abilities to recognize and understand EE relationships; to analyze EE in complex transport systems; to think of how systems are embedded within different domains and different scales, and to deal with uncertainty.
3. **Critical thinking competency**: The ability to question norms, practices and opinions in relation to transport sector efficiency; to reflect on self-values, perceptions and actions in EE interventions; and to take a position in the sustainability discourse.

Functional Competencies (Skills and know-how)
4. **Anticipatory competency**: The abilities to understand and evaluate multiple futures – possible, probable and desirable of the transport sector EE; to create one's own visions for the future; to apply the precautionary principle; to assess the consequences of actions, and to deal with risks and changes in the area of EE in the transport sector .
5. **Strategic competency**: The abilities to collectively develop and implement innovative actions for energy efficient transport systems that further sustainability at the local level and further afield.
6. **Integrated problem-solving competency**: The overarching ability to apply different problem-solving frameworks to complex transport problems and develop viable, inclusive and equitable solution options that promote energy efficiency, integrating the above-mentioned competences.

Attitudinal Competencies (Behavioural and Values)
7. **Normative competency**: The abilities to understand and reflect on the norms, behaviours and values that underlie one's actions on EE in the transport sector; and to negotiate related sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions.
8. **Collaboration competency**: The abilities to learn from others; to understand and respect the needs, perspectives and actions of others; to understand, relate to and be sensitive to others; to deal with conflicts in a group, and to facilitate collaborative and participatory problem-solving in transport sector EE challenges.
9. **Self-awareness competency**: The ability to reflect on one's own role in the local community and (global) society; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires in relation to EE in transport.

B.4: ASSESSMENT OF SKILLS AND KNOWLEDGE GAP IN ENERGY EFFICIENCY (EE) WITHIN THE TRANSPORT SECTOR IN SRI LANKA

Questionnaire to Obtain Data on the Employment and Competency Levels & Requirements

Stakeholder Category: Education Sector Actors – Education Specialist

Please refer the Guidance Note annexed before responding

Stage 1: Basic Information for Relevancy (Refer the Section B of the Guidance Note)

Institution	
Faculty/Department/Division	
Job Title/Position	

(A) Awareness & Proficiency on Competency based Curriculum Development. Pls tick							
Awareness	Well-informed		Fairly		Vaguely		Not aware	
Proficiency	High		Fair		Low/Slight		None	

(B) Awareness & Proficiency on Resource Efficiency. Pls tick							
Awareness	Well-informed		Fairly		Vaguely		Not aware	
Proficiency	High		Fair		Low/Slight		None	

Stage 2: Detailed Information on Relevancy

2.1 Educational Background			
Academic Qualifications	Course	Area of Specialization	Whether education methods was covered in the study programme (Y/N)
	Postgraduate level		
	Bachelor's level		
	Diploma level		
	Certificate courses		
Professional Qualifications / Memberships of Professional bodies			

2.2 Education Sector Experience					
Key positions held in the educational sector	1. 2. 3.			Years of experience in education sector	
Specific education / training related to competency based education / curriculum development (Pls tick)	Postgraduate level		Extended Courses (> 3 months)		
	Research		Short Courses (< 3 months)		
	Seminars/workshops		Non-formal (media)		
Roles & Responsibilities assumed in the education sector so far (Pls tick)	Policy and strategies		Curriculum review/moderation		
	Curriculum development		Educational material development		
	Teaching & labs		Administration		

Stage 3: Feedback on Competency Levels (Refer the Section C of the Guidance Note)

3.1 Recommendation on Competency Levels for Energy Efficiency Education.

Pls denote the emphasis level as High (H), Medium (M), Low (L) or None (N) for each category of education

Competencies		Technical Certificate	Technical Diploma	Undergraduate Degree	Postgraduate Degree	Professional Courses
Cognitive	Information					
	Systems thinking					
	Critical thinking					
Functional	Anticipatory					
	Strategic					
	Integrated problem-solving					
Attitudinal	Normative					
	Collaboration					
	Self-awareness					

3.2 Recommendation on Scope / Depth of Study under each Category of Resource/Energy Efficiency Area.

Pls denote the emphasis level as High (H), Medium (M), Low (L) or None (N) for each category of education

Energy Efficiency Area	Technical Certificate	Technical Diploma	Undergraduate Degree	Postgraduate Degree	Professional Courses
System Efficiency Reduce/avoid travel or the need to travel (by organizing land use, social and economic activities in such a way that the need for transport and the use of fossil fuels is reduced)					
Trip Efficiency Shift to more energy efficient modes (by making use of resource-efficient modes like public transport and non-motorized modes to reduce resource consumption per trip)					
Vehicle Efficiency Vehicle technology & Operational characteristics (by using advanced technologies & cleaner fuels and by optimizing vehicle operation to consume as little resources as possible per vehicle-km)					

IMPORTANT:

Please go through the information provided in the Guidance Note in the next pages, before completing the above questionnaire.

Guidance Note for the Questionnaire – Education Sector Actors

(A) The Energy Efficiency in Transport System

Although the energy efficiency (EE) has a simple and direct meaning technically, analysis of overall EE of a transport system is a complex topic, particularly in the urban environment, and needs holistic approach to comprehend the interconnectedness and interactions among different factors and elements when proposing interventions. The main framework for such strategic action is commonly referred to as Avoid/Reduce-Shift-Improve (A-S-I) approach, which means:

- Avoiding/reducing inefficient or unnecessary travel or transport, where appropriate, e.g. by improved and integrated urban planning with access to public transit development, compact city form, transport demand management, less complex and extended supply chains, economic instruments, and ICT to reduce travel such as e-communication options;

- Shifting travel/transport to improve trip efficiency by most efficient or environmentally friendly mode (such as public transport, non-motorized transport) or combination of modes capable of meeting the travel/transport needs through relevant land use planning, infrastructure development and economic instruments; and/or shifting to off-peak travel;

- Improving the energy & environmental performance of transport through technological, operational, regulatory (fuel economy, emissions, fuel quality/

cleaner fuels), economic, and/or infrastructure improvements to make transport vehicles and equipment and the provision of transport more energy efficient and less carbon intensive.

The above three elements result in improvement of the overall performance in the transport sector in relation to EE in three basic facets, namely system efficiency, travel (or trip) efficiency and vehicle efficiency, respectively. The interrelation between the three facets in the EE of transport system with A-S-I approach is illustrated in Figure A.1, which facilitates the identification of the activities and programme for implementation under each intervention area. This in turn provide a sound basis to establish subject areas, required knowledge & skills, competencies, and thus the curricula in related educational and capacity building programmes.

(B) The Hierarchical Levels for the Potential Impacts by Education Sector Actors on EE in Transport (Reference to Stage 1 of the Questionnaire)

The educationalist's ability to impact on capacity building of learners (target group) in any educational or training programme depends on the level of involvement in the curriculum development and delivery, the emphasis of the particular subject module/lesson within the programme, as well as the level of expertise (or proficiency) on the related subject matters/topics. Assessing the relative levels of each helps to select the most appropriate players among relevant education and training providers to be

Figure A.1: The overall energy efficiency concept in a transport system

consulted for obtaining feedbacks. Thus, the following criteria are used in the present study to establish the hierarchical levels for the potential impacts of education sector actors on competency building on EE in transport.

(a) Type of Module/Lesson

Three levels of significance of the subject/module of concern within the programme as:

- *Core subject* is deemed essential/compulsory and shall take by a learner for the successful completion of the programme.

- *Elective subject* is one chosen by a learner from a set of subjects specified for particular focus area/ sub-specialization within the programme. Usually, elective subjects provide a depth of knowledge in a chosen subject area and the choice is more restrictive.

- *Optional subject* is one chosen by a learner from a wider range of subjects, with limited or no restrictions for the choice. Usually, these subjects cover complementary/ supplementary topics of the main study area.

(b) Level of Involvement

Three levels of significance based on the responsibility and engagement in either curriculum development or delivery of the subject/module of concern as:

- *Direct/Main involvement* in which the educationalist is the key resource person or in-charge of the curriculum development or delivery of the programme.

- *Some/Partial involvement* in which the educationalist provides supportive role in the curriculum development or delivery of the programme.

- *Minor/Little involvement* in which the educationalist does not involved with the curriculum development or delivery, but provides inputs or feedback to improve them.

(c) Level of Expertise

This is depicted through two aspects as awareness and proficiency, each with three levels of significance as:

- *Well informed* - up to date, extensive information on the subject is acquired/accessible.

- *Fairly informed* - general trends & basic information on the subject is acquired/accessible.

- *Vaguely informed* - related information is rarely pursued and limited acquisition.

- *Highly proficient* - well practiced, versatile knowledge; recognized as a sector expert.

- *Fairly proficient* – adequate knowledge, common engagement; recognized as a sector player.

- *Slightly proficient*– basic knowledge, development stage of skills, newcomer to the sector.

(C) Core Competencies for Implementation of Resource/Energy Efficiency Projects in the Transport Sector

Cognitive Competencies (Knowledge)
1. **Information competency**: The ability to access, acquire and process information on topics of resource or energy efficiency (EE) in transport sector (covering the three areas of system efficiency, trip efficiency and vehicle efficiency in line with the Avoid/Reduce-Shift-Improve concept).
2. **Systems thinking competency**: The abilities to recognize and understand EE relationships; to analyze EE in complex transport systems; to think of how systems are embedded within different domains and different scales, and to deal with uncertainty.
3. **Critical thinking competency**: The ability to question norms, practices and opinions in relation to transport sector efficiency; to reflect on self-values, perceptions and actions in EE interventions; and to take a position in the sustainability discourse.
Functional Competencies (Skills and know-how)
4. **Anticipatory competency**: The abilities to understand and evaluate multiple futures – possible, probable and desirable of the transport sector EE; to create one's own visions for the future; to apply the precautionary principle; to assess the consequences of actions, and to deal with risks and changes in the area of EE in the transport sector .
5. **Strategic competency**: The abilities to collectively develop and implement innovative actions for energy efficient transport systems that further sustainability at the local level and further afield.

6.	**Integrated problem-solving competency**: The overarching ability to apply different problem-solving frameworks to complex transport problems and develop viable, inclusive and equitable solution options that promote energy efficiency, integrating the above-mentioned competences.
Attitudinal Competencies (Behavioural and Values)	
7.	**Normative competency**: The abilities to understand and reflect on the norms, behaviours and values that underlie one's actions on EE in the transport sector; and to negotiate related sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions.
8.	**Collaboration competency**: The abilities to learn from others; to understand and respect the needs, perspectives and actions of others; to understand, relate to and be sensitive to others; to deal with conflicts in a group, and to facilitate collaborative and participatory problem-solving in transport sector EE challenges.
9.	**Self-awareness competency**: The ability to reflect on one's own role in the local community and (global) society; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires in relation to EE in transport.

B.5: ASSESSMENT OF SKILLS AND KNOWLEDGE GAP IN ENERGY EFFICIENCY WITHIN THE TRANSPORT SECTOR IN SRI LANKA

Interview Questions to Obtain Data on the Competency Levels

Stakeholder Category: Transport Sector Actors

1. **Basic Information for Relevancy**

- Mode of the Interview: Physical / Online / Both
- Affiliation (Institution; Division/Department): ....
- Relevancy and involvement in transport related activities (particularly urban):

  Interest: .Primary / Secondary / Minor / Low

  Influence: High / Moderate / Low / None.
- Awareness & competency on energy efficiency in transport sector (particularly urban):

  Awareness: Sound / Fair / Low / No

  Competency: High / Fair / Low / None.

2. **Detailed Information for Assessment**

- Academic & Professional Qualifications: ....
- Specific Trainings related to transport: ....
- Job title and years of experience: ....
- Management level: Strategic / Tactical / Operational
- Roles and responsibilities: Policy / Planning / Implementation / Operation
- Cognitive competency levels on main EE areas of urban transport sector:

Energy efficiency intervention areas of the urban transport systems		Knowledge level				
		None	Basic	Intermediate	Advanced	Expert
Reduce/avoid travel or the need to travel	Policy					
	Planning					
	Implementation					
	Operation					
Shift to more energy efficient modes	Policy					
	Planning					
	Implementation					
	Operation					
Vehicle technology & Operational characteristics	Policy					
	Planning					
	Implementation					
	Operation					

- Functional competency levels on main EE areas of urban transport sector:

Energy efficiency intervention areas of the urban transport systems		Skill level				
		None	Basic	Intermediate	Advanced	Expert
Reduce/avoid travel or the need to travel	Policy					
	Planning					
	Implementation					
	Operation					
Shift to more energy efficient modes	Policy					
	Planning					
	Implementation					
	Operation					
Vehicle technology & Operational characteristics	Policy					
	Planning					
	Implementation					
	Operation					

- Other Comments and Recommendations related to Implementation of Energy Efficiency (EE) Projects in the Transport Sector:

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B.6: ASSESSMENT OF SKILLS AND KNOWLEDGE GAP IN ENERGY EFFICIENCY WITHIN THE TRANSPORT SECTOR IN SRI LANKA

Interview Questions to Obtain Data on the Competency Levels

Stakeholder Category: Education Sector Actors

1. **Basic Information for Relevancy**

- Mode of the Interview: Physical / Online / Both
- Affiliation (Institution; Division/Department): ………………………………………………………………………………………………
- Main Subject Module (Transport/Energy Efficiency related) involved with:
- Type of Module:Core or Compulsory / Elective / Optional
- Involvement:Direct or Major / Some or Partial / Minor or Little.
- Awareness & Proficiency on Energy Efficiency in Transport Sector (particularly urban):

  Awareness: Well-informed / Fairly / Vaguely / Not aware

  Proficiency: High / Fair / Low or Slight / None.

2. **Detailed Information for Assessment**

- Academic Qualifications: ………
- Specific Trainings related to transport: …………………………………………………………………………………………………
- Job title and years of teaching experience: …………………………………………………………………………………………
- Transport related subjects offered: ……………………………………………………………………………………………………
- Roles and responsibilities: Curriculum development / Teaching / Research
- Details of the study programmes already offered (related to transport systems / EE):

Level of the Programme	Postgraduate		Undergraduate		Diploma	
Title of the course/programme						
Module title (transport/EE related)						
Number of credits / teaching hrs						
Topics on EE/Transport systems						
Related Learning Objectives (LOs)						
Related Programme Outcomes (POs)						
Targeted Competencies H – High, M – Medium, L – Low, N - None	Knowledge		Skills		Attitudes/Values	
EE Areas that could be included for improvement						
Potential method/s of introduction	Lecture		Lab. work		Project/Assignment	

- Details of the new study programme/s proposed (related to transport systems / EEr):

Level of the Programme	Postgraduate		Undergraduate		Diploma	
Title of the course/programme						
Module title (transport/EE related)						
Number of credits / teaching hrs						
Topics on EE/Transport systems						
Related Learning Objectives (LOs)						
Related Programme Outcomes (POs)						
Targeted Competencies H – High, M – Medium, L – Low, N - None	Knowledge		Skills		Attitudes/Values	
Potential method/s of introduction	New module in existing course			In a new course		

- Other Comments and Recommendations related to Implementation of Energy Efficiency (EE) Projects in the Transport Sector:

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Annex C: Activity Plan

Table C1: Time schedule of activities and sub-activities of the project (weekly)

Activity/Sub-activity	Feb.	March	April	May	June	July	August	September	October	Nov.
Activity 1										
Sub-activity 1.1	▓									
Sub-activity 1.2		▓								
Sub-activity 1.3	▓	▓								
Sub-activity 1.4		▓								
Sub-activity 1.5		▓								
Sub-activity 1.6		▓								
Sub-activity 1.7		▓								
Activity 2										
Sub-activity 2.1		▓								
Sub-activity 2.2			▓							
Sub-activity 2.3			▓							
Activity 3										
Sub-activity 3.1			▓							
Sub-activity 3.2				▓						
Sub-activity 3.3				▓						
Sub-activity 3.4				▓						
Sub-activity 3.5					▓	▓				
Sub-activity 3.6					▓	▓				
Sub-activity 3.7							▓			
Sub-activity 3.8							▓			
Activity 4										
Sub-activity 4.1						▓	▓			
Sub-activity 4.2						▓	▓			
Sub-activity 4.3							▓			
Activity 5										
Sub-activity 5.1			▓							
Sub-activity 5.2				▓						
Sub-activity 5.3					▓	▓	▓	▓		
Sub-activity 5.4					▓	▓	▓			
Sub-activity 5.5								▓		
Sub-activity 5.6								▓		
Sub-activity 5.7					▓	▓	▓			
Activity 6										
Sub-activity 6.1									▓	
Sub-activity 6.2									▓	
Sub-activity 6.3										▓
Deliverables		R1				PR		R2+3		R4

Note: R1 to R4 represent the deliverables 1 to 4. PR represents an intermediate progress report.

Annex D: SUTP Sourcebook for Policy-makers

The SUTP Sourcebook for Policy-makers: List of Modules

Institutional and policy orientation

1a. The Role of Transport in Urban Development Policy

1b. Urban Transport Institutions

1c. Private Sector Participation in Urban Transport Infrastructure Provision

1d. Economic Instruments

1e. Raising Public Awareness about Sustainable Urban Transport

1f. Financing Urban Transport

1g. Urban Freight in Developing Cities.

Land use planning and transport demand management

2a. Land Use Planning and Urban Transport

2b. Mobility Management

2c. Parking Management.

Transit, walking and cycling

3a. Mass Transit Options

3b. Bus Rapid Transit

3c. Bus Regulation and Planning

3d. Preserving and Expanding the Role of Non-motorized Transport

3e. Car-Free Development.

Vehicles and fuels

4a. Cleaner Fuels and Vehicle Technologies

4b. Inspection & Maintenance and Roadworthiness

4c. Two- and Three-Wheelers

4d. Natural Gas Vehicles

4e. Intelligent Transport Systems

4f. Eco Driving.

Environmental and health impacts

5a. Air Quality Management

5b. Urban Road Safety

5c. Noise and its Abatement

5d. The CDM in the Transport Sector

5e. Transport and Climate Change

5f. Adapting Urban Transport to Climate Change

5g. Urban Transport and Health

5h. Urban Transport and Energy Efficiency.

Resources

6. Resources for Policy-makers.

Social and cross-cutting issues on urban transport

7a. Gender and Urban Transport: Smart and Affordable.

Annex E: Functions and Duties of Stakeholder Institutions in the Transport Sector

Following table presents the functions and duties of the stakeholder institutions selected for the consultation and their EE area/s in the transport sector.

Table E.1: Stakeholder institutions selected form the transport sector

Stakeholder Institution		Functions in Transport	Main EE Area
Ministry of Transport		Sector policy, strategy, planning in transport	Travel efficiency
Department of Motor Traffic (DMT)		Regulatory, Vehicle registrations, Information,	Vehicle efficiency
SLVET Project Office		Management of SLVET	Vehicle efficiency
National Transport Commission (NTC)		Policy advisory and monitoring of bus passenger transport services	Travel efficiency
Sri Lanka Transport Board (SLTB)		Bus passenger transport services	Vehicle efficiency
Ministry of Power & Energy		Sector policy, Strategy, planning in transport energy	System efficiency
Sri Lanka Sustainable Energy Authority (SLSEA)		Regulatory aspects in transport energy management; Alternative energies/fuels; Data management	Vehicle efficiency
Ceylon Electricity Board (CEB)		Electric infrastructure development	Vehicle efficiency
Ceylon Petroleum Corporation (CPC)		Transport fuel management	Vehicle efficiency
Ministry of Environment		Sector policy, Strategy, planning in environment impacts of transport	System efficiency
Central Environmental Authority (CEA)		Regulatory aspects in environment impacts of transport	Vehicle efficiency
Sustainable Development Council (SDC)		Policies, strategies and mainstream SDGs in transport	System efficiency
National Planning Department (NPD)		Policies, planning, financial management	System efficiency
Road Development Authority (RDA)		Planning, design, development, implementation and operation of transport infrastructure	Travel efficiency
Urban Development Authority (UDA)		Planning, design, development, implementation and operation of transport infrastructure	System efficiency
Road Passenger Transport Authority (RPTA)	Western	Planning and providing infrastructure facilities for passenger transport services	Travel efficiency
	North Western		
	Sabaragamuwa		
	Uva		
	Southern		
CleanCo Lanka (Pvt) Ltd		Vehicle emission testing	Vehicle efficiency
Laugfs EcoSri Ltd		Vehicle emission testing	Vehicle efficiency
Toyota Lanka (Pvt) Ltd		Vehicle service and repair	Vehicle efficiency
Diesel & Motor Engineering PLC (DEMO)		Vehicle service and repair	Vehicle efficiency
David Pieris Motor Company (Pvt) Ltd (DPMC)		Vehicle service and repair	Vehicle efficiency
GoEV - JLanka Technologies (Pvt) Limited		Electric vehicles charging infrastructure	Vehicle efficiency

Stakeholder Institution	Functions in Transport	Main EE Area
I2C Pvt Ltd	ICT solutions for transport	Vehicle efficiency
Sri Lanka Society of Transport & Logistics (SLSTL)	Advisory, Facilitation	Travel efficiency
Sri Lanka Energy Managers Association (SLEMA)	Advisory, Facilitation	Travel efficiency
Institute of Automotive Engineers of Sri Lanka (IAESL)	Advisory, Facilitation	Vehicle efficiency
CleanAir SL	Advocacy, Awareness	Travel efficiency
Janathakshan GTE Ltd	Advocacy, Awareness	System efficiency
SLYCAN Trust	Advocacy, Awareness	System efficiency

Annex F: Details of the Transport Experts

The details of the transport experts contributed to the study are given in the following table:

Table F.1: The details for the transport experts

Name	Present Affiliation	Previous positions
Prof. Amal S. Kumarage	Head of the Department, Senior Professor, Department of Transport & Logistics, University of Moratuwa.	✓ Chairman, National Transport Commission; ✓ Chairman of the Chartered institute of Logistics & Transport Sri Lanka (CILTSL); ✓ Vice President of CILT International. ✓ Advisor to the Government of Sri Lanka.
Prof. Lalithasiri Gunaruwan	Professor, Department of Economics, University of Colombo	✓ Secretary, Ministry of Internal Transport; ✓ Secretary, Ministry of Transport; ✓ General Manager Railway, Sri Lanka Railways; ✓ Chairman, Millennium Challenge Corporation Compact (MCC) Review Committee.
Dr. Don S. Jayaweera	Co-secretary, Presidential Taskforce on Economic Revival and Poverty Eradication	✓ Chairman, National Transport Commission; ✓ Secretary, Ministry of Transport; ✓ Director General, Ministry of Finance and Planning; ✓ Director, National Council for. Economic Development.
Prof. Saman Bandara	Director, Center for Intelligent Transport Systems, Senior Professor, Transportation Engineering Division, Department Civil Engineering, University of Moratuwa	✓ Chairman, Road Development Authority; ✓ Chairman, Chartered Institute of Logistics & Transport, Sri Lanka ✓ Member, National Transport Commission; ✓ Vice President, Highway Engineering Society; ✓ Member, National Council for Road Safety ✓ Fellow, Chartered Institute of Logistics and Transport, Sri Lanka
Dr. B.M.S. Batagoda	Senior Consultant	✓ Secretary, Ministry of Power & Energy; ✓ Deputy Secretary to the Treasury, Ministry of Finance and Planning; ✓ Director General – Department of National Planning; ✓ Chief Executive Officer - Project Management Bureau; ✓ Director General - Operations and Review.
Dr. Jagath Munasinghe	Senior Lecturer, Department of Town & Country Planning, University of Moratuwa	✓ Director General, National Planning Department; ✓ Chairman, Urban Development Authority
Eng Ranjith Padmasiri	Senior Consultant	✓ Director General, Sri Lanka Sustainable Energy Authority (SLSEA);
Dr. Pasad Kulatunga	Member, Transport Expert Committee, SLSEA; Executive Director, RE2H2 Energy (Pvt) Ltd	✓ Group Chief Executive Officer, Fairway Holdings (Pvt.) Ltd ✓ Founder & Managing Director, Sustainable Alternative (Pvt) Ltd
Mr. Anura Vidanagamage	Managing Director, Industrial Solutions Lanka (Pvt) Ltd	✓ Director, Cleanco Lanka (Pvt) Ltd

Annex G: Details of the Transport Sector Staff

Following table presents the details of the staff contributed to the survey in the transport sector, including their staff category.

Key: Structured Questionnaire – SQ; Physical Workshop – PW; Physical Interview – PI; Online Interview – OI, Zoom meeting - ZM

Table G.1: The details for the respondents in the transport sector institutions

Stakeholder Institution	Name	Job title	Designated staff category	Mode/s of Consultation
CEA	Mr. K.H. MuthukudaArachchi	Deputy Director General, Environmental Pollution Control Division	Strategic	OI
	Mr. L.D. Jayasuriya	Assistant Director	Tactical	SQ; OI
	Ms. Hiranthi Janz	Deputy Director	Tactical	SQ; OI
	Mr. S.H.K. Sathischandra	Senior Environment Officer	Operational	SQ; OI
CEB	Mr. Ronald F. Comester	Deputy General Manager (R&D)	Strategic	SQ; OI
	Mr. W.H. Wickramarathne	Deputy General Manager (Assert Management-Hydro-Mechanical)	Strategic	OI
	Mr. Buddhika Samarasinghe	Chief Engineer	Tactical	SQ; OI
	Mr. A.J.Y.D. Manoj	Electrical Engineer	Operational	SQ
CleanAir SL	Mr. Ruwan Weerasuriya	General Secretary	Strategic	SQ; PI
	Mr. Sampath Ranasinghe	President	Strategic	SQ; PI
	Mr. Anura Jayatilake	Member and former President	Tactical	SQ; OI
	Mr. Nuvan Jayaratne	Member	Operational	SQ; OI
	Mr. Nanda Senaratne	Member	Operational	SQ; PI
CleanCo Lanka (Pvt) Ltd	Mr. Surendra Perera	Deputy General Manager - Operations	Strategic	SQ; PW
	Mr. Thushara Kumara	Manager - Operations/IT/Quality	Strategic	SQ; PW
	Mr Thilina Rathnayake	Software Engineer - IT	Tactical	SQ; PW
	Mr Janaka Nedurana	Assistant Manager - Training	Tactical	SQ; PW
	Mr. Mohamed Nafees	Senior Executive; Management	Tactical	SQ; PW
	Mr. Dilhan Epa	Manager - Technical	Tactical	SQ; PW
	Mr. Jude Fernando	Senior Executive (Operations)	Operational	SQ; PW
	Mr. Sandun Samoon	Maintenance-In-Charge (Civil)	Operational	SQ; PW
	Mr. Kasun	Executive (Operations)	Operational	SQ
	Mr. Sisira Mapa Abeykoon	Executive (Operations)	Operational	SQ
CPC	Mr. Sriyananda Edirisinghe	Refinery Manager	Strategic	OI
DIMO	Mr. Vimukthi Randeny	Principal, DIMO Training School	Strategic	OI

Stakeholder Institution	Name	Job title	Designated staff category	Mode/s of Consultation
DMT	Mr. J.A.S. Jayaweera	Assistant Commissioner (Technical)	Strategic	SQ; OI
	Mr. A.L.M. Faruk	Chief Examiner (Monaragala District)	Tactical	OI
	Mr. Janaka Alahapperuma	Chief Examiner (Nuwera Eliya District)	Tactical	OI
	Mr. T. Sivayogan	Chief Examiner (Batticaloa District)	Tactical	OI
	Mr. J.D.S.A. Sandaraj	Chief Examiner (Kandy District)	Tactical	PW; PI
	Mr. N.V.P. Thilina Karunasena	Examiner (Gampaha District)	Operational	SQ; OI
	Mr. Adikari	Examiner (Anuradhapura District)	Operational	SQ; OI
DPMC	Mr. Channa Ranawaka	Divisional Manager (Service)	Tactical	OI
I2C Pvt Ltd	Mr. Surath Pasindu Gajanayake	Chief Operating Officer	Strategic	SQ; OI
IAESL	Mr. Upul Perera	Acting President / Vice President	Strategic	SQ; OI
	Mr. Sujeewa Tennakoon	Council Member	Tactical	OI
Janathakshan GTE Ltd	Mr. Ranga Pallawala	Chief Executive Officer	Strategic	SQ; OI
	Mr. Damitha Samarakoon,	Former Deputy Director, Consultant	Tactical	SQ; OI
	Mr. Namiz Musafer	Director	Tactical	SQ; PW; PI
JLanka Techn. Pvt Ltd	Mr. Sujeeva Premaratne	Consultant	Tactical	SQ; PI
Laugfs EcoSri Ltd	Mr. U.P.S. Dissanayake	DGM (Operations)	Strategic	SQ; PW
	Mr. K.R.P. Perera	Manager (Technical)	Tactical	SQ; PW
	Mr. K.D.N.D. Fernando	Senior Manager (Logistics)	Tactical	SQ; PW
	Mr. W.O.V. De Silva	Manager (Marketing)	Tactical	SQ; PW
	Mr. P.D.I. Lakmal	Senior Executive (Technical)	Operational	SQ; PW
	Mr. M.E. Kandanage	Junior Executive (Technical)	Operational	SQ; PW
	Mr. J.K.N.U.B. Jayaneththi	Assistant Manager (Quality & Stand.)	Operational	SQ; PW
	Mr. R A P Madushanka	Assistant Manager (R&D)	Operational	SQ; PW
	Mr. W.N. Madushanke	Assistant Manager (Projects)	Operational	SQ; PW
	Mr. T.C.U. Mendis	Area Manager	Operational	SQ; PW
	Mr. W.V.H. Madhusanka	Area Manager	Operational	SQ; PW
	Mr. R.D.P.S. Perera	Assistant Area Manager	Operational	SQ; PW
LECO	Mr. S.D.C. Gunawardana	System Development Manager	Strategic	SQ
Ministry of Environment	Dr. R.D.S. Jayathunga	Director (CCS)	Strategic	SQ
	Mr. L.K.S.U. Dharmakeerthi	Director (ARM&NOU)	Strategic	SQ; PI
	Mr. Ruwan Weerasuriya	Assistant Director (CCS)	Tactical	SQ; PI
	Ms. Thiris Inoka	Assistant Director (ARM&NOU)	Tactical	SQ; PI
	Ms. Methmali Rajaguru	Development Officer (CCS)	Operational	SQ; PI
	Ms. Hasula Wickremasinghe	Programme Assistant (Environment)	Operational	SQ; PI
	Mr. Tharaka Salinda	Development Officer (PMU Project)	Operational	SQ; PI
	Ms. Kasuni Popagoda	Development Officer (ARM&NOU)	Operational	SQ; PI
	Mr. Nanda Lal Senarathne	Development Officer (ARM&NOU)	Operational	SQ; PI
	Mr. Manoj Prasanna	Programme Assistant (Environment)	Operational	SQ

Stakeholder Institution	Name	Job title	Designated staff category	Mode/s of Consultation
Ministry of Power & Energy	Mr. Merril Gunathilaka	Additional Secretary (Technical, Policy & Research)	Strategic	SQ; OI
	Mr. Sulakshana Jayawardena	Director (Development)	Tactical	SQ; OI
Ministry of Transport	Mr. S.S. Kularatne	Director (Planning)	Strategic	SQ; OI
NPD	Ms. Shiranthi Ratnayake	Additional Director General	Strategic	OI
	Mr. Dammika Premarathna	Director (Education, Higher Education, Skills Development, ICT, S&T)	Tactical	OI
	Mr. Udaya Mallawarachchi	Director (Roads, Ports, Aviation & Transport)	Tactical	OI
NTC	Ms. Sherine Athukorala	Director (Quality Assurance)	Strategic	SQ; OI
RDA	Ms. D. N. Siyambalapitiya	Director (Planning)	Strategic	SQ; OI
	Mr. C.G. Senarathna	Deputy Director (Environmental and Social Development)	Tactical	SQ
	Mr. U.T. Withana	Additional Director, Construction Division	Tactical	SQ; OI
	Mr. K.P. Kodituwakku	Project Director (PMU of LDPP)	Tactical	SQ; OI
	Mr. Chamath Nalaka Silva	Transport System Analyst (Planning)	Operational	SQ
	Mr. Anil Munasinghe	Project Engineer (PMU of LDPP)	Operational	SQ
RPTA (North Western)	Ms. C.P. Liyanage	Manager (Finance & Admin)	Tactical	OI
RPTA (Sabaragamuwa)	Mr. N.T.K. Jayasena	DGM (Rathnapura District)	Tactical	OI
RPTA (Southern)	Mr. B.M.A. Raja Kumara	Director General	Strategic	OI
RPTA (Uva)	Mr. K.S. Kumara	Chairman	Strategic	OI
	Mr. Ananda Karunanayake	Director General	Strategic	OI
RPTA (Western)	Mr. Jeevinda Keerthirathna	Assistant Manager (Operation)	Operational	OI
	Mr. I.S. Karunarathne	Assistant Manager (IT)	Operational	OI
SDC	Dr. M.M.S.S.B. Yalegama	Director General	Strategic	SQ; OI
	Ms. Samanthi Senanayake	Director (Development)	Strategic	OI
	Ms. Nadeeka Amarasinghe	Assistant Director	Tactical	SQ; OI
	Ms. Sheron Hewawaduge	Assistant Director	Tactical	SQ; OI
	Ms. Nipuni P. Senanayake	Sustainable Development Officer	Operational	OI
	Mr. Hasith Sandaruwan	Sustainable Development Officer	Operational	OI
	Mr. Isuru Gomus	Sustainable Development Officer	Operational	OI
	Ms. Chamoda Halambaarachchi	Sustainable Development Officer	Operational	OI
	Mr. Sajitha Perera	Sustainable Development Officer	Operational	OI
	Ms. Dilini Shashikala	Sustainable Development Officer	Operational	OI
SLEMA	Mr. R.F. Comester	President	Strategic	SQ; OI
	Mr. K.G.C. Jayasekera	Member	Tactical	SQ; OI
	Mr. N. Musafar	Member	Operational	SQ; OI

Stakeholder Institution	Name	Job title	Designated staff category	Mode/s of Consultation
SLSEA	Mr. Ranjith Sepala	Chairman	Strategic	SQ; PI
	Dr. Asanka S. Rodrigo	Director General	Strategic	SQ; PI
	Mr. Harsha Wickramasinghe	DDG (Strategy)	Strategic	SQ; PI
	Mr. H.A. Vimal Nadeera	DDG (Operations)	Strategic	SQ; PI
	Mr. Chamila Jayasekera	Director (Strategy)	Tactical	SQ; PI
	Mr. Anuruddha Kariyawasam	Senior Specialist (Energy Management)	Tactical	SQ; PI
	Mr. Prasanna Maldeniya	Engineer	Tactical	SQ; PI
	Ms. Ravini Karunarathne	Engineer	Operational	SQ; PI
	Mr. Saman J. Elvitigala	Senior Engineer	Operational	SQ; PI
	Ms. Gayathri Jayapala	Engineer	Operational	SQ; PI
	Ms. Irosha S. Kalugalage	Senior Professional (Engineering)	Operational	SQ; PI
	Ms. Apsara Katugaha	Engineer	Operational	SQ; PI
SLSTL	Dr. Tissa Liyanage	Executive Committee Member	Tactical	SQ; OI
	Mr. Janaka Weerawardana	Executive Committee Member	Tactical	SQ; OI
SLTB	Mr. G.K. Ariyarathna	Deputy General Manager (Technical)	Strategic	OI
	Mr. H.M.S. Herath	Area Engineer (Kurunegala & Puttalam)	Tactical	OI
	Mr. R.A.S. Rupashinghe	Area Engineer (Annuradapura & Polonnaruwa)	Tactical	OI
SLVET Office	Mr. Anura Dissanayake	Former Project Manager/AC (Technical)	Strategic	SQ; PI
	Ms. Asoka Samanmali	Project Assistant	Tactical	SQ; PI
	Ms. Tharanga Dulani	Project Assistant	Tactical	SQ; PI
	Mr. Ajitha Fernando	Technician	Operational	SQ; OI
	Mr. Asela Morawaka	Technician	Operational	SQ; OI
	Mr. Banuka Jayathunga	Technician	Operational	SQ; OI
	Mr. Buddhika Herath	Technician	Operational	SQ; OI
	Mr. Mohomad Marzook	Technician	Operational	SQ; OI
	Mr. B.W. Samantha	Technician	Operational	SQ; OI
	Mr. Sameera Amarasinghe	Technician	Operational	SQ; OI
SLYCAN Trust	Ms. Vositha Wijenayake	Executive Director	Strategic	SQ
	Mr. Dennis Mombauer	Director: Research & Education	Strategic	SQ
	Ms. Thadshajiny Kandasamy	Research and Programme Officer	Tactical	SQ
	Ms. Chalani Marasinghe	Research Assistant	Operational	SQ
	Ms. Maleesha Fernando	Intern	Operational	SQ
	Mr. Ashan Karunananda	Research Assistant	Operational	SQ
	Ms. Thimali Dharmakeerthi	Research Assistant	Operational	SQ
	Mr. Dinethra Rodrigo	Policy Analyst & Knowledge Content Developer	Operational	SQ
	Mr. Nipun Dias	Research Officer	Operational	SQ

Stakeholder Institution	Name	Job title	Designated staff category	Mode/s of Consultation
UDA	Ms. W.M.N.N. Wijesinghe	Town Planner (Matara District Office)	Strategic	SQ; OI
	Mr. Sukhitha Ranasinghe	Town Planner (R&D Division)	Strategic	SQ
	-	Town Planner (R&D Division)	Strategic	SQ
	Ms. Chulesha Geeganage	Town Planner	Tactical	SQ; OI
	Mr. Kasun Chathuranga	Town Planner	Tactical	SQ
	Mr. Vichithra Sampath	Town Planner	Tactical	SQ
	Mr. Lakshan Dissanayaka	Town Planner	Tactical	SQ
	Mr. M.M. Riswan	Town Planner	Tactical	SQ
	-	Enforcement Planner	Operational	SQ
	Ms. Sathya Jeewanthi	Town Planner	Operational	SQ
Transport Sector Experts	Prof. Amal S. Kumarage	Senior Professor, University of Moratuwa (UoM)	Strategic	SQ; OI
	Prof. T. Lalithasiri Gunaruwan	Senior Professor, University of Colombo	Strategic	SQ; OI
	Prof. J.M.S.J. Bandara	Senior Professor, UoM	Strategic	SQ: OI, ZM
	Dr. D.S. Jayaweera	Co-Secretary, Presidential Taskforce - ERPE	Strategic	SQ
	Dr. B.M.S. Batagoda	Former Secretary, MoP&E, Senior Consultant	Strategic	SQ; OI
	Dr. Jagath Munasinghe	Senior Lecturer -UoM; Former Chairman - UDA	Strategic	SQ; OI
	Eng. M.M.R. Padmasiri	Former DG – SLSEA, Senior Consultant	Strategic	SQ; OI
	Eng. Anura Vidanagamage	Managing Director, Industrial Solutions Lanka Pvt Ltd	Strategic	SQ
	Dr. Pasad Kulatunga	Member, Transport Expert Committee, SLSEA	Strategic	SQ; OI

Annex H: Feedbacks of the Transport Sector Actors – Stage 1

Table H.1: The Key to Abbreviations

Interest		Influence		Knowledge		Competency	
Primary	P	High	H	Sound	S	High	H
Secondary	S	Moderate	M	Fair	F	Fair	F
Minor	M	Low	L	Low	L	Low	L
Low	L	No	N	None	N	None	N
Staff Category		Strategic level	SL	Tactical level	TL	Operational level	OL

Table H.2: The feedback of the transport sector actors – Stage 1

#	Institute	Staff Category	Interest	Influence	Knowledge	Competency
1	CEA	SL	P	H	F	L
2	CEA	TL	P	H	S	F
3	CEA	TL	S	L	S	F
4	CEA	OL	S	L	L	L
5	CEB	SL	S	H	F	F
6	CEB	SL	S	H	S	F
7	CEB	TL	S	L	F	F
8	CEB	OL	S	L	F	L
9	CASL	SL	P	H	F	F
10	CleanAir SL	SL	P	M	S	F
11	CleanAir SL	TL	P	N	F	F
12	CleanAir SL	OL	S	M	F	F
13	CleanAir SL	OL	P	M	S	F
14	CleanCo	SL	P	H	S	H
15	CleanCo	SL	S	M	F	F
16	CleanCo	TL	P	H	S	H
17	CleanCo	TL	P	M	F	F
18	CleanCo	TL	P	M	S	H
19	CleanCo	TL	P	H	S	H
20	CleanCo	OL	S	M	F	F
21	CleanCo	OL	S	M	F	F
22	CleanCo	OL	S	M	S	H
23	CleanCo	OL	S	M	S	H
24	CPC	SL	P	H	S	F
25	DIMO	SL	S	H	S	F
26	DMT	SL	P	H	S	H
27	DMT	TL	P	M	F	F
28	DMT	TL	P	M	F	F

#	Institute	Staff Category	Interest	Influence	Knowledge	Competency
29	DMT	TL	P	M	F	F
30	DMT	TL	P	H	S	H
31	DMT	OL	P	L	S	H
32	DMT	OL	P	M	F	F
33	DPMC	TL	P	M	S	H
34	I2C	SL	P	M	F	F
35	IAESL	SL	P	H	S	H
36	IAESL	TL	P	H	F	F
37	JaTh	SL	S	L	F	F
38	JaTh	TL	S	L	S	F
39	JaTh	TL	S	L	S	F
40	JLan	TL	P	H	S	H
41	Laugfs	SL	P	H	S	H
42	Laugfs	TL	P	M	S	F
43	Laugfs	TL	P	M	S	F
44	Laugfs	TL	S	M	L	L
45	Laugfs	OL	S	L	F	F
46	Laugfs	OL	P	M	F	F
47	Laugfs	OL	P	M	F	H
48	Laugfs	OL	P	M	S	F
49	Laugfs	OL	S	M	F	F
50	Laugfs	OL	S	H	F	H
51	Laugfs	OL	S	M	F	F
52	Laugfs	OL	S	M	F	F
53	LECO	SL	S	L	F	F
54	MoE	SL	S	L	F	L
55	MoE	SL	S	M	F	L
56	MoE	TL	P	H	F	F
57	MoE	TL	S	M	F	F
58	MoE	OL	S	H	F	F
59	MoE	OL	S	L	F	L
60	MoE	OL	P	M	S	H
61	MoE	OL	P	M	S	F
62	MoE	OL	P	M	S	F
63	MoE	OL	S	M	F	F
64	MoP&E	SL	P	L	S	H
65	MoP&E	TL	P	M	F	F
66	MoT	SL	P	L	F	F
67	NPD	SL	P	H	S	H
68	NPD	TL	S	H	L	L
69	NPD	TL	P	H	S	F
70	NTC	SL	P	H	S	H

#	Institute	Staff Category	Interest	Influence	Knowledge	Competency
71	RDA	SL	P	H	S	H
72	RDA	TL	S	M	F	F
73	RDA	TL	P	M	S	F
74	RDA	TL	S	M	F	F
75	RDA	OL	P	H	F	L
76	RDA	OL	S	H	S	F
77	RPTA-NWP	TL	S	M	F	F
78	RPTA-SG	TL	S	M	F	F
79	RPTA-Southern	SL	P	H	S	H
80	RPTA-UVA	SL	P	H	F	F
81	RPTA-UVA	SL	P	H	F	F
82	RPTA-WP	OL	S	M	L	L
83	RPTA-WP	OL	S	M	L	L
84	SDC	SL	P	M	F	F
85	SDC	SL	P	M	F	F
86	SDC	TL	P	H	S	H
87	SDC	TL	P	M	S	F
88	SDC	OL	S	L	F	L
89	SDC	OL	S	L	F	F
90	SDC	OL	M	L	L	L
91	SDC	OL	S	M	F	F
92	SDC	OL	S	M	L	L
93	SDC	OL	S	L	L	L
94	SLEMA	SL	S	H	F	F
95	SLEMA	TL	S	L	L	L
96	SLEMA	OL	S	L	S	F
97	SLSEA	SL	S	H	F	F
98	SLSEA	SL	P	M	F	F
99	SLSEA	SL	S	M	F	F
100	SLSEA	SL	P	H	F	F
101	SLSEA	TL	S	L	L	L
102	SLSEA	TL	P	M	S	F
103	SLSEA	TL	P	M	F	F
104	SLSEA	OL	S	M	L	L
105	SLSEA	OL	S	M	F	F
106	SLSEA	OL	M	L	F	L
107	SLSEA	OL	M	L	F	L
108	SLSEA	OL	S	L	F	L
109	SLSTL	TL	P	H	S	H
110	SLSTL	TL	P	M	F	F
111	SLTB	SL	P	H	S	H

#	Institute	Staff Category	Interest	Influence	Knowledge	Competency
112	SLTB	TL	P	H	S	H
113	SLTB	TL	P	H	S	H
114	SLVET	SL	P	H	S	H
115	SLVET	TL	P	M	S	F
116	SLVET	TL	P	M	S	F
117	SLVET	OL	P	L	F	F
118	SLVET	OL	P	N	S	H
119	SLVET	OL	P	L	S	H
120	SLVET	OL	P	L	S	H
121	SLVET	OL	P	L	S	F
122	SLVET	OL	S	L	F	F
123	SLVET	OL	S	N	F	F
124	SLVET	OL	P	L	F	F
125	SLYCAN T	SL	S	M	F	L
126	SLYCAN T	SL	S	M	F	L
127	SLYCAN T	TL	S	L	L	L
128	SLYCAN T	OL	S	L	F	L
129	SLYCAN T	OL	M	N	L	N
130	SLYCAN T	OL	S	L	F	F
131	SLYCAN T	OL	M	N	L	L
132	SLYCAN T	OL	M	L	L	N
133	SLYCAN T	OL	S	L	F	F
134	TOYOTA	SL	P	M	S	H
135	UDA	SL	P	H	S	H
136	UDA	SL	P	H	F	F
137	UDA	SL	P	M	F	F
138	UDA	TL	P	H	F	F
139	UDA	TL	S	M	F	F
140	UDA	TL	P	H	S	L
141	UDA	TL	P	H	F	F
142	UDA	TL	P	H	F	F
143	UDA	OL	S	L	L	L
144	UDA	OL	S	L	L	L
145	Transport Expt.	SL	P	H	S	H
146	Transport Expt.	SL	P	L	S	H
147	Transport Expt.	SL	P	H	S	H
148	Transport Expt.	SL	P	H	S	H
149	Transport Expt.	SL	P	H	S	H
150	Transport Expt.	SL	P	M	S	F
151	Transport Expt.	SL	P	M	S	F
152	Transport Expt.	SL	P	M	F	F
153	Transport Expt.	SL	S	H	S	F

Annex I: Feedbacks of the Transport Sector Actors – Stage 2, Part 1 Educational Background and Roles and Responsibilities in the Employment/ Profession

Table I.1: The Key to Abbreviations

Highest Academic Qualification (AQ)		Professional Qualifications (PQ)		Specific Education related to Transport		Roles & Responsibilities	
Postgraduate	P	Yes	Y	Yes	Y	Yes	Y
Undergraduate	U	No/No response	N	No/No response	N	No/No response	N
Diploma	D	Staff Categories					
Other/No response	O	Strategic level	SL	Tactical level	TL	Operational level	OL

Table I.2: The feedback of the transport sector actors – Stage 2 - Educational Background

#	Institute	Staff Category	Highest AQ	PQ	Modes of Awareness and Education related to Transport								
					School	Technical	Occupational	UG	PG	Research	Seminar/ Workshop	Specific trainings	Non-formal (media)
1	CEA	SL	P	N	N	N	N	N	Y	Y	Y	N	N
2	CEA	TL	U	N	N	N	N	N	N	N	Y	Y	N
3	CEA	TL	P	Y	N	N	N	N	N	N	Y	N	N
4	CEA	OL	P	N	N	N	Y	N	N	N	Y	Y	Y
5	CEB	SL	P	Y	N	N	Y	N	Y	Y	Y	Y	N
6	CEB	SL	P	Y	N	N	N	N	Y	N	Y	N	N
7	CEB	TL	P	Y	N	N	N	N	N	N	Y	N	Y
8	CEB	OL	P	Y	N	N	Y	N	N	N	Y	N	N
9	CleanAir SL	SL	P	N	N	N	Y	N	Y	Y	Y	Y	Y
10	CleanAir SL	SL	P	Y	N	Y	Y	N	N	Y	Y	Y	Y
11	CleanAir SL	TL	P	Y	Y	N	N	Y	Y	N	Y	N	Y
12	CleanAir SL	OL	P	N	N	N	Y	N	N	N	Y	N	Y
13	CleanAir SL	OL	U	N	N	N	Y	N	N	N	Y	N	Y
14	CleanCo	SL	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
15	CleanCo	SL	P	N	N	Y	Y	N	N	N	Y	Y	N
16	CleanCo	TL	P	Y	Y	Y	N	Y	N	N	Y	Y	N
17	CleanCo	TL	P	Y	N	N	N	N	N	N	Y	N	N
18	CleanCo	TL	U	N	N	N	Y	N	N	N	Y	N	Y
19	CleanCo	TL	D	N	Y	Y	N	N	N	N	Y	Y	N
20	CleanCo	OL	D	N	Y	Y	N	N	N	N	Y	N	N
21	CleanCo	OL	U	N	Y	N	N	Y	N	N	Y	Y	N
22	CleanCo	OL	P	N	Y	Y	N	Y	N	N	Y	Y	N
23	CleanCo	OL	D	N	Y	Y	N	N	N	N	Y	N	N

#	Institute	Staff Category	Highest AQ	PQ	Modes of Awareness and Education related to Transport								
					School	Technical	Occupational	UG	PG	Research	Seminar/ Workshop	Specific trainings	Non-formal (media)
24	CPC	SL	U	N	N	N	Y	N	N	N	Y	N	N
25	DIMO	SL	U	N	N	N	Y	N	N	N	Y	N	N
26	DMT	SL	P	Y	N	Y	Y	N	Y	Y	N	Y	Y
27	DMT	TL	D	N	N	Y	Y	N	N	N	Y	Y	N
28	DMT	TL	D	N	N	Y	Y	N	N	N	Y	Y	N
29	DMT	TL	U	N	N	Y	Y	N	N	N	Y	Y	N
30	DMT	TL	D	N	N	Y	Y	N	N	N	Y	Y	N
31	DMT	OL	P	N	N	Y	Y	N	N	N	Y	Y	N
32	DMT	OL	D	N	N	Y	Y	N	N	N	Y	Y	N
33	DPMC	TL	P	N	N	N	Y	N	N	N	Y	Y	N
34	I2C	SL	U	Y	N	N	N	N	Y	Y	N	N	N
35	IAESL	SL	P	Y	N	Y	Y	N	Y	N	Y	Y	N
36	IAESL	TL	P	Y	N	Y	Y	Y	N	N	Y	Y	N
37	JaTh	SL	P	N	N	N	N	N	Y	Y	Y	Y	Y
38	JaTh	TL	U	Y	N	N	N	N	N	N	Y	Y	N
39	JaTh	TL	P	Y	N	N	N	N	Y	N	Y	Y	Y
40	JLan	TL	D	Y	N	Y	Y	N	N	N	Y	Y	Y
41	Laugfs	SL	P	N	N	N	Y	N	N	N	Y	Y	N
42	Laugfs	TL	U	N	N	N	N	N	N	N	Y	N	Y
43	Laugfs	TL	U	Y	N	N	N	N	N	N	Y	N	Y
44	Laugfs	TL	P	Y	Y	N	N	N	N	N	N	N	Y
45	Laugfs	OL	D	N	N	Y	Y	N	N	N	N	N	N
46	Laugfs	OL	D	N	Y	Y	Y	N	N	N	N	N	N
47	Laugfs	OL	U	N	N	N	N	N	N	N	Y	N	Y
48	Laugfs	OL	D	N	N	N	N	N	N	N	Y	N	Y
49	Laugfs	OL	D	N	N	N	N	N	N	N	Y	N	Y
50	Laugfs	OL	N	N	N	N	N	N	N	N	N	N	N
51	Laugfs	OL	N	N	N	N	N	N	N	N	N	N	N
52	Laugfs	OL	D	N	N	Y	Y	N	N	N	Y	N	N
53	LECO	SL	U	Y	N	N	N	N	N	N	Y	N	Y
54	MoE	SL	P	N	N	N	N	N	N	N	Y	N	N
55	MoE	SL	P	N	N	N	N	N	N	N	Y	N	Y
56	MoE	TL	P	N	N	N	Y	N	Y	Y	Y	Y	Y
57	MoE	TL	P	N	N	N	Y	Y	Y	N	Y	N	Y
58	MoE	OL	P	N	N	N	N	N	N	N	Y	N	Y
59	MoE	OL	P	N	N	N	Y	N	N	N	Y	N	Y
60	MoE	OL	U	N	N	N	N	Y	N	N	N	Y	N
61	MoE	OL	U	N	N	N	Y	N	N	N	Y	N	Y
62	MoE	OL	U	N	N	N	Y	N	N	N	Y	N	Y

#	Institute	Staff Category	Highest AQ	PQ	School	Technical	Occupational	UG	PG	Research	Seminar/ Workshop	Specific trainings	Non-formal (media)
							Modes of Awareness and Education related to Transport						
63	MoE	OL	P	Y	N	N	N	N	N	N	N	N	Y
64	MoP&E	SL	P	Y	N	N	N	N	N	N	N	N	Y
65	MoP&E	TL	P	Y	N	N	N	N	N	N	Y	N	Y
66	MoT	SL	P	N	N	N	N	N	N	Y	Y	N	N
67	NPD	SL	P	N	N	N	N	N	N	N	Y	N	N
68	NPD	TL	P	N	N	N	N	N	N	N	Y	N	N
69	NPD	TL	P	N	N	N	N	N	N	N	Y	Y	N
70	NTC	SL	P	Y	N	N	Y	N	Y	N	N	N	N
71	RDA	SL	U	Y	N	N	Y	N	N	Y	Y	Y	Y
72	RDA	TL	P	Y	N	N	N	Y	Y	N	N	N	N
73	RDA	TL	P	Y	N	N	N	Y	Y	N	Y	N	N
74	RDA	TL	P	Y	N	N	Y	Y	Y	N	Y	N	N
75	RDA	OL	U	N	N	N	Y	Y	N	Y	Y	Y	N
76	RDA	OL	P	Y	N	N	N	N	Y	N	N	N	N
77	RPTA-NWP	TL	U	N	N	N	N	N	N	N	Y	N	Y
78	RPTA-SG	TL	P	N	N	N	N	N	N	N	Y	N	Y
79	RPTA-Sout.	SL	U	N	N	N	N	N	N	N	Y	N	Y
80	RPTA-UVA	SL	N	N	N	N	N	N	N	N	N	N	Y
81	RPTA-UVA	SL	U	N	N	N	N	N	N	N	Y	N	N
82	RPTA-WP	OL	U	N	N	N	N	N	N	N	Y	N	N
83	RPTA-WP	OL	U	N	N	N	N	N	N	N	Y	N	N
84	SDC	SL	P	N	N	N	N	N	N	N	Y	N	N
85	SDC	SL	P	N	N	N	N	N	N	N	Y	N	N
86	SDC	TL	P	Y	N	N	Y	Y	Y	N	Y	N	Y
87	SDC	TL	P	N	N	N	Y	Y	N	N	N	N	Y
88	SDC	OL	U	N	N	N	N	N	N	N	Y	N	N
89	SDC	OL	P	N	N	N	N	N	N	N	Y	N	N
90	SDC	OL	U	N	N	N	N	N	N	N	N	N	Y
91	SDC	OL	U	N	N	N	N	N	N	N	Y	N	N
92	SDC	OL	U	N	N	N	N	N	N	N	Y	N	N
93	SDC	OL	U	N	N	N	N	N	N	N	N	N	N
94	SLEMA	SL	P	Y	N	N	Y	N	Y	Y	Y	Y	N
95	SLEMA	TL	P	Y	N	N	N	N	N	N	Y	N	N
96	SLEMA	OL	P	Y	N	N	N	N	Y	N	Y	Y	Y
97	SLSEA	SL	P	Y	N	Y	N	N	N	Y	Y	N	N
98	SLSEA	SL	P	Y	N	N	N	Y	N	N	Y	N	N
99	SLSEA	SL	P	Y	N	N	N	N	N	N	Y	N	N
100	SLSEA	SL	P	N	N	N	N	N	N	N	Y	N	N
101	SLSEA	TL	P	Y	N	N	N	N	N	N	Y	N	N

#	Institute	Staff Category	Highest AQ	PQ	Modes of Awareness and Education related to Transport								
					School	Technical	Occupational	UG	PG	Research	Seminar/ Workshop	Specific trainings	Non-formal (media)
102	SLSEA	TL	P	Y	N	N	Y	N	N	N	Y	N	N
103	SLSEA	TL	P	Y	N	N	Y	N	N	N	Y	N	Y
104	SLSEA	OL	P	Y	N	N	N	N	N	N	Y	N	N
105	SLSEA	OL	U	Y	Y	N	N	N	N	N	Y	N	Y
106	SLSEA	OL	P	Y	N	N	N	N	N	N	Y	N	N
107	SLSEA	OL	P	Y	N	N	N	N	N	N	Y	N	N
108	SLSEA	OL	P	N	Y	N	N	Y	N	N	Y	Y	Y
109	SLSTL	TL	P	Y	N	N	N	N	Y	Y	Y	Y	Y
110	SLSTL	TL	P	Y	N	N	Y	Y	Y	Y	Y	Y	N
111	SLTB	SL	U	N	N	N	Y	N	N	N	Y	Y	N
112	SLTB	TL	D	N	N	Y	Y	N	N	Y	Y	Y	Y
113	SLTB	TL	D	N	N	Y	Y	N	N	Y	Y	Y	Y
114	SLVET	SL	D	N	N	Y	Y	N	N	N	Y	Y	Y
115	SLVET	TL	U	N	N	N	N	Y	N	Y	Y	Y	N
116	SLVET	TL	D	N	N	N	Y	N	N	Y	Y	Y	N
117	SLVET	OL	D	N	N	Y	Y	N	N	N	Y	N	N
118	SLVET	OL	D	N	N	Y	Y	N	N	N	Y	Y	Y
119	SLVET	OL	D	N	N	Y	Y	N	N	N	N	Y	N
120	SLVET	OL	D	N	N	Y	Y	N	N	N	Y	Y	Y
121	SLVET	OL	D	N	N	Y	Y	N	N	N	Y	Y	N
122	SLVET	OL	D	N	N	Y	Y	N	N	N	N	Y	N
123	SLVET	OL	D	N	N	Y	Y	N	N	N	Y	Y	N
124	SLVET	OL	D	N	N	Y	Y	N	N	N	Y	Y	Y
125	SLYCAN T	SL	P	Y	N	N	N	N	N	Y	Y	N	N
126	SLYCAN T	SL	P	N	N	N	N	N	N	Y	N	N	Y
127	SLYCAN T	TL	U	Y	Y	N	N	Y	N	Y	N	Y	N
128	SLYCAN T	OL	P	N	N	N	N	Y	N	N	Y	N	N
129	SLYCAN T	OL	U	N	N	N	N	N	N	N	N	N	N
130	SLYCAN T	OL	P	N	N	N	N	N	N	N	N	N	Y
131	SLYCAN T	OL	P	Y	Y	N	N	N	N	N	N	N	N
132	SLYCAN T	OL	U	N	N	N	N	N	N	N	N	N	Y
133	SLYCAN T	OL	U	N	N	N	N	Y	N	N	N	N	N
134	TOYOTA	SL	N	N	N	N	N	N	N	N	N	N	N
135	UDA	SL	P	Y	N	N	Y	Y	Y	Y	Y	N	Y
136	UDA	SL	U	Y	N	N	N	Y	N	N	Y	N	N
137	UDA	SL	P	Y	N	N	N	N	N	N	N	N	Y
138	UDA	TL	U	Y	N	N	N	Y	N	N	Y	N	N
139	UDA	TL	P	Y	N	N	N	Y	Y	Y	Y	N	N
140	UDA	TL	U	N	N	N	Y	Y	N	N	N	N	N

#	Institute	Staff Category	Highest AQ	PQ	Modes of Awareness and Education related to Transport								
					School	Technical	Occupational	UG	PG	Research	Seminar/Workshop	Specific trainings	Non-formal (media)
141	UDA	TL	P	Y	N	N	N	Y	N	N	Y	N	N
142	UDA	TL	U	Y	N	N	N	Y	N	N	Y	N	N
143	UDA	OL	U	Y	N	N	N	N	N	N	N	N	N
144	UDA	OL	P	Y	N	N	Y	Y	N	N	N	N	N
145	Trans. Expt.	SL	P	Y	N	N	N	Y	Y	Y	Y	Y	Y
146	Trans. Expt.	SL	P	Y	N	N	N	N	N	Y	Y	N	N
147	Trans. Expt.	SL	P	Y	N	N	N	Y	Y	Y	Y	Y	Y
148	Trans. Expt.	SL	P	Y	N	N	Y	N	Y	Y	Y	Y	N
149	Trans. Expt.	SL	P	Y	N	N	N	N	N	Y	Y	N	N
150	Trans. Expt.	SL	P	Y	N	N	N	N	Y	Y	Y	N	Y
151	Trans. Expt.	SL	P	Y	N	N	N	N	N	N	Y	Y	Y
152	Trans. Expt.	SL	U	Y	N	N	N	N	N	N	Y	N	Y
153	Trans. Expt.	SL	P	Y	N	N	Y	N	N	Y	Y	N	N

Table I.3: The feedback of the transport sector actors – Stage 2 - Roles and responsibilities in the employment / profession

#	Institute	Staff Category	Roles and responsibilities								
			Policy/Strategy	Planning	Admin.	Design/Develop.	Coordination	Implemen.	Supervision	Operation	Reporting
1	CEA	SL	Y	Y	N	N	N	N	N	N	N
2	CEA	TL	Y	N	Y	N	Y	Y	Y	Y	Y
3	CEA	TL	N	N	Y	N	N	Y	N	N	Y
4	CEA	OL	N	N	N	N	N	Y	Y	Y	Y
5	CEB	SL	Y	Y	N	Y	N	Y	N	N	N
6	CEB	SL	Y	Y	N	N	N	Y	N	N	N
7	CEB	TL	Y	Y	N	Y	Y	N	N	N	N
8	CEB	OL	N	Y	N	Y	Y	Y	Y	Y	N
9	CleanAir SL	SL	N	Y	N	N	Y	N	N	N	N
10	CleanAir SL	SL	N	N	N	Y	Y	Y	Y	Y	Y
11	CleanAir SL	TL	Y	Y	Y	Y	Y	Y	Y	Y	Y
12	CleanAir SL	OL	N	Y	N	Y	Y	N	Y	Y	Y
13	CleanAir SL	OL	Y	Y	N	N	Y	N	N	N	Y
14	CleanCo	SL	Y	Y	Y	Y	Y	Y	N	Y	Y
15	CleanCo	SL	N	Y	Y	Y	Y	Y	Y	Y	Y
16	CleanCo	TL	Y	Y	N	Y	Y	Y	Y	Y	Y
17	CleanCo	TL	Y	Y	N	N	N	N	N	N	N
18	CleanCo	TL	N	N	N	N	Y	N	N	Y	Y
19	CleanCo	TL	Y	Y	N	Y	Y	Y	Y	Y	Y
20	CleanCo	OL	N	N	N	Y	Y	Y	Y	Y	Y
21	CleanCo	OL	N	N	N	N	Y	Y	Y	Y	Y

#	Institute	Staff Category	Policy/ Strategy	Planning	Admin.	Design/ Develop.	Coordination	Implemen.	Supervision	Operation	Reporting
22	CleanCo	OL	N	N	N	N	Y	Y	Y	Y	Y
23	CleanCo	OL	N	N	N	Y	Y	Y	Y	Y	Y
24	CPC	SL	Y	Y	Y	Y	N	Y	N	N	N
25	DIMO	SL	N	Y	Y	N	N	Y	Y	Y	N
26	DMT	SL	Y	Y	Y	Y	Y	Y	Y	N	Y
27	DMT	TL	N	Y	N	N	Y	Y	Y	Y	N
28	DMT	TL	N	Y	N	N	Y	Y	Y	Y	N
29	DMT	TL	N	Y	Y	N	N	Y	Y	Y	N
30	DMT	TL	N	Y	Y	N	Y	Y	Y	Y	Y
31	DMT	OL	N	N	N	N	Y	Y	Y	Y	Y
32	DMT	OL	N	N	N	N	Y	Y	Y	Y	Y
33	DPMC	TL	N	Y	Y	N	Y	Y	Y	N	N
34	I2C	SL	Y	Y	Y	N	N	Y	N	Y	N
35	IAESL	SL	Y	Y	Y	Y	Y	N	N	N	N
36	IAESL	TL	N	Y	Y	Y	Y	Y	Y	Y	N
37	JaTh	SL	Y	Y	Y	N	N	N	N	N	N
38	JaTh	TL	N	Y	N	Y	Y	N	Y	N	Y
39	JaTh	TL	Y	Y	Y	Y	Y	Y	Y	Y	Y
40	JLan	TL	Y	Y	Y	Y	Y	Y	Y	Y	Y
41	Laugfs	SL	Y	Y	Y	Y	N	N	N	N	N
42	Laugfs	TL	N	Y	Y	N	Y	Y	N	N	N
43	Laugfs	TL	N	Y	Y	N	Y	Y	Y	Y	Y
44	Laugfs	TL	N	Y	Y	Y	Y	Y	Y	Y	Y
45	Laugfs	OL	N	N	N	N	N	N	N	Y	N
46	Laugfs	OL	N	Y	N	Y	Y	N	N	N	Y
47	Laugfs	OL	N	Y	N	N	N	N	N	Y	Y
48	Laugfs	OL	N	Y	Y	N	N	Y	Y	N	Y
49	Laugfs	OL	N	Y	Y	N	Y	Y	Y	N	Y
50	Laugfs	OL	N	N	N	N	N	N	N	N	N
51	Laugfs	OL	N	N	N	N	N	N	N	N	N
52	Laugfs	OL	N	N	N	N	Y	Y	Y	N	Y
53	LECO	SL	N	Y	Y	Y	N	Y	Y	Y	N
54	MoE	SL	Y	Y	N	N	N	N	N	N	N
55	MoE	SL	Y	Y	Y	N	Y	N	N	N	N
56	MoE	TL	Y	Y	Y	N	Y	N	Y	N	Y
57	MoE	TL	Y	Y	N	Y	Y	Y	N	N	Y
58	MoE	OL	N	N	N	Y	Y	N	N	Y	Y
59	MoE	OL	N	N	N	N	Y	N	N	N	Y
60	MoE	OL	N	N	N	Y	N	Y	N	Y	N
61	MoE	OL	N	Y	N	N	Y	N	N	N	Y

#	Institute	Staff Category	Policy/ Strategy	Planning	Admin.	Design/ Develop.	Coordination	Implemen.	Supervision	Operation	Reporting
62	MoE	OL	N	Y	N	N	Y	N	N	N	Y
63	MoE	OL	N	N	N	N	Y	N	N	N	N
64	MoP&E	SL	Y	Y	Y	N	Y	N	N	N	Y
65	MoP&E	TL	Y	N	Y	Y	Y	N	Y	N	N
66	MoT	SL	Y	Y	Y	N	N	N	N	N	N
67	NPD	SL	Y	Y	N	N	N	N	N	N	N
68	NPD	TL	N	Y	N	N	N	N	N	N	N
69	NPD	TL	Y	Y	N	N	N	N	N	N	N
70	NTC	SL	Y	N	N	N	N	N	N	N	N
71	RDA	SL	Y	Y	Y	Y	Y	N	N	N	N
72	RDA	TL	N	N	Y	Y	Y	Y	Y	Y	N
73	RDA	TL	N	N	N	N	Y	Y	N	N	N
74	RDA	TL	N	N	Y	Y	Y	Y	N	N	N
75	RDA	OL	N	Y	Y	N	Y	Y	Y	N	Y
76	RDA	OL	N	N	N	N	N	Y	N	N	N
77	RPTA-NWP	TL	N	Y	Y	N	N	Y	N	N	N
78	RPTA-SG	TL	N	Y	Y	N	N	Y	N	N	N
79	RPTA-Southern	SL	Y	Y	Y	N	N	Y	N	N	N
80	RPTA-UVA	SL	Y	Y	Y	N	N	Y	N	N	N
81	RPTA-UVA	SL	Y	Y	Y	Y	N	Y	N	N	N
82	RPTA-WP	OL	N	N	N	N	Y	Y	N	Y	Y
83	RPTA-WP	OL	N	N	N	N	N	Y	N	Y	Y
84	SDC	SL	Y	Y	Y	Y	Y	Y	Y	Y	Y
85	SDC	SL	Y	Y	Y	Y	Y	N	Y	N	N
86	SDC	TL	N	Y	Y	Y	Y	Y	N	N	N
87	SDC	TL	N	Y	Y	Y	Y	Y	Y	Y	Y
88	SDC	OL	N	Y	N	N	Y	Y	N	Y	Y
89	SDC	OL	N	Y	N	N	Y	Y	N	Y	Y
90	SDC	OL	N	Y	N	N	Y	Y	N	Y	Y
91	SDC	OL	N	Y	N	N	Y	Y	N	Y	Y
92	SDC	OL	N	Y	N	N	Y	Y	N	Y	Y
93	SDC	OL	N	Y	N	N	Y	Y	N	Y	Y
94	SLEMA	SL	Y	Y	N	Y	N	Y	N	N	N
95	SLEMA	TL	Y	Y	N	Y	N	N	Y	N	N
96	SLEMA	OL	N	N	Y	N	Y	Y	Y	Y	Y
97	SLSEA	SL	Y	Y	Y	Y	Y	N	Y	N	N
98	SLSEA	SL	Y	Y	Y	N	Y	Y	Y	N	Y
99	SLSEA	SL	Y	Y	Y	Y	Y	N	Y	N	N
100	SLSEA	SL	Y	Y	Y	N	Y	N	Y	N	N

#	Institute	Staff Category	Policy/ Strategy	Planning	Admin.	Design/ Develop.	Coordination	Implemen.	Supervision	Operation	Reporting
101	SLSEA	TL	Y	Y	N	Y	N	N	Y	N	N
102	SLSEA	TL	N	Y	N	Y	Y	N	N	N	Y
103	SLSEA	TL	N	Y	N	Y	Y	N	Y	N	Y
104	SLSEA	OL	N	N	N	N	Y	Y	N	N	Y
105	SLSEA	OL	N	N	Y	Y	N	Y	Y	N	Y
106	SLSEA	OL	Y	Y	N	Y	Y	Y	Y	N	Y
107	SLSEA	OL	Y	Y	N	Y	Y	Y	Y	Y	Y
108	SLSEA	OL	N	Y	Y	Y	N	N	N	Y	Y
109	SLSTL	TL	Y	Y	N	Y	N	Y	Y	N	Y
110	SLSTL	TL	Y	Y	N	Y	N	N	N	N	N
111	SLTB	SL	Y	Y	Y	Y	Y	Y	N	N	N
112	SLTB	TL	Y	Y	Y	Y	Y	Y	Y	Y	Y
113	SLTB	TL	Y	Y	Y	Y	Y	Y	Y	Y	Y
114	SLVET	SL	Y	Y	Y	Y	Y	Y	Y	Y	Y
115	SLVET	TL	N	N	N	N	Y	Y	N	Y	Y
116	SLVET	TL	N	N	Y	N	Y	Y	N	Y	Y
117	SLVET	OL	N	N	N	N	N	N	N	Y	Y
118	SLVET	OL	N	N	N	N	N	Y	N	Y	Y
119	SLVET	OL	N	N	N	N	N	Y	Y	Y	Y
120	SLVET	OL	N	N	N	N	Y	Y	Y	Y	Y
121	SLVET	OL	N	N	N	N	N	Y	N	Y	Y
122	SLVET	OL	N	N	N	N	N	N	Y	Y	Y
123	SLVET	OL	N	N	N	N	N	N	N	Y	Y
124	SLVET	OL	N	N	N	N	N	N	N	Y	Y
125	SLYCAN T	SL	Y	Y	Y	Y	Y	Y	Y	Y	Y
126	SLYCAN T	SL	Y	Y	Y	Y	Y	N	N	N	N
127	SLYCAN T	TL	Y	Y	Y	N	Y	N	N	N	Y
128	SLYCAN T	OL	Y	N	N	N	N	N	N	N	Y
129	SLYCAN T	OL	N	N	N	N	Y	N	N	N	Y
130	SLYCAN T	OL	N	Y	N	Y	Y	N	N	Y	Y
131	SLYCAN T	OL	N	N	N	N	Y	N	N	N	Y
132	SLYCAN T	OL	Y	Y	Y	Y	Y	N	N	N	Y
133	SLYCAN T	OL	N	N	N	N	Y	N	N	N	Y
134	Toyota	SL	N	N	N	N	N	N	N	N	N
135	UDA	SL	Y	Y	N	Y	Y	N	N	N	N
136	UDA	SL	Y	Y	N	Y	Y	Y	N	N	Y
137	UDA	SL	Y	Y	N	N	Y	N	N	N	Y
138	UDA	TL	Y	Y	N	Y	Y	Y	N	N	Y
139	UDA	TL	N	Y	N	Y	N	N	N	N	N
140	UDA	TL	Y	Y	N	Y	Y	Y	N	N	N

#	Institute	Staff Category	Policy/ Strategy	Planning	Admin.	Design/ Develop.	Coordination	Implemen.	Supervision	Operation	Reporting
							Roles and responsibilities				
141	UDA	TL	Y	Y	N	Y	Y	Y	N	N	Y
142	UDA	TL	Y	Y	N	Y	Y	Y	N	N	Y
143	UDA	OL	N	Y	N	N	N	Y	N	N	Y
144	UDA	OL	N	Y	N	N	N	N	N	N	N
145	Transport Expt.	SL	Y	Y	Y	Y	Y	Y	N	N	Y
146	Transport Expt.	SL	Y	Y	Y	Y	Y	Y	Y	Y	Y
147	Transport Expt.	SL	Y	Y	Y	Y	Y	Y	N	N	N
148	Transport Expt.	SL	Y	Y	Y	Y	Y	Y	Y	Y	Y
149	Transport Expt.	SL	Y	Y	N	N	Y	N	N	N	N
150	Transport Expt.	SL	Y	N	N	N	Y	N	N	N	N
151	Transport Expt.	SL	Y	N	N	N	N	N	N	N	N
152	Transport Expt.	SL	N	Y	Y	Y	Y	Y	Y	Y	Y
153	Transport Expt.	SL	N	N	N	Y	N	Y	Y	Y	Y

Annex J: Feedbacks of the Transport Sector Actors – Stage 2, Part 2: Levels of Cognitive and Functional Competencies

Table J.1: The Key to Abbreviations

Knowledge and Skill Level		Energy Efficiency Area		Staff Categories	
Expert	E	System Efficiency	SE	Strategic level	SL
Advanced	A	Trip Efficiency	TE	Tactical level	TL
Intermediate	I	Vehicle Efficiency	VE	Operational level	OL
Basic	B	Overall Efficiency	OL	Competency	
None/Limited/No response	N			Knowledge	KN
Not relevant				Skills	SK

Table J.2: The feedback of the transport sector actors – Stage 2 – Levels of cognitive and functional competencies

#	Institute	Staff Cat.	Key EE Area	SE Policy KN	SE Policy SK	SE Plan. KN	SE Plan. SK	SE Implem. KN	SE Implem. SK	SE Oper. KN	SE Oper. SK	TE Policy KN	TE Policy SK	TE Plan. KN	TE Plan. SK	TE Implem. KN	TE Implem. SK	TE Oper. KN	TE Oper. SK	VE Policy KN	VE Policy SK	VE Plan. KN	VE Plan. SK	VE Implem. KN	VE Implem. SK	VE Oper. KN	VE Oper. SK
1	CEA	SL	VE	B	B	B	B					B	B	B	B					I	I	I	I				
2	CEA	TL	VE			B	B	B	B					B	B	B	B					B	B	B	B		
3	CEA	TL	VE			I	I	I	I					I	I	I	I					I	I	I	B		
4	CEA	OL	VE					B	B	B	B					B	B	I	I					B	I	I	I
5	CEB	SL	VE	B	B	B	B					B	B	B	B					A	A	A	A				
6	CEB	SL	VE	I	B	I	B					I	B	I	B					I	B	I	B				
7	CEB	TL	VE			B	B	B	B					A	I	I	I					I	B	B	B		
8	CEB	OL	VE					N	N	N	N					I	I	I	I					N	N	N	N
9	CleanAir SL	SL	SE	I	I	I	I					I	I	I	I					I	I	I	I				
10	CleanAir SL	SL	SE	A	A	A	A					A	A	A	A					I	I	I	I				
11	CleanAir SL	TL	SE			A	A	A	I					A	A	A	I					A	A	A	I		
12	CleanAir SL	OL	SE					I	B	B	B					I	I	B	I					I	I	I	B
13	CleanAir SL	OL	SE					I	I	A	I					I	I	I	I					I	I	I	B
14	CleanCo	SL	VE	A	A	A	A					A	A	A	A					A	A	A	A				
15	CleanCo	SL	VE	I	I	I	I					I	I	I	I					I	I	I	I				
16	CleanCo	TL	VE			I	I	I	I					I	I	I	I					I	I	I	I		
17	CleanCo	TL	VE			B	B	B	B					I	I	I	I					I	I	I	I		
18	CleanCo	TL	VE			I	I	I	I					I	I	I	I					I	I	I	I		
19	CleanCo	TL	VE			A	A	A	A					A	A	A	A					A	A	A	A		
20	CleanCo	OL	VE					I	I	I	I					I	I	I	I					I	I	I	I

| # | Institute | Staff Cat. | Key EE Area | System Efficiency (SE) | | | | | | | | Trip Efficiency (TE) | | | | | | | | Vehicle Efficiency (VE) | | | | | | | |
| | | | | Policy | | Plan. | | Implem. | | Oper. | | Policy | | Plan. | | Implem. | | Oper. | | Policy | | Plan. | | Implem. | | Oper. | |
				KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK
21	CleanCo	OL	VE					I	B	I	B					I	B	I	B					I	B	I	B
22	CleanCo	OL	VE					I	B	I	B					I	B	I	B					I	B	I	B
23	CleanCo	OL	VE					I	I	I	B					I	B	I	I					I	I	I	I
24	CPC	SL	VE	I	B	I	B					I	B	I	B					A	B	A	B				
25	DIMO	SL	VE	B	B	B	B					B	B	B	B					I	I	A	A				
26	DMT	SL	VE	A	A	A	A					A	A	A	A					E	E	A	A				
27	DMT	TL	VE			B	B	B	B					B	B	B	B					I	I	A	A		
28	DMT	TL	VE			B	B	I	B					B	B	I	B					I	A	A	A		
29	DMT	TL	VE			B	B	B	B					B	B	B	B					A	A	A	A		
30	DMT	TL	VE			B	B	B	B					B	B	B	B					I	I	A	A		
31	DMT	OL	VE					B	B	B	B					B	B	B	B					A	A	A	A
32	DMT	OL	VE					B	B	B	B					B	B	B	B					A	A	A	A
33	DPMC	TL	VE			B	B	B	B					B	B	B	B					I	I	A	A		
34	I2C	SL	SE	B	B	B	B					A	I	I	I					A	A	A	A				
35	IAESL	SL	VE	I	I	I	I					I	I	I	I					A	A	E	E				
36	IAESL	TL	VE			I	B	I	B					I	B	I	B					A	A	A	A		
37	JaTh	SL	SE	A	I	I	I					I	I	B	B					I	I	B	B				
38	JaTh	TL	SE			I	I	I	I					I	I	I	I					I	I	I	I		
39	JaTh	TL	SE			I	I	I	I					I	I	I	I					I	I	I	I		
40	JLan	TL	VE			A	A	A	A					A	A	A	A					A	A	A	A		
41	Laugfs	SL	VE	A	A	A	A					A	A	A	A					A	A	A	A				
42	Laugfs	TL	VE			A	A	A	A					A	A	A	I					A	A	A	I		
43	Laugfs	TL	VE			A	I	A	I					I	I	I	I					I	I	I	I		
44	Laugfs	TL	VE			B	B	B	B					B	B	B	B					B	B	B	B		
45	Laugfs	OL	VE					B	B	B	B					B	B	B	B					I	I	I	I
46	Laugfs	OL	VE					B	B	B	B					B	B	B	B					B	B	B	B
47	Laugfs	OL	VE					I	I	I	A					I	I	I	I					I	I	A	I
48	Laugfs	OL	VE					I	I	I	I					I	I	I	I					I	I	I	I
49	Laugfs	OL	VE					B	B	B	B					B	B	B	B					B	B	B	B
50	Laugfs	OL	VE					I	I	I	B					I	B	I	B					I	B	A	B
51	Laugfs	OL	VE					I	B	I	B					I	B	I	B					I	B	I	B
52	Laugfs	OL	VE					I	I	B	B					B	B	B	B					B	B	B	B
53	LECO	SL	VE	B	I	I	I					A	I	A	I					A	I	A	I				
54	MoE	SL	OL	I	I	N	N					I	I	N	N					B	B	N	N				
55	MoE	SL	OL	A	A	I	I					A	I	I	I					B	B	B	B				
56	MoE	TL	OL			A	I	A	I					I	I	I	I					I	I	I	I		
57	MoE	TL	OL			B	B	B	B					I	I	I	I					N	B	N	I		
58	MoE	OL	OL					B	B	B	B					B	N	B	N					N	N	N	N
59	MoE	OL	OL					B	I	B	I					B	A	B	A					B	A	B	E

#	Institute	Staff Cat.	Key EE Area	System Efficiency (SE)								Trip Efficiency (TE)								Vehicle Efficiency (VE)							
				Policy		Plan.		Implem.		Oper.		Policy		Plan.		Implem.		Oper.		Policy		Plan.		Implem.		Oper.	
				KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK
60	MoE	OL	OL					A	A	A	A					A	I	A	I					A	I	I	A
61	MoE	OL	OL					I	B	I	B					I	B	I	B					B	B	B	B
62	MoE	OL	OL					I	I	A	I					I	I	I	I					I	I	I	B
63	MoE	OL	OL					B	N	B	N					B	N	B	N					N	N	N	N
64	MoP&E	SL	SE	N	B	N	B					B	B	B	B					I	B	I	B				
65	MoP&E	TL	SE			I	B	B	B					I	B	B	B					B	B	B	B		
66	MoT	SL	OL	I	B	I	I					B	B	I	I					B	I	I	I				
67	NPD	SL	OL	A	I	A	I					A	I	A	I					I	I	I	I				
68	NPD	TL	OL			B	B	B	B					B	B	B	B					B	B	B	B		
69	NPD	TL	OL			A	A	A	A					A	E	A	E					A	I	A	I		
70	NTC	SL	TE	A	A	A	A					A	A	A	A					B	B	B	B				
71	RDA	SL	TE	A	A	E	E					E	E	E	E					I	I	I	I				
72	RDA	TL	TE			I	I	I	I					I	I	I	I					I	I	I	I		
73	RDA	TL	TE			I	I	I	I					I	I	I	I					B	B	B	B		
74	RDA	TL	TE			I	I	I	I					I	I	I	I					B	B	B	N		
75	RDA	OL	TE					I	B	I	B					B	B	B	B					B	B	B	B
76	RDA	OL	TE					A	I	B	B					A	B	B	B					B	N	B	N
77	RPTA-NWP	TL	TE			I	B	I	B					I	B	I	B					B	B	B	B		
78	RPTA-SG	TL	TE			I	B	B	B					I	B	B	B					B	B	B	B		
79	RPTA-Southern	SL	TE	E	A	E	E					E	A	E	E					A	A	E	E				
80	RPTA-UVA	SL	TE	B	B	B	B					B	B	B	B					B	B	B	B				
81	RPTA-UVA	SL	TE	B	B	I	B					B	B	I	B					B	B	B	B				
82	RPTA-WP	OL	TE					B	B	B	B					B	B	B	B					B	N	B	N
83	RPTA-WP	OL	TE					B	B	B	N					B	B	B	N					B	B	B	N
84	SDC	SL	OL	I	B	I	B					I	B	I	B					B	B	B	B				
85	SDC	SL	OL	B	B	B	B					B	B	B	B					B	B	B	B				
86	SDC	TL	OL			A	A	A	A					A	A	A	A					A	A	A	A		
87	SDC	TL	OL			A	A	A	A					A	A	A	A					A	A	A	A		
88	SDC	OL	OL					B	B	N	N					B	B	N	N					N	N	N	N
89	SDC	OL	OL					B	B	B	N					B	B	B	N					B	B	N	N
90	SDC	OL	OL					B	N	N	N					B	N	N	N					N	N	N	N
91	SDC	OL	OL					B	N	N	N					B	N	N	N					N	N	N	N
92	SDC	OL	OL					N	N	N	N					N	N	N	N					N	N	N	N
93	SDC	OL	OL					N	N	N	N					N	N	N	N					N	N	N	N
94	SLEMA	SL	OL	B	B	B	B					B	B	B	B					A	A	A	A				

#	Institute	Staff Cat.	Key EE Area	System Efficiency (SE)								Trip Efficiency (TE)								Vehicle Efficiency (VE)							
				Policy		Plan.		Implem.		Oper.		Policy		Plan.		Implem.		Oper.		Policy		Plan.		Implem.		Oper.	
				KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK
95	SLEMA	TL	OL			I	B	B	B					B	B	B	B					B	B	B	B		
96	SLEMA	OL	OL					I	I	B	B					I	I	B	B					I	I	B	B
97	SLSEA	SL	OL	I	I	I	B					I	B	I	B					B	B	B	B				
98	SLSEA	SL	OL	A	I	A	I					A	I	A	I					I	I	I	I				
99	SLSEA	SL	OL	A	I	A	B					A	I	I	B					A	I	A	B				
100	SLSEA	SL	OL	B	N	B	N					B	B	I	B					B	N	N	N				
101	SLSEA	TL	OL			I	B	B	B					B	B	B	B					B	B	B	B		
102	SLSEA	TL	OL			I	B	I	B					I	B	I	B					A	B	I	B		
103	SLSEA	TL	OL			I	I	B	B					I	I	B	B					N	N	N	N		
104	SLSEA	OL	OL					B	B	B	B					B	B	B	B					N	N	N	N
105	SLSEA	OL	OL					B	B	B	B					B	B	B	B					B	B	B	B
106	SLSEA	OL	OL					B	B	B	B					B	B	B	B					N	N	N	N
107	SLSEA	OL	OL					B	B	B	B					B	B	B	B					B	B	B	B
108	SLSEA	OL	OL					I	B	B	B					I	A	B	I					N	N	N	N
109	SLSTL	TL	OL			A	A	A	A					A	A	A	A					B	B	N	N		
110	SLSTL	TL	OL			E	E	E	A					A	A	A	I					I	B	B	B		
111	SLTB	SL	VE	I	I	I	I					I	I	I	I					E	E	E	E				
112	SLTB	TL	VE			I	I	I	I					I	I	I	I					E	A	E	A		
113	SLTB	TL	VE			B	B	B	B					I	I	B	B					E	A	E	A		
114	SLVET	SL	VE	I	I	I	I					I	I	I	I					E	E	E	E				
115	SLVET	TL	VE			A	I	I	I					A	I	A	I					I	I	I	I		
116	SLVET	TL	VE			A	I	I	I					A	I	A	I					I	I	I	I		
117	SLVET	OL	VE					B	B	B	B					N	N	N	B					B	B	A	A
118	SLVET	OL	VE					B	B	B	B					B	B	B	I					A	I	A	A
119	SLVET	OL	VE					B	B	B	B					B	B	B	B					A	A	E	A
120	SLVET	OL	VE					B	B	B	N					B	B	B	N					A	A	E	I
121	SLVET	OL	VE					B	B	B	B					B	B	B	B					I	I	A	I
122	SLVET	OL	VE					B	N	B	B					B	N	B	B					I	I	I	I
123	SLVET	OL	VE					N	N	B	B					N	N	B	B					I	B	I	I
124	SLVET	OL	VE					B	N	B	B					B	N	B	B					I	I	I	I
125	SLYCANT	SL	OL	A	I	I	I					A	I	I	I					I	B	I	B				
126	SLYCANT	SL	OL	A	I	A	I					A	I	A	I					B	B	B	B				
127	SLYCANT	TL	OL			I	B	B	B					I	B	B	B					I	B	B	B		
128	SLYCANT	OL	OL					B	B	B	B					B	B	B	B					B	B	B	N
129	SLYCANT	OL	OL					B	N	B	N					B	N	B	N					N	N	N	N
130	SLYCANT	OL	OL					I	B	B	B					I	B	B	B					B	B	B	B

| # | Institute | Staff Cat. | Key EE Area | System Efficiency (SE) | | | | | | | | Trip Efficiency (TE) | | | | | | | | Vehicle Efficiency (VE) | | | | | | | |
| | | | | Policy | | Plan. | | Implem. | | Oper. | | Policy | | Plan. | | Implem. | | Oper. | | Policy | | Plan. | | Implem. | | Oper. | |
				KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK	KN	SK
131	SLYCANT	OL	OL					B	B	B	B					B	B	B	B					B	B	B	N
132	SLYCANT	OL	OL					B	N	B	N					B	N	B	N					N	N	N	N
133	SLYCANT	OL	OL					B	B	B	N					B	B	B	N					B	N	B	N
134	Toyota	SL	VE	N	N	N	N					N	N	N	N					N	N	N	N				
135	UDA	SL	SE	A	A	A	A					A	A	A	A					A	A	A	A				
136	UDA	SL	SE	B	B	I	B					B	B	I	B					N	N	N	N				
137	UDA	SL	SE	B	I	I	I					N	B	N	B					N	N	N	N				
138	UDA	TL	SE			I	B	B	B					I	B	B	B							N	N	N	N
139	UDA	TL	SE			I	I	B	B					I	I	B	B							N	N	N	N
140	UDA	TL	SE			I	I	I	B					I	I	I	B							B	B	B	N
141	UDA	TL	SE			B	B	B	B					B	B	B	B							B	N	B	N
142	UDA	TL	SE			I	I	I	B					I	I	I	B							N	N	N	N
143	UDA	OL	SE					B	B	N	N					B	B	N	N					N	N	N	N
144	UDA	OL	SE					I	B	B	B					I	B	B	B					B	N	N	N
145	Tran. Expt.	SL	OE																										
146	Tran. Expt.	SL	OE																										
147	Tran. Expt.	SL	OE																										
148	Tran. Expt.	SL	OE																										
149	Tran. Expt.	SL	OE																										
150	Tran. Expt.	SL	OE																										
151	Tran. Expt.	SL	OE																										
152	Tran. Expt.	SL	OE																										
153	Tran. Expt.	SL	OE																										

Annex K: Details of the Education Specialists

The details of the education specialist contributed to the study are given in the following table:

Table K.1: The details for the education specialists

Name	Present Affiliation	Previous positions
Prof. K.K.C.K. Perera	Secretary, Ministry of Education	✓ Vice Chancellor, University of Moratuwa; ✓ Dean, Faculty of Engineering, University of Moratuwa; ✓ Director, Institute of Technology University of Moratuwa; ✓ Director, Staff Development Centre, University of Moratuwa; ✓ Vice-chairman, Ceylon Electricity Board; ✓ Commissioner, Sri Lanka Inventors Commission; ✓ Director General, The Sri Lanka Institute of Advanced Technological Education (SLIATE); ✓ Chairman, National Aquatic Resources & Research Development Agency (NARA).
Dr. T.A. Piyasiri	Consultant, Science and Technology Human Resource Development (STHRD) Project	✓ Vice Chancellor, University of Vocational Technology (UoVT); ✓ Director General - Tertiary & Vocational Education Commission; ✓ Director, Institute of Technology University of Moratuwa; ✓ Vice Chairman (Planning) / Member, National Education Commission; ✓ Chairman, Standing Committee on Technical and Vocational Education; ✓ Overall coordinator for Technology Stream, University Grant Commission.
Prof. R.A. Attalage	Dean, Faculty of Graduate Studies, SLIIT	✓ Deputy Vice Chancellor, University of Moratuwa; ✓ Commissioner, Public Utilities Commission of Sri Lanka; ✓ Chairman, National Institute of Fisheries and Nautical Engineering (NIFNE).
Dr. P.A.B.A.R. Perera	Senior Consultant	✓ Director, Institute of Technology University of Moratuwa; ✓ Head, Department of Mechanical Engineering, University of Moratuwa; ✓ Faculty Consultant, Colombo Plan Staff College; ✓ ADB Consultant – Technical Education Development Project; ✓ Consultant, Bachelor of Technology degree programmes; ✓ City and Guilds Consultant – Curriculum development.
Dr. S.D.R. Perera,	Director, Science and Technology Human Resource Development (STHRD) Project	✓ Director General - Tertiary & Vocational Education Commission;
Dr. R.A.M.P. Ranaweera	Senior Lecturer, University of Moratuwa	✓ Director, Quality Assurance Cell, University of Moratowa

Name	Present Affiliation	Previous positions
Dr. L.D.J.F. Nanayakkara	Senior Consultant	✓ Senior Lecturer, Department of Industrial Management, University of Kelaniya; ✓ Consultant, Bachelor of Technology degree programmes.
Dr. D.D.D. Suraweera	Senior Lecturer, Department of Electrical & Electronics Technology, Faculty of Engineering Technology, University of Vocational Technology (UoVT)	✓ Dean, Faculty of Industrial and Vocational Technology, UoVT; ✓ Head, Department of Education and Training, UoVT; ✓ Deputy Director, Curriculum Development, UoVT; ✓ Member, Technical & Vocational Education Standing Committee; ✓ Member of Policy Formulating Group, National Policy on Technical & Vocational Education; ✓ Learning Resource Development Center (LRDC).
Mrs. M.M.P.D. Samarasekara	Senior Lecturer, Department of Civil Engineering, Institute of Technology, University of Moratuwa (ITUM)	✓ Director, ITUM; ✓ Member, Senate, University of Moratuwa.

Annex L: Details of the Educationalists

Following table presents the details of the staff contributed to the survey in the education sector, their affiliations and the method/s of consultations.

Key: Structured Questionnaire – SQ; Physical Workshop – PW; Physical Interview – PI; Online Interview – OI, Zoom meeting - ZM

Table L.1: The details for the respondents in the transport sector institutions

Education Institute	Department/Division/Faculty	Name	Job title	Mode/s of Consultation
University of Moratuwa	Department of Civil Engineering, Faculty of Engineering	Prof. J.M.S.J. Bandara	Senior Professor	SQ; OI; ZM
		Dr. D.I. De Silva	Senior Lecturer	SQ; OI
		Dr. H.R. Pasindu	Senior Lecturer	SQ; OI; ZM
		Dr. L. Perera	Senior Lecturer	SQ; OI; ZM
	Department of Mechanical Engineering, Faculty of Engineering	Dr. H.K.G. Punchihewa	Head of the Department	SQ; PI
		Dr. R.A.C.P. Ranasinghe	Senior Lecturer	SQ; PI
		Dr. M.A. Wijewardane	Senior Lecturer	SQ; PI
		Mr. C.M.S.P. De Silva	Lecturer	SQ; PI
	Department of Transport & Logistic Management, Faculty of Engineering	Mr. S.N. Bentotage	Senior Lecturer	SQ; PI
		Ms. T. Amalan	Lecturer	SQ; OI
	Department of Town & Country Planning, Faculty of Architecture	Dr. A.B. Jayasinghe	Senior Lecturer	SQ; OI
		Ms. H.M.M. Herath	Lecturer	SQ; OI
	Industrial Training Division, Faculty of Engineering	Eng. Plnr. T.A. Gamage	Senior Lecturer; Director	SQ; PI
		Eng. R. Sankaranarayana	Senior Lecturer	SQ; PI
University of Peradeniya	Department of Civil Engineering, Faculty of Engineering	Dr. A.G.H.J. Edirisinghe	Senior Lecturer	SQ; PW
	Department of Mechanical Engineering, Faculty of Engineering	Dr. D.A.A.C. Ratnaweera	Head of the Department	SQ; PW
		Dr. S.D.G.S.P. Gunawardane	Senior Lecturer	SQ; PW
	Department of Chemical and Process Engineering	Prof. D.G.G.P. Karunaratne	Professor	SQ; PW
		Dr. C.S. Kalpage	Senior Lecturer	SQ; PW
Sabaragamuwa University of Sri Lanka	Department of Engineering Technology, Faculty of Technology	Eng. R. Sankaranarayana	Visiting Lecturer	OI

Education Institute	Department/Division/Faculty	Name	Job title	Mode/s of Consultation
University of Jaffna	Department of Civil Engineering, Faculty of Engineering	Dr. A. Anburuvel	Head of the Department	OI
	Department of Engineering Technology, Faculty of Technology	Dr. B. Ketheesan	Head of the Department	SQ; OI
		Mr. R.C. Ambagala	Lecturer	OI
		Eng. R. Sankaranarayana	Visiting Lecturer	OI
University of Ruhuna	Department of Civil and Environmental Engineering, Faculty of Engineering	Dr. T.M. Rengarasu	Senior Lecturer	PW; PI
		Dr. C. Tushara	Senior Lecturer	SQ; PW; PI
	Department of Mechanical & Manufacturing Engineering, Faculty of Engineering	Dr. N.K. Hettiarachchi	Head of the Department	SQ; PW
		Dr. C. Ambawatte	Senior Lecturer	SQ; PW
		Dr. H.C.P. Karunasena	Senior Lecturer	SQ; PW
	Department of Biosystems Technology, Faculty of Technology	Mr. W.A.H.M. Karunarathne	Lecturer	SQ; PW
	Department of Engineering Technology, Faculty of Technology	Ms. W.G.A. Pabasara	Lecturer	SQ; PW
	Department of Agricultural Engineering, Faculty of Agriculture	Prof. C.M. Navarathne	Senior Professor	SQ; PW
		Mrs. C.P. Rupasinghe	Senior Lecturer	SQ; PW
		Mr W.B.M.A.C. Bandara	Lecturer	SQ; OI
		Mrs. M.G.G. Awanthi	Lecturer	SQ; OI
		Mr. K.M.T.S. Bandara	Lecturer	SQ; OI
University of Colombo	Department of Zoology and Environment Sciences, Faculty of Science	Prof. E. Lokupitiya	Professor	SQ; OI
Uva Wellassa University	Department of Engineering Technology, Faculty of Technological Studies	Eng. R. Sankaranarayana	Visiting Lecturer	OI
Wayamba University	Department of Mechanical & Manufacturing Technology, Faculty of Technology	Dr. I.P.M. Wickramasinghe	Head of the Department	SQ; OI
		Ms. R. Attanayake	Visiting Lecturer	OI
University of Sri Jayawardenapura	Department of Forestry & Environmental Science, Faculty of Applied Sciences	Dr. P. Perera	Senior Lecturer	SQ; OI
		Dr. V.M. Jayasooriya,	Senior Lecturer	SQ; OI
University of Kelaniya	Department of Zoology and Environmental Management, Faculty of Science	Dr. W.A.R.T.W.R. Bandara	Senior Lecturer	OI

Education Institute	Department/Division/Faculty	Name	Job title	Mode/s of Consultation
South Eastern University	Department of Mechanical Engineering, Faculty of Engineering	Prof. A.M. Muzathik	Professor	SQ, OI
		Eng. R. Sankaranarayana	Visiting Lecturer	OI
Open University of Sri Lanka	Department of Mechanical Engineering, Faculty of Engineering	Dr I.U. Atthanayake	Head of the Department	SQ, OI
Kotelawala Defense University	Department of Mechanical Engineering, Faculty of Engineering	Dr. R.M.P.S. Bandara	Senior Lecturer	SQ, OI
	Department of Management and Finance, Faculty of Management, Social Sciences and Humanities	Dr. R.M.N.T. Sirisoma	Senior Lecturer	SQ, OI
Sri Lanka Institute of Information Technology	Department of Mechanical Engineering, Faculty of Engineering	Dr. M.S.M. Perera	Senior Lecturer	SQ, ZM
		Mr. K.Y. Abeyasinghe	Research Associate	SQ, ZM
		Mr. W. Maddumage	Research Associate	SQ, ZM
	Department of Civil Engineering, Faculty of Engineering	Prof. S. Karunaratne	Professor	SQ, OI
National School of Business Management	Faculty of Engineering	Dr. C. Perera	Dean	OI
Colombo International Nautical and Engineering College	Department of Logistic & Transport, Faculty of Management & Social Sciences	Prof. E.K.D.L.P. Edirisinghe	Dean	OI
University of Vocational Technology	Department of Electrical & Electronics Technology, Faculty of Engineering Technology	Dr. D.D.D. Suraweera	Senior Lecturer	OI
		Mrs. J.K. Kanthi	Senior Lecturer	OI
Institute of Technology University of Moratuwa	Division of Civil Engineering Technology	Mrs. M.M.P.D. Samarasekara	Senior Lecturer	SQ, OI
	Division of Mechanical Engineering Technology	Dr. P.D.C. Kumara	Senior Lecturer	SQ, OI
Ceylon-German Technical Training Institute	Automobile Mechanic	Ms. A.M.R.N. Attanayake	Visiting Lecturer	OI
Automobile Engineering Training Institute	Automobile Mechanic Division	Mr. W.M.S. Fonseka	Head	SQ, OI
		Mr. W.M.D.D. Dayananda	Instructor	SQ, OI

Education Institute	Department/Division/ Faculty	Name	Job title	Mode/s of Consultation
University College of Kuliyapitiya (UCK)	Automobile Technology Division	Ms. A.M.R.N. Attanayake	Lecturer/Course Coordinator	OI
Sri Lanka Institute of Advanced Technological Education	Mechanical Engineering	Ms. K.G. Thamari	Assistant lecturer	SQ, OI
David Pieris Motor Company (Pvt) Ltd	Field Service Division	Mr. C. Ranawaka	Divisional Manager Service	SQ. OI
	Technical Training Center	Mr. Asanka	Senior Service Cum Technical Training Coordinator	SQ
		Mr. Channa	Executive – Technical Training	SQ
		Mr. Aruna	Officer – Technical training	SQ
		Mr. Jegaanesan	Executive – Technical Training	SQ
Toyota Lanka (Private) Limited	Training Division	Mr. A. Suraweera	Service Advisor/ Assistant Manager	OI
Diesel & Motor Engineering Academy for Technical Skills	Training School	Mr. V. Randeny	Manager	OI
CleanCo Lanka Limited	Operations	Mr. S. Perera	Deputy General Manager	SQ, PW
		Mr. D. Epa	Manager - Technical	SQ, PW
	Human Resource	Mr. J. Nedurana	Assistant Manager- Training	SQ, PW
Laugfs Eco Sri Limited	Technical Training	Mr. H.B.H. Pathmasiri	Manager - Technical Training	SQ, PW
Sri Lanka Institute of Development Administration	Environment	Mrs. N.J. Jayasundera.	Senior Consultant	SQ; OI
Sri Lanka Energy Managers Association	-	Dr. A. Wickramasinghe	Director	SQ; OI
	-	Mr. T.F.N. Perera	Director	SQ; OI
	-	Mr. D.D. Ananda Namal	Member	SQ; OI
Institute of Automotive Engineers of Sri Lanka	-	Mr. U. Perera	Vice President	OI
National Cleaner Production Centre	-	Mr. S. Kumarasena.	Chief Executive Officer	SQ; OI
	Energy Department	Mr. R. Wijemanne	Energy Expert	SQ; OI

Annex M: Feedbacks of the Education Sector Actors – Stage 1

Table M.1: The Key to Abbreviations

Type of Module		Level of Involvement		Awareness		Proficiency	
Core/Compulsory	C	Direct/Major	D	Well-informed	W	High	H
Elective	E	Some/Partial	S	Fairly	F	Fair	F
Optional	O	Minor/Little	M	Vaguely	V	Low/Slight	L
None	N	None	N	Not aware	N	None	N

Table M.2: The feedback of the educationalists – Stage 1

#	Institute	Staff Identity	Type of Module	Level of Involvement	Awareness	Proficiency
1	AETI	AM_1	C	D	W	H
2	AETI	AM_2	C	D	F	F
3	CGTTI	AM_1	C	D	F	F
4	CINEC	SHM_1	C	D	W	H
5	CleanCo	HR_1	C	M	F	L
6	CleanCo	OP_1	C	D	W	H
7	CleanCo	OP_2	C	D	W	H
8	DATS	AM_1	C	D	F	F
9	DPMC	FSD_1	C	S	W	F
10	DPMC	TTC_1	C	D	W	H
11	DPMC	TTC_2	C	D	W	H
12	DPMC	TTC_3	E	S	F	F
13	DPMC	TTC_4	E	S	F	F
14	EcoSri	TT_1	C	D	F	F
15	IAESL	TT_1	C	D	W	H
16	ITUM	CET_1	C	D	F	F
17	ITUM	MET_1	C	D	F	F
18	KDU	MF_1	C	D	W	H
19	KDU	ME_1	C	D	F	F
20	NCPC	RM_1	C	S	F	L
21	NCPC	RM_2	E	S	F	F
22	NSBM	FE_1	E	S	V	L
23	OUSL	ME_1	C	D	F	L
24	SEU	ME_1	C	D	W	H
25	SEU	ME_2	C	D	W	F
26	SLEMA	EM_1	C	D	V	L
27	SLEMA	EM_2	C	S	F	F
28	SLEMA	EM_3	C	S	F	F

#	Institute	Staff Identity	Type of Module	Level of Involvement	Awareness	Proficiency
29	SLIATE	ME_1	O	M	V	F
30	SLIDA	ENV_1	C	D	F	F
31	SLIIT	CE_1	C	D	F	L
32	SLIIT	ME_1	C	D	F	F
33	SLIIT	ME_2	O	M	F	F
34	SLIIT	ME_3	O	M	F	L
35	SUSL	ET_1	C	D	W	F
36	TOYOTA	TD_1	C	D	F	F
37	UCK	AT_1	C	D	F	F
38	UoC	ZES_1	C	D	F	F
39	UoJ	CE_1	C	D	V	L
40	UoJ	AT_1	C	D	W	H
41	UoJ	AT_2	C	D	W	F
42	UoJ	CT_1	C	D	V	L
43	UoK	ECM_1	C	D	W	H
44	UoM	CE_1	C	S	W	F
45	UoM	CE_2	C	D	W	F
46	UoM	CE_3	C	D	W	F
47	UoM	CE_4	C	D	W	F
48	UoM	ME_1	E	M	W	F
49	UoM	ME_2	E	S	W	H
50	UoM	ME_3	C	D	W	H
51	UoM	ME_4	C	D	W	H
52	UoM	TLM_1	C	D	W	H
53	UoM	TLM_2	C	D	W	H
54	UoM	ITD_1	O	M	F	F
55	UoM	ITD_2	C	S	W	F
56	UoM	TCP_1	C	D	W	F
57	UoM	TCP_2	C	M	W	L
58	UoP	CE_1	C	D	F	F
59	UoP	CPE_1	C	D	F	L
60	UoP	CPE_2	E	S	F	F
61	UoP	ME_1	C	D	F	H
62	UoP	ME_2	E	D	W	F
63	UoR	AE_1	C	S	W	H
64	UoR	GT_1	C	D	W	H
65	UoR	GT_2	C	D	W	H
66	UoR	GT_3	C	S	W	H
67	UoR	GT_4	C	D	F	F
68	UoR	CEE_1	C	D	W	H
69	UoR	CEE_2	C	D	W	H

#	Institute	Staff Identity	Type of Module	Level of Involvement	Awareness	Proficiency
70	UoR	MEE_1	C	D	W	F
71	UoR	MEE_2	E	D	W	H
72	UoR	MEE_3	E	S	F	F
73	UoR	BST_1	C	D	W	F
74	UoR	ET_1	C	D	F	F
75	UoVT	FET_1	O	M	F	F
76	UoVT	FET_2	O	M	F	L
77	USJP	FES_1	C	S	F	F
78	USJP	FES_2	C	D	W	H
79	UWU	ET_1	C	D	W	F
80	WUSL	MMT_1	O	S	F	F
81	WUSL	MMT_2	C	D	F	F
82	ES	ES_1			W	F
83	ES	ES_2			F	F
84	ES	ES_3			W	H
85	ES	ES_4			F	F
86	ES	ES_5			W	F
87	ES	ES_6			W	H
88	ES	ES_7			W	H
89	ES	ES_8			F	F
90	ES	ES_9			F	F

Annex N: Feedbacks of the Education Sector Actors – Stage 2, Part 1 Educational Background, Experience and Roles and Responsibilities

Table N.1: The Key to Abbreviations

Highest Academic Qualification (AQ)		Professional Qualifications (PQ)		Specific Education related to Transport		Roles & Responsibilities	
Postgraduate	P	Yes	Y	Yes	Y	Yes	Y
Undergraduate	U	No/No response	N	No/No response	N	No/No response	N
Diploma	D						

Table N.2: The feedback of the educationalists – Stage 2 - Educational Background

#	Institute	Staff Identity	Highest AQ	PQ	Modes of Awareness and Education related to Transport								
					School	Technical	Occupational	UG	PG	Research	Seminar/ Workshop	Specific trainings	Non-formal (media)
1	AETI	AM_1	D	N	N	Y	Y	N	N	N	Y	Y	N
2	AETI	AM_2	D	N	N	Y	Y	N	N	N	Y	Y	Y
3	CGTTI	AM_1	P	N	N	N	Y	Y	N	N	Y	N	N
4	CINEC	SHM_1	P	Y	N	N	N	N	Y	Y	Y	Y	N
5	CleanCo	HR_1	D	Y	Y	Y	Y	N	N	N	N	N	N
6	CleanCo	OP_1	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
7	CleanCo	OP_2	D	N	Y	Y	Y	N	N	N	Y	Y	N
8	DATS	AM_1	U	N	N	Y	Y	Y	N	N	Y	Y	N
9	DPMC	FSD_1	P	N	N	Y	N	Y	N	N	Y	Y	N
10	DPMC	TTC_1	D	N	N	Y	N	N	N	N	Y	Y	N
11	DPMC	TTC_2	U	N	N	Y	Y	N	N	N	Y	N	N
12	DPMC	TTC_3	D	N	N	Y	Y	N	N	N	Y	N	N
13	DPMC	TTC_4	U	N	N	Y	Y	Y	N	N	Y	Y	N
14	EcoSri	TT_1	D	Y	N	Y	N	N	N	N	Y	N	Y
15	IAESL	TT_1	P	Y	N	Y	Y	N	Y	Y	Y	Y	Y
16	ITUM	CET_1	P	N	N	N	Y	N	N	N	Y	N	N
17	ITUM	MET_1	P	Y	N	N	Y	N	N	N	N	N	N
18	KDU	MF_1	P	Y	N	N	N	Y	Y	Y	Y	Y	Y
19	KDU	ME_1	P	Y	N	N	N	Y	N	N	N	N	N
20	NCPC	RM_1	P	N	N	N	N	N	N	N	Y	Y	Y
21	NCPC	RM_2	U	Y	N	Y	N	N	N	N	Y	N	Y
22	NSBM	FE_1	P	N	N	N	N	N	N	N	Y	N	Y
23	OUSL	ME_1	P	Y	N	N	N	N	N	N	N	N	N
24	SEU	ME_1	P	Y	N	N	N	Y	N	Y	Y	N	N
25	SEU	ME_2	P	N	Y	Y	Y	Y	Y	Y	Y	Y	Y

#	Institute	Staff Identity	Highest AQ	PQ	School	Technical	Occupational	UG	PG	Research	Seminar/ Workshop	Specific trainings	Non-formal (media)
													Modes of Awareness and Education related to Transport
26	SLEMA	EM_1	P	N	N	N	N	N	N	N	Y	N	N
27	SLEMA	EM_2	P	N	N	Y	N	N	N	N	Y	Y	N
28	SLEMA	EM_3	P	Y	N	N	N	N	N	N	N	N	Y
29	SLIATE	ME_1	U	N	N	N	Y	Y	N	N	N	N	Y
30	SLIDA	ENV_1	P	N	N	N	N	N	Y	N	Y	Y	N
31	SLIIT	CE_1	P	N	N	N	N	N	N	Y	Y	N	N
32	SLIIT	ME_1	P	N	N	N	Y	Y	Y	Y	N	Y	Y
33	SLIIT	ME_2	U	N	N	N	N	N	Y	Y	N	N	N
34	SLIIT	ME_3	U	N	N	N	N	N	N	Y	N	N	N
35	SUSL	ET_1	P	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
36	TOYOTA	TD_1	U	N	N	Y	Y	Y	N	N	Y	Y	N
37	UCK	AT_1	P	N	N	N	Y	Y	N	N	Y	N	N
38	UoC	ZES_1	P	N	N	N	N	N	Y	N	N	N	N
39	UoJ	CE_1	P	N	N	N	N	Y	Y	Y	Y	N	N
40	UoJ	AT_1	P	Y	N	N	Y	Y	N	N	Y	N	N
41	UoJ	AT_2	P	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
42	UoJ	CT_1	P	N	N	N	N	Y	N	N	Y	N	N
43	UoK	ECM_1	P	N	N	N	N	Y	Y	Y	Y	N	N
44	UoM	CE_1	P	N	N	N	N	Y	Y	Y	Y	Y	N
45	UoM	CE_2	P	Y	N	N	N	N	Y	Y	Y	N	N
46	UoM	CE_3	P	Y	N	N	N	N	Y	Y	N	N	N
47	UoM	CE_4	P	Y	N	N	N	N	Y	Y	Y	N	N
48	UoM	ME_1	P	N	N	N	Y	N	N	Y	Y	Y	N
49	UoM	ME_2	P	Y	N	N	N	Y	Y	Y	N	N	N
50	UoM	ME_3	P	Y	N	Y	N	Y	Y	Y	N	N	N
51	UoM	ME_4	U	N	N	N	N	Y	N	Y	Y	N	N
52	UoM	TLM_1	P	Y	N	Y	Y	Y	Y	Y	Y	N	N
53	UoM	TLM_2	P	N	N	Y	Y	Y	Y	Y	Y	Y	N
54	UoM	ITD_1	P	N	N	N	Y	Y	Y	N	N	N	N
55	UoM	ITD_2	P	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
56	UoM	TCP_1	P	Y	N	N	N	N	N	N	N	N	N
57	UoM	TCP_2	P	N	N	N	N	N	N	N	N	N	N
58	UoP	CE_1	P	N	N	N	N	Y	Y	Y	Y	Y	Y
59	UoP	CPE_1	P	N	N	N	N	N	N	N	N	N	Y
60	UoP	CPE_2	P	N	N	N	N	N	N	N	N	N	N
61	UoP	ME_1	P	N	N	N	N	Y	N	Y	N	N	N
62	UoP	ME_2	P	Y	N	N	N	Y	N	N	N	Y	N
63	UoR	AE_1	P	N	N	N	N	N	N	N	N	N	N
64	UoR	GT_1	P	N	N	N	N	N	Y	N	N	N	N
65	UoR	GT_2	P	Y	N	N	N	N	N	Y	Y	Y	Y

#	Institute	Staff Identity	Highest AQ	PQ	School	Technical	Occupational	UG	PG	Research	Seminar/ Workshop	Specific trainings	Non-formal (media)
					Modes of Awareness and Education related to Transport								
66	UoR	GT_3	U	N	N	N	N	Y	N	Y	Y	N	Y
67	UoR	GT_4	P	N	N	N	N	N	N	N	N	N	N
68	UoR	CEE_1	P	Y	N	N	N	Y	Y	Y	Y	N	N
69	UoR	CEE_2	Y	N	N	N	Y	Y	N	N	Y	N	N
70	UoR	MEE_1	P	Y	N	N	N	N	N	N	N	N	Y
71	UoR	MEE_2	P	Y	N	N	N	Y	Y	N	Y	N	N
72	UoR	MEE_3	P	Y	N	N	N	N	N	N	Y	N	Y
73	UoR	BST_1	P	N	N	N	N	N	N	N	N	N	Y
74	UoR	ET_1	U	N	N	N	N	N	N	N	Y	N	N
75	UoVT	FET_1	P	Y	N	N	Y	N	N	N	Y	N	N
76	UoVT	FET_2	P	Y	N	N	N	N	N	N	Y	Y	Y
77	USJP	FES_1	P	Y	N	N	N	N	N	N	Y	N	N
78	USJP	FES_2	P	N	N	N	N	N	Y	Y	Y	N	N
79	UWU	ET_1	P	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
80	WUSL	MMT_1	P	N	N	N	N	N	N	N	N	N	Y
81	WUSL	MMT_2	P	N	N	N	Y	Y	N	N	Y	N	N

Table N.3: The feedback of the education specialists – Stage 2 - Educational background and education sector experience

#	Group	Staff Identity	Highest AQ	PQ	PG Level	Extended Courses (> 3 months)	Short Courses (< 3 months)	Research	Seminars/ workshops	Non-formal (media)
					Specific education / training related to competency based education / curriculum development					
1	Education Specialists	ES_1	P	Y	Y	Y	Y	Y	Y	Y
2		ES_2	P	Y	N	N	N	Y	Y	N
3		ES_3	P	Y	N	N	N	N	N	Y
4		ES_4	P	Y	N	N	N	Y	Y	N
5		ES_5	P	N	N	N	N	N	N	N
6		ES_6	P	Y	N	N	N	Y	Y	Y
7		ES_7	P	N	N	N	Y	Y	Y	Y
8		ES_8	P	Y	Y	N	Y	N	Y	Y
9		ES_9	P	N	N	N	N	N	Y	N

Table N.4: The feedback of the educationalists – Stage 2 – Educational roles and responsibilities

#	Institute	Staff Identity	Roles and responsibilities					
			Curriculum development	Educational material development	Teaching & labs	Research & Industry project	Consultancy	Administration
1	AETI	AM_1	Y	Y	Y	N	N	Y
2	AETI	AM_2	N	Y	Y	N	N	N
3	CGTTI	AM_1	N	Y	Y	N	N	Y
4	CINEC	SHM_1	Y	Y	Y	Y	Y	Y
5	CleanCo	HR_1	N	N	N	N	N	N
6	CleanCo	OP_1	Y	Y	Y	N	N	N
7	CleanCo	OP_2	Y	Y	Y	N	N	N
8	DATS	AM_1	N	Y	Y	N	N	N
9	DPMC	FSD_1	Y	Y	N	N	N	N
10	DPMC	TTC_1	Y	Y	N	N	N	N
11	DPMC	TTC_2	Y	Y	N	N	N	Y
12	DPMC	TTC_3	N	Y	Y	N	N	Y
13	DPMC	TTC_4	Y	Y	Y	N	N	N
14	EcoSri	TT_1	Y	Y	Y	Y	Y	Y
15	IAESL	TT_1	Y	Y	Y	Y	Y	Y
16	ITUM	CET_1	Y	Y	Y	N	N	N
17	ITUM	MET_1	Y	Y	Y	Y	N	N
18	KDU	MF_1	Y	Y	Y	Y	Y	N
19	KDU	ME_1	Y	Y	Y	Y	Y	Y
20	NCPC	RM_1	Y	Y	Y	N	Y	Y
21	NCPC	RM_2	Y	Y	N	N	N	N
22	NSBM	FE_1	Y	Y	Y	Y	Y	Y
23	OUSL	ME_1	Y	Y	Y	Y	N	Y
24	SEU	ME_1	Y	Y	Y	Y	Y	Y
25	SEU	ME_2	Y	Y	Y	N	N	Y
26	SLEMA	EM_1	N	N	Y	Y	N	N
27	SLEMA	EM_2	N	Y	N	Y	Y	Y
28	SLEMA	EM_3	N	Y	Y	Y	Y	Y
29	SLIATE	ME_1	N	N	Y	N	N	N
30	SLIDA	ENV_1	Y	Y	N	N	N	N
31	SLIIT	CE_1	Y	Y	Y	Y	N	N
32	SLIIT	ME_1	Y	Y	Y	Y	Y	N
33	SLIIT	ME_2	N	N	Y	N	N	N
34	SLIIT	ME_3	N	N	N	Y	N	N
35	SUSL	ET_1	Y	Y	Y	N	N	Y
36	TOYOTA	TD_1	N	Y	Y	N	N	N
37	UCK	AT_1	N	Y	Y	N	N	Y
38	UoC	ZES_1	Y	Y	Y	Y	Y	Y
39	UoJ	CE_1	Y	Y	Y	Y	Y	N

40	UoJ	AT_1	Y	Y	Y	N	N	N
41	UoJ	AT_2	Y	Y	Y	N	N	Y
42	UoJ	CT_1	Y	Y	N	N	N	N
43	UoK	ECM_1	Y	Y	Y	Y	Y	N
44	UoM	CE_1	Y	Y	Y	Y	Y	Y
45	UoM	CE_2	N	N	Y	Y	Y	Y
46	UoM	CE_3	Y	Y	Y	Y	Y	Y
47	UoM	CE_4	Y	Y	Y	Y	Y	Y
48	UoM	ME_1	Y	Y	Y	Y	Y	Y
49	UoM	ME_2	Y	Y	Y	Y	Y	Y
50	UoM	ME_3	Y	Y	Y	Y	Y	Y
51	UoM	ME_4	Y	Y	Y	Y	Y	Y
52	UoM	TLM_1	Y	Y	Y	Y	Y	N
53	UoM	TLM_2	Y	Y	Y	Y	Y	Y
54	UoM	ITD_1	N	Y	Y	N	N	N
55	UoM	ITD_2	Y	Y	Y	N	N	Y
56	UoM	TCP_1	Y	Y	Y	Y	Y	N
57	UoM	TCP_2	Y	Y	Y	Y	N	N
58	UoP	CE_1	Y	Y	Y	Y	Y	Y
59	UoP	CPE_1	Y	Y	Y	Y	N	N
60	UoP	CPE_2	Y	Y	Y	Y	Y	Y
61	UoP	ME_1	Y	Y	Y	Y	N	Y
62	UoP	ME_2	Y	Y	Y	N	N	N
63	UoR	AE_1	N	N	Y	N	N	N
64	UoR	GT_1	Y	Y	Y	Y	Y	Y
65	UoR	GT_2	Y	Y	Y	Y	Y	Y
66	UoR	GT_3	Y	Y	Y	Y	N	N
67	UoR	GT_4	N	Y	Y	N	N	N
68	UoR	CEE_1	Y	Y	Y	Y	Y	N
69	UoR	CEE_2	N	N	Y	Y	N	N
70	UoR	MEE_1	Y	Y	Y	Y	N	Y
71	UoR	MEE_2	Y	Y	Y	Y	Y	Y
72	UoR	MEE_3	Y	Y	Y	Y	Y	Y
73	UoR	BST_1	N	N	Y	Y	N	N
74	UoR	ET_1	Y	N	Y	N	N	N
75	UoVT	FET_1	Y	Y	Y	Y	Y	Y
76	UoVT	FET_2	Y	Y	Y	N	N	Y
77	USJP	FES_1	Y	N	Y	N	N	N
78	USJP	FES_2	Y	Y	Y	Y	N	Y
79	UWU	ET_1	Y	Y	Y	N	N	Y
80	WUSL	MMT_1	N	N	N	Y	N	Y
81	WUSL	MMT_2	N	Y	Y	N	N	Y

Table N.5: The feedback of the education specialists – Stage 2 – Roles and responsibilities assumed in the education sector

#	Stakeholder Group	Staff Identity	Roles and responsibilities					
			Policy and strategies	Curriculum review/ moderation	Curriculum development	Educational material development	Teaching & labs	Administration
1	Education Specialists	ES_1	Y	Y	Y	Y	Y	Y
2		ES_2	Y	Y	Y	Y	Y	Y
3		ES_3	Y	Y	Y	Y	Y	Y
4		ES_4	N	Y	Y	Y	Y	Y
5		ES_5	N	N	N	N	N	N
6		ES_6	Y	Y	Y	Y	Y	Y
7		ES_7	Y	Y	Y	Y	Y	N
8		ES_8	Y	Y	Y	Y	Y	Y
9		ES_9	Y	Y	Y	Y	Y	Y

Annex O: Attributes of Qualification Holders Defined in SLQF

Table O.1: Attributes of qualification holders from SLQF Level 3 to SLQF Level 6

SLQF Level 3 (Diploma)	SLQF Level 4 (Higher Diploma)	SLQF Level 5 (Bachelors Degree)	SLQF Level 6 (Bachelors Honours Degree)
The qualification holders: - Should have an have an understanding of theory, practice, relevant methodology and recent developments in a particular area of study. - Should be able to apply the concepts and principles in the area of study and suggest solutions to problems in an employment context. - Should be able to communicate successfully, the results to specialist and non-specialist audiences and exercise personal responsibilities and leadership in some tasks in the workplace. - Should be capable of carrying out further training and acquire new competencies which will help to enhance their capacity to bear responsibilities. - Should display qualities and transferable skills as well as subject specific skills necessary for employment, carry out further training and manage their own learning.	The qualification holders: - Should have a deep understanding of theory, practice, relevant methodology and recent developments in a particular area of study. - Should be able to apply the concepts and principles in the area of study, analyze information and suggest solutions to problems in an employment context. - Should be able to communicate successfully, the results of analysis and arguments to specialist and non-specialist audiences and exercise personal responsibilities and leadership in some tasks in the workplace. - Should be capable of carrying out further training and acquire new competencies which will help to enhance their capacity to bear responsibilities. - Should display qualities and transferable skills as well as subject specific skills necessary for employment, carry out further training and manage their own learning.	The qualifications holders: - Should know about the well-established principles and content in their fields of study. - Should be information literate; what they can do with what they have acquired from wide learning, use appropriate techniques to initiate and undertake analysis of information, to identify problems and find solutions to them. - Should display qualities and skills necessary for employment or further learning. - Should be able to communicate information effectively to specialist and wider society. - Should be able to acquire additional competencies; pursue further learning; be a change agent; assume responsibility for decision making.	The qualifications holders: - Should be able to construct and sustain arguments - Should be able to solve problems using appropriate ideas and techniques in a professional context - Should be able to demonstrate thorough and systematic understanding of core aspects of the subject of study. - Should be able to accurately use the established techniques of analysis within that discipline - Should be able to clearly communicate information, ideas, issues, problems and solutions to specialist as well as non-specialist audiences - Should be able to ready to exercise initiative, identify situations they need support from others - Should be able to prepared to carry out further training and manage own learning

Table O.2: Attributes of qualification holders from SLQF Level 7 to SLQF Level 9

SLQF Level 7 (Postgraduate Certificate)	SLQF Level 8 (Postgraduate Diploma)	SLQF Level 9 (Masters Degree By Course Work)
The qualification holders: - should be able to demonstrate clear understanding of theoretical knowledge - should display critical awareness of current issues in the subject area. - should also be able to deal with complex issues systematically and make sound judgments and communicate decisions clearly to others. - should demonstrate self-direction in tackling and solving problems and be able to plan and implement tasks in a professional manner.	The qualification holders: - should be able to demonstrate clear understanding of theoretical knowledge - should display critical awareness of current issues in the subject area - should apply techniques relevant to their professional practice/ chosen field of study. - should also be able to deal with complex issues systematically and creatively, and make sound judgments and communicate decisions clearly to others. - should demonstrate self-direction and originality in tackling and solving problems and be able to plan and implement tasks independently in a professional manner.	The qualification holders: - should be able to demonstrate thorough understanding of theoretical knowledge. - should display critical awareness of current issues in their subject area. - should apply techniques relevant to their professional practice. - should also be able to deal with complex issues systematically and creatively and make sound judgments and communicate decisions clearly to others. - should demonstrate self-direction and originality in tackling and solving problems and be able to plan and implement tasks at professional levels.

Annex P: Feedbacks of the Education Sector Actors – Stage 2, Part 2 Details of the Programmes Offered

Table P.1: The Key to Abbreviations

Main EE Areas		Learning Outcomes (LOs)		Programme Outcomes (POs)		Level of Emphasis on Targeted Competencies	
System Efficiency	SE	Given	Y	Specified	Y	High	H
Travel Efficiency	TE	Not given/No response	N	Not specified	N	Medium	M
Vehicle Efficiency	VE					Low	L
None/Not Clear	NC					None	N

Table P.2: The feedback of the educationalists – Stage 2 - Details of the Programmes Offered

#	Institute	Staff Identity	EE Area				LOs	POs	Level of Emphasis on Targeted Competencies		
			System Efficiency	Travel Efficiency	Vehicle Efficiency	None/Not Clear			Cognitive	Functional	Attitudinal
1	AETI	AM_1	N	N	Y	N	Y	N	M	H	L
2	AETI	AM_2	N	N	Y	N	Y	N	M	H	L
3	CGTTI	AM_1	N	N	Y	N	Y	Y	M	H	N
4	CINEC	SHM_1	N	N	N	Y	N	N	M	M	N
5	CleanCo	HR_1	N	N	Y	N	Y	Y	M	H	M
6	CleanCo	OP_1	N	N	Y	N	Y	Y	M	H	M
7	CleanCo	OP_2	N	N	Y	N	Y	Y	M	M	L
8	DATS	AM_1	N	N	Y	N	N	N	M	H	N
9	DPMC	FSD_1	N	N	Y	N	N	N	M	H	M
10	DPMC	TTC_1	N	N	Y	N	Y	Y	H	H	L
11	DPMC	TTC_2	N	N	Y	N	Y	Y	M	H	M
12	DPMC	TTC_3	N	N	Y	N	Y	Y	M	H	L
13	DPMC	TTC_4	N	N	Y	N	Y	Y	H	H	L
14	EcoSri	TT_1	N	N	Y	N	Y	Y	H	H	H
15	IAESL	TT_1	N	N	Y	N	Y	Y	H	H	H
16	ITUM	CET_1	N	N	N	N	N	N	N	N	N
17	ITUM	MET_1	N	N	Y	N	Y	Y	M	L	L
18	KDU	MF_1	Y	N	N	N	Y	Y	H	L	M
19	KDU	ME_1	N	N	Y	N	Y	Y	H	L	M
20	NCPC	RM_1	N	Y	N	N	Y	Y	M	M	H
21	NCPC	RM_2	N	N	Y	N	N	N	L	H	L
22	NSBM	FE_1	N	N	N	N	N	N	H	M	L
23	OUSL	ME_1	N	N	Y	N	Y	Y	H	L	L

#	Institute	Staff Identity	EE Area				LOs	POs	Level of Emphasis on Targeted Competencies		
			System Efficiency	Travel Efficiency	Vehicle Efficiency	None/Not Clear			Cognitive	Functional	Attitudinal
24	SEU	ME_1	N	N	Y	N	Y	N	M	M	N
25	SEU	ME_2	N	N	Y	N	Y	N	M	H	N
26	SLEMA	EM_1	Y	N	N	N	Y	Y	H	H	L
27	SLEMA	EM_2	Y	N	N	N	Y	Y	H	L	L
28	SLEMA	EM_3	N	N	N	N	N	N	N	N	N
29	SLIATE	ME_1	N	N	Y	N	N	Y	M	M	N
30	SLIDA	ENV_1	Y	N	N	N	N	N	H	M	H
31	SLIIT	CE_1	Y	N	N	N	N	N	H	M	H
32	SLIIT	ME_1	N	N	Y	N	Y	Y	H	M	H
33	SLIIT	ME_2	N	N	N	N	N	N	N	N	N
34	SLIIT	ME_3	N	N	N	N	N	N	N	N	N
35	SUSL	ET_1	N	N	Y	N	N	Y	M	H	M
36	TOYOTA	TD_1	N	N	Y	N	N	N	M	H	N
37	UCK	AT_1	N	N	Y	N	Y	Y	M	H	N
38	UoC	ZES_1	Y	N	N	N	Y	Y	H	H	H
39	UoJ	CE_1	N	Y	N	N	N	N	H	H	L
40	UoJ	AT_1	N	N	Y	N	Y	N	M	H	N
41	UoJ	AT_2	N	N	Y	N	Y	N	M	H	N
42	UoJ	CT_1	N	Y	N	N	N	N	H	H	N
43	UoK	ECM_1	Y	N	N	N	Y	Y	M	M	L
44	UoM	CE_1	N	Y	N	N	Y	N	H	H	L
45	UoM	CE_2	N	Y	N	N	N	N	N	N	N
46	UoM	CE_3	N	Y	N	N	Y	N	M	H	N
47	UoM	CE_4	N	Y	N	N	Y	N	M	H	N
48	UoM	ME_1	N	N	N	N	N	N	N	N	N
49	UoM	ME_2	N	N	Y	N	Y	Y	H	H	L
50	UoM	ME_3	N	N	Y	N	Y	Y	H	N	M
51	UoM	ME_4	N	N	Y	N	Y	Y	M	M	M
52	UoM	TLM_1	N	Y	N	N	Y	Y	H	M	H
53	UoM	TLM_2	Y	N	N	N	N	N	H	H	M
54	UoM	ITD_1	Y	N	N	N	Y	N	H	H	N
55	UoM	ITD_2	N	N	Y	N	N	N	H	M	H
56	UoM	TCP_1	Y	N	N	N	Y	Y	H	H	L
57	UoM	TCP_2	Y	N	N	N	Y	Y	H	H	L
58	UoP	CE_1	N	Y	N	N	Y	Y	H	H	H
59	UoP	CPE_1	N	N	N	N	N	N	N	N	N
60	UoP	CPE_2	N	N	Y	N	Y	N	M	M	L
61	UoP	ME_1	N	N	Y	N	Y	Y	M	M	M
62	UoP	ME_2	N	N	Y	N	Y	Y	H	L	N

#	Institute	Staff Identity	System Efficiency	Travel Efficiency	Vehicle Efficiency	None/Not Clear	LOs	POs	Cognitive	Functional	Attitudinal
			EE Area						Level of Emphasis on Targeted Competencies		
63	UoR	AE_1	N	N	Y	N	N	N	H	M	N
64	UoR	GT_1	Y	N	N	N	Y	Y	H	M	L
65	UoR	GT_2	Y	N	N	N	Y	Y	M	H	H
66	UoR	GT_3	N	N	Y	N	N	Y	H	M	M
67	UoR	GT_4	Y	N	N	N	Y	Y	H	M	L
68	UoR	CEE_1	Y	N	N	N	Y	Y	H	M	N
69	UoR	CEE_2	Y	N	N	N	Y	N	H	M	H
70	UoR	MEE_1	N	N	N	N	N	N	H	M	H
71	UoR	MEE_2	N	N	Y	N	Y	Y	H	H	H
72	UoR	MEE_3	Y	N	N	N	Y	Y	H	L	L
73	UoR	BST_1	N	N	N	N	Y	Y	H	M	L
74	UoR	ET_1	Y	N	N	N	N	N	H	M	L
75	UoVT	FET_1	N	N	Y	N	Y	Y	M	M	L
76	UoVT	FET_2	N	N	Y	N	Y	Y	M	M	L
77	USJP	FES_1	Y	N	N	N	Y	N	M	N	M
78	USJP	FES_2	Y	N	N	N	N	N	H	M	H
79	UWU	ET_1	N	N	Y	N	N	Y	M	H	N
80	WUSL	MMT_1	N	N	Y	N	Y	N	H	M	L
81	WUSL	MMT_2	N	N	Y	N	N	N	H	H	N

Annex Q: Recommendations of Educational Specialists – Competencies

Table Q.1: The Key to Abbreviations

Competencies							Competencies	
Cognitive		**Cognitive**		**Cognitive**		High		H
Information	INF	Anticipatory	ANT	Normative	NOM	Medium		M
Systems thinking	SYT	Strategic	STR	Collaboration	COL	Low		L
Critical thinking	CRT	Integrated problem-solving	IPS	Self-awareness	SAW	None		N

Table Q.2: The feedback of the education specialists – Competencies in technical certificate courses

#	Respondent	Technical Certificate								
		Cognitive			**Functional**			**Attitudinal**		
		INF	SYT	CRT	INF	SYT	CRT	INF	SYT	CRT
1	ES_1	H	M	L	L	L	L	H	H	H
2	ES_2	L	L	N	L	N	N	N	M	M
3	ES_3	M	L	N	L	N	N	L	L	M
4	ES_4	M	L	L	L	N	N	M	M	M
5	ES_5	M	L	L	L	L	L	H	H	H
6	ES_6	L	H	L	M	L	N	H	M	H
7	ES_7	M	N	L	N	L	L	N	L	M
8	ES_8	M	L	L	L	L	L	H	H	H
9	ES_9	H	M	L	M	L	N	H	M	L

Table Q.3: The feedback of the education specialists – Competencies in technical diplomas

#	Respondent	Technical Certificate								
		Cognitive			**Functional**			**Attitudinal**		
		INF	SYT	CRT	INF	SYT	CRT	INF	SYT	CRT
1	ES_1	H	M	L	L	L	L	H	H	H
2	ES_2	M	L	N	M	L	N	L	M	H
3	ES_3	M	M	L	L	L	N	L	M	M
4	ES_4	M	M	M	L	L	L	M	M	H
5	ES_5	H	M	L	L	L	L	H	H	H
6	ES_6	M	H	M	M	M	N	M	M	H
7	ES_7	H	N	L	L	L	M	L	M	H
8	ES_8	H	L	L	M	M	M	H	H	H
9	ES_9	H	M	L	H	M	L	H	M	L

Table Q.4: The feedback of the education specialists – Competencies in undergraduate degree programmes

#	Respondent	Technical Certificate								
		Cognitive			Functional			Attitudinal		
		INF	SYT	CRT	INF	SYT	CRT	INF	SYT	CRT
1	ES_1	H	H	M	M	M	H	H	H	H
2	ES_2	H	H	M	H	M	M	M	H	H
3	ES_3	H	H	H	M	H	H	H	H	H
4	ES_4	H	H	H	M	M	M	M	H	H
5	ES_5	H	H	H	M	M	H	H	H	H
6	ES_6	H	H	M	H	H	M	M	H	H
7	ES_7	H	M	L	M	M	H	M	H	H
8	ES_8	H	M	M	H	H	M	H	H	H
9	ES_9	H	H	M	H	M	M	H	H	M

Table Q.5: The feedback of the education specialists – Competencies in postgraduate degree programmes

#	Respondent	Technical Certificate								
		Cognitive			Functional			Attitudinal		
		INF	SYT	CRT	INF	SYT	CRT	INF	SYT	CRT
1	ES_1	`	H	H	H	H	H	H	H	H
2	ES_2	M	H	H	M	H	H	H	H	H
3	ES_3	H	H	H	H	H	H	H	H	H
4	ES_4	H	H	H	H	H	H	H	H	H
5	ES_5	H	H	H	H	H	H	H	H	H
6	ES_6	L	H	H	L	M	H	L	L	H
7	ES_7	M	H	M	H	H	H	H	H	L
8	ES_8	H	H	H	H	H	H	H	H	H
9	ES_9	H	H	M	H	H	H	H	H	H

Table Q.6: The feedback of the education specialists – Competencies in professional courses

#	Respondent	Technical Certificate								
		Cognitive			Functional			Attitudinal		
		INF	SYT	CRT	INF	SYT	CRT	INF	SYT	CRT
1	ES_1	H	H	H	H	H	M	H	H	H
2	ES_2	M	H	M	M	H	H	M	M	M
3	ES_3	H	H	H	H	H	H	H	H	H
4	ES_4	H	H	H	H	H	H	H	H	H
5	ES_5	H	H	H	H	H	H	H	H	H
6	ES_6	M	H	M	N	L	M	H	H	H
7	ES_7	M	M	M	H	H	M	H	H	L
8	ES_8	H	H	H	H	H	H	H	H	H
9	ES_9	H	M	M	M	M	M	M	M	L

Annex R: Recommendations Of Educational Specialists – Energy Efficiency Areas

Table R.1: The Key to Abbreviations

EE Area		Levels of Importance	
		High	H
System Efficiency	SE	Medium	M
Trip Efficiency	TE	Low	L
Vehicle Efficiency	VE	None	N

Table R.2: The feedback of the education specialists – Energy efficiency area in educational programmes

#	Respondent	Technical Certificate			Technical Diploma			Undergraduate Degree			Postgraduate Degree			Professional Courses		
		SE	TE	VE	SE	TE	VE	SE	TE	VE	SE	TE	VE	SE	TE	VE
1	ES_1	M	M	H	M	M	H	H	M	H	H	H	M	H	H	M
2	ES_2	N	L	H	L	M	H	M	H	M	H	H	L	M	M	L
3	ES_3	M	M	L	H	H	M	H	H	H	H	H	H	H	H	H
4	ES_4	L	M	M	M	M	M	H	H	H	H	H	H	H	H	H
5	ES_5	M	M	M	H	H	H	H	H	H	H	H	H	H	H	H
6	ES_6	M	H	L	M	H	M	H	H	H	M	H	M	H	H	M
7	ES_7	N	L	L	L	M	M	M	H	H	M	H	H	H	M	M
8	ES_8	H	H	L	H	H	M	H	M	H	H	M	H	H	M	H
9	ES_9	M	M	H	H	H	H	H	H	H	H	H	H	M	M	M

Energy Efficiency Skills strengthen the capacity necessary for implementation in developing countries, including the creation and promotion of the skills necessary at the local level to design and execute technically and financially sound energy efficiency projects.

As a means of supporting the energy transition of developing economies and accelerating project implementation; this project is part of the Copenhagen Center for Energy Efficiency efforts to develop local skills and knowledge among energy efficiency-related professionals, to enhance skills for faster, higher quality and more effective energy efficiency implementation.

This report was developed with the Ceylon Chamber of Commerce support and performed a contextual assessment of the skills and knowledge gaps between professionals working in the energy efficiency sector (transport) and in educational programs that train these professionals. In this way, skills and knowledge gaps are identified, and the way is opened for future improvement opportunities that favour the expansion of Energy Efficiency in the Transport Sector in Sri Lanka.

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