Fiscal Policy Options with the Use of Fuel Economy Policy Implementation Tool (FEPIT) in Nepal

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ACRONYMS

BEV	Battery Electric Vehicle
CAFÉ	Corporate Average Fuel Economy
CEVS	Carbon Emission Based Vehicle Scheme
CO_2	Carbon Dioxide
COP	Conference of Parties
DOC	Department of Custom
DOTM	Department of Transport Management
EPA	Environment Protection Agency
EU	European Union
EV	Electric Vehicles
FE	Fuel Economy
FEPIT	Fuel Economy Policy Implementation Tool
GFEI	Global Fuel Economic Initiatives
GGI	Global Green Growth Institute
GHG	Greenhouse Gas
GoN	Government of Nepal
HEPS	High Efficiency Performance Standards
ICE	Internal Combustion Engine
ICIMOD	International Centre for Integrated Mountain Development
IEA	International Energy Agency
LDVs	Light-Duty Vehicles
Lge	Litre Gasoline Equivalent
LPG	Liquefied Petroleum Gas
MEPS	Minimum Efficiency Performance Standards
MY	Model Year
NDC	Nationally Determined Contributions
NEDC	New European Driving Cycle
NHTSA	National Highway Traffic Safety Administration
NOC	Nepal Oil Corporation
OECD	Organisation for Economic Co-operation and Development
PHEVs	Plug in Hybrid Electric Vehicles
SEMARNAT	Secretaria de Medio Ambiente y Recursos Naturales
SLCPs	Short-Lived Climate Pollutants
SLVET	Sri Lanka Vehicle Emissions Test
VES	Vehicular Emission Scheme

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EXECUTIVE SUMMARY

Global climate is changing faster than at any time since the rise of human civilization and it is challenging society to adapt to those changes. The current dependence on fossil fuels, if continued, will increase atmospheric greenhouse gas emissions, which have a detrimental effect on climate change. Transport generates a large and growing share of anthropogenic greenhouse gas emissions, and therefore, enforceable and robust policies are needed in order to mitigate transport-based emissions. In Nepal, the unmanaged transport sector and fuel energy-related GHG emissions are the leading causes of deteriorating air quality. In the present context, it has become very essential to develop its fuel economy standards or undertake fiscal policy measures to improve FE and reduce fuel-related CO_2 emissions in line with the targets from GFEI. Baseline study of the newly registered LDVs in Nepal from 2005 to 2016 showed that the fuel economy of Nepal was 6.98 Lge/100km in 2005 and was enhanced to 5.90 Lge/100 km in 2016 at an improvement rate of 1.9% per annum. The annual average CO_2 emission was 159 g/km in 2005, and it went down to 140 g/km in 2016.

In order to analyse different fiscal policy options, the baseline data inputs of 2014 and 2016 were used in the Fuel Economy Policy Implementation Tool (FEPIT) developed by IEA to develop various scenarios and to assess the impact of policy measures such as GFEI fuel economy target, CO_2- based vehicle registration tax, CO_2- based vehicle circulation tax, and fuel taxation from 2016 to 2030. The major three outputs of the FEPIT model are new registration composition of LDVs, average fuel economy of the new registration, and average CO_2 emissions per km. There were various scenarios developed but the impact assessment of two scenarios – Baseline Trend Scenario and Combined User-Defined Scenario with the recent fiscal measure of Road Construction Fee at the time of new registration of LDVs were analysed (Table *1*).

Table 1 Impact Assessment of FEPIT

Policy Scenarios	GFEI targetLge/100 km	User defined target Lge/100 km
Base year (2016)	5.90	5.90
Projection year - combined policy scenario (2030)	3.03	3.28
Projection year - Baseline trend (2030)	5.12	5.12
	CO_2 emission g/km	CO_2 emission g/km
Base year (2016)	139.85	139.85
Projection year - combined policy scenario (2030)	71.96	77.78
Projection year - Baseline trend (2030)	121.39	121.39

In the Combined User- Defined Scenario with the imposition of Road Construction fee at the registration time of new LDVs, fuel economy would be 3.28 Lge/100 km in 2030, which would be 44% lower than the fuel economy of 5.90 Lge/100 km in 2016. It is 36% lower than fuel economy of 5.12 Lge/100 km in 2030 in the baseline trend scenario. Average CO_2 emissions

in the Combined User-Defined Scenario would be 78 g/km in 2030, which is highly lower than emission of 140 g/km in 2016. It is also significantly lower than 121 g/km of Baseline Trend Scenario in 2030. A fiscal policy such as emission-related Road Construction fee at the time of registration introduced from 2019 would have a positive impact on fuel economy and CO_2 emissions of the new LDVs.

BEVs are insignificant in Nepal's vehicle markets, but consumers' interests are growing at a rapid pace. Hence, outside FEPIT, it was also analyzed if BEVs occupy 30% share in newly registered LDVs in 2030. This assumption is in line with the proposed strategic plan for Electric mobility in Province 3 of Nepal and the 30@30 scenario of IEA for scaling up of global electric mobility. It showed that the weighted average fuel economy of newly registered LDVs will be 3.72 Lge/100km in 2030, which is lower than 5.12 Lge/100 km of the Baseline trend scenario in 2030. Nepal's focus on fuel economy and reduction of emissions related fiscal policy measures is in a positive direction and would help in achieving GFEI's FE target in 2030.

CHAPTER 1: INTRODUCTION

1.1 Background

Climate change has become a major challenge in the world. In total, carbon dioxide (CO2) emissions from the transport sector contribute 23% in the world in 2010 with urban transport accounting for almost 40% of end-use energy consumption (Sims et al., 2014). According to GCP (2018), the total carbon dioxide emissions from fossil fuels and industry in the world rose by 1.6 percent in 2017 to 36.2 gigatonnes of CO_2. Furthermore, the Global Carbon Project presumes that this number is projected to climb to a record of 37.1 gigatonnes CO_2 in 2018.

To significantly reduce fuel carbon emission, the energy intensity of transport modes, and to encourage travel by the most efficient modes, policy intervention is required. Because automobiles and their supporting infrastructure impact the environment in numerous ways, a wide array of environmental policies and strategies has been employed in different circumstances to restrain private LDV use, promote mass transit modes, manage traffic congestion and promote new fuels in order to reduce fossil fuel use, air pollution, and GHG emissions.

Transport generates a large and growing share of anthropogenic greenhouse gas emissions, and therefore, enforceable and robust policies are needed in order to mitigate transport-based emissions. In Nepal, the unmanaged transport sector and fuel energy-related GHG emissions are the leading causes of deteriorating air quality. The total GHG emission from the transport sector was 2.74 million metric tons in 2015, which accounted for 26% of the total energy-related GHG emissions in the country (ICIMOD, 2017). Nepal imports fuels and vehicles, mostly from India. Nepal has not developed its roadmap for fuel quality standards and as such, follows emissions standards and fuel quality standards of India. In this context, it has become very imperative to develop its fuel economy standards or undertake fiscal policy measures to improve FE and reduce fuel-related CO_2 emissions in line with the targets from GFEI. This current study tries to focus on the assessment of FE policies by use of the Fuel Economy Policies Implementation Tool (FEPIT) from the base year 2016 to 2030. Regarding battery electric vehicle (BEV), since the number of BEVs in 2016 is insignificant and penetration of BEVs in the Nepal automotive markets may significantly increase. Hence, future prospective penetration of BEVs is separately investigated outside the FEPIT model.

1.2 Fuel Economy and Emissions Policies in the World

1.2.1 Fuel Economy and emission policies in the developed world and developing Countries

Fuel consumption trend in developed countries shows a decreasing trend compared to that of other developing countries due to the shift in electric mobility as well as fuel-efficient technologies (GEFI, 2013). The world average fuel economy in 2005 was 8.8 Lge/100km and has improved to 7.2 Lge/100km in 2017 at an annual improvement rate of 1.7%. However, the required improvement rate is 2.8% to achieve the GFEI target. GFEI has set the target to improve the fuel efficiency of light-duty vehicles fuel economy by 50% for all the new vehicles by 2030 from the 2005 baseline level (GFEI, 2019). It sets the global average target of 4.4 Lge/100 km by 2030. The fuel economy of emerging economies countries was 8.6 Lge/100 km in 2005 and enhanced to 7.5 Lge/100 km in 2017, with an improvement rate of 1.2% per annum.

Though there are growing trends in fuel economy improvement in both the developed and the developing countries, the trend in most of the countries indicates that policy intervention is essential to meet the GFEI targets by 2030 and 2050 for meeting the FE targets and reducing the CO_2 emissions.

i. United States

The United States has federal standards for regulating fuel economy and greenhouse gas emission (GHG). A Corporate Average Fuel Economy (CAFE) standard is promulgated by the U.S. Department of Transportation´s National Highway Traffic Safety Administration (NHTSA) for regulating fuel economy. The current phase (Second phase) of Model Year (MY) 2017-2025, CAFÉ, and GHG emissions were promulgated on 15 October 2012 (Lattanzio, Canis, & Tsang, 2019). The manufacturers agreed to reduce GHG emissions from new passenger cars and light trucks by about 50% by 2025, compared to 2010, with fleet-wide average fuel economy rising nearly 50 miles under the agreement. After President Donald Trump took office on 14 March 2017, EPA and NHTSA announced their joint intention to reconsider their earlier determination. On 02 April 2018, EPA released a revised final determination of the MY 2022-2025, which they had termed as inappropriate and too stringent. While fuel economy, rated in miles per gallon achieved, has risen from 13 mpg to 25 mpg under the CAFÉ standards (i.e., since 1978), the program is only one of many possible policy options that could conserve fuel and reduce GHG emissions. Similarly, in addition to a federally mandated performance standard, some state and local governments have proposed or promulgated policies to serve similar ends (Lattanzio et al., 2019).

ii. European Union (EU)

The European Union has adopted the world's most progressive fuel economy standard. It is easy to meet tighter standards as Europe has high fuel taxes and a high baseline fuel economy of small cars and more fuel-efficient diesel engines (Anderson, Parry, Sallee, & Fischer, 2011).

The EU regulation has set binding carbon dioxide (CO_2) emission targets for new passenger cars and light commercial vehicles for 2025 and 2030, respectively. The agreed-upon targets on 17 December 2018 aim to reduce the average CO_2 emissions from new cars by 15% in 2025 and by 37.5% in 2030, both relative to a 2021 baseline (ICCT, 2019a). With this new regulation, the EU becomes the only market worldwide to have set mandatory new car CO_2 targets up to the year 2030. For the year 2030, the EU has set a CO_2 target of approximately 59 g/km. The test cycles (i.e., vehicle running patterns) used in Europe are the New European Driving Cycle (NEDC).

The next stage of emission standard on Post-Euro 6 standards has already started the regulatory work in Europe, which aims to continue to improve the emissions performance of new road vehicles, addressing their contribution to the persistent air quality issues across Europe (ICCT, 2019c).

iii. Japan

Japan has recently announced a new fuel economy standard in June 2019 for passenger vehicles. These new fuel economy standards aim to improve fuel efficiency by 32.4 percent by 2030, compared with 19.2 km/L of 2016 levels (ICCT, 2019b). It means new standards require an average fleet of gasoline-equivalent fuel gasoline-equivalent fuel economy 25.4 Km/L by the year 2030. For the first time in Japan fuel economy standards, these new 2030 standards have covered battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), including gasoline, diesel, and liquefied petroleum gas (LPG) vehicles that were included in the 2020 standards. The 2030 standards also follow the methodology called the top –runner concepts used in the 2020 standards.

iv. Canada

Canada is expected to continue its alignment with the US in adopting Phase 2 vehicle efficiency standards in LDVs. It has already implemented world-class emissions standards in the process of phasing in more stringent Tier 3 emissions standards (tailpipe) for light-duty vehicles (Miller, Du, & Kodjak, 2017).

v. Australia

Australia has not yet adopted an LDV efficiency standard but is actively exploring this pathway. Australia has implemented tailpipe emission standards roughly equivalent to Euro 5/V, and the government has been exploring pathways to Euro 6/VI equivalent standards, too (Miller et al., 2017).

vi. China

China sets maximum fuel consumption standards for each vehicle, based on weight rather than average fleet-wide standards. China announced all-new light-duty vehicles to comply with the requirements of phase 6a from 2020 and phase 6b from 2023. China 6 standard is similar to the Euro 6 regulation (DieselNet, 2019).

vii. Other countries

Brazil has implemented tailpipe emission standards roughly equivalent to Euro 5/V. Mexican emissions requirements for new vehicles and engines are adopted by the Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT). Current standards are NOM-042-SEMARNAT-2003, which is a mix of US Tier 1 and 2 and Euro 3 and 4 Standards. It has been in effect since 2004 (TransportPolicy.net, 2019a). Russia has been adopting Euro V standards for light-duty vehicles since 2016. Russia follows European standards of vehicles and tailpipe emission standards (TransportPolicy.net, 2019b).

1.2.2 Fuel Economy and emissions policies in South East Asian Countries

In recent decades, growth in emissions of carbon dioxide has been more rapid in South East Asia than in any other area of the world. The average LDV fuel consumption was about 7.2 liters of gasoline-equivalent LGe/100km in 2015 across Thailand, Indonesia, Malaysia, the Philippines, and Singapore, slightly higher than the world average of 7.0 LGe/100km. The average across the Organisation for Economic Co-operation and Development (OECD) countries is about 6.8 LGe/100km. It indicates that in the long run, there is adequate technology to significantly improve the efficiency of vehicles.

Singapore introduced the Carbon Emission Based Vehicle Scheme (CEVS) in 2013 to tax vehicles based on their carbon emission, but in 2018 transitioned to a new mechanism- the Vehicular Emissions Scheme (VES). The VES assesses vehicles based on CO_2 emissions, also assesses them based on hydrocarbon, carbon monoxide, nitrogen oxides, and particulate matter emissions to calculate rebates and surcharges (NEA, 2018).

Thailand does not have fuel economy standards in place but is currently developing them. Since 2015, consumer labeling for fuel consumption has been required which provides other indicators such as the pollutant emission class. A tax incentive for the production of "eco-vehicles" was established in 2009, offering reduced excise taxes (10-14% instead of 30-40%) for vehicles complying with specific requirements (RVO, 2016). The registration tax for new vehicles has been based on CO_2 emissions since 2016. It has also introduced voluntary Minimum Efficiency Performance Standards (MEPS) and High-Efficiency Performance Standards (HEPS). Indonesia and Malaysia provide tax incentives for the domestic production of fuel-efficient cars but not for consumers. These schemes are geared towards industry development, rather than the objective of reducing fuel consumption.

In Vietnam, voluntary fuel consumption limits were introduced for two-wheelers and passenger cars in 2013 (Tacderas, 2015). When compared, the voluntary standards in Thailand and Vietnam to the mandatory standard in the European Union it is evident that both the Vietnamese fuel consumption standard, as well as the Thai MEPS and HEPS, are much less stringent than the EU CO_2 emissions standard. The Vietnamese standards, as well as the Thai MEPS, allow fuel consumption to be about twice as high as the European limits for a specific weight interval.

1.2.3 Fuel Economy and emissions policies in South Asian Countries

South Asian countries depend on fuel imports, and fuel prices are volatile. There is an enormous state subsidy on fuels, putting pressure on national budgets. Without reliable and effective emission standards, there will be higher impacts of air pollution on climate change. The government of India decided to move directly from BS-IV to BS-VI from April 2020. In September 2016, India finalized Bharat VI standards for light- and heavy-duty vehicles (DieselNet, 2019). In Bangladesh, as per Bangladesh's Roads and Highways Department, emissions standard for light-duty diesel vehicles was Euro I, with a proposed move to Euro II in 2018, and Euro III by 2020. In Sri Lanka, SLVET program was developed and implemented throughout the country to control emissions from mobile sources. It was effective from 2008. The test procedures employed are no-load idle and fast-idle test for gasoline vehicles and snap acceleration test for diesel vehicles. Energy efficiency or fuel economy in the transport sector has not specific regulation yet (Sugathapala, 2015). As per Sri Lanka's Petroleum Resources Development, the Euro 4 emissions standard Diesel and Petrol have been produced.

1.3 Fuel Economy and Emissions trend in Nepal as per the Baseline study

The average fuel economy of light-duty vehicles in emerging countries falls between 6.5 to 8.5 Lge/100km, whereas India has the lowest fuel consumption of 5.6 Lge/100km (IEA, 2019) and an average CO_2 emission of 121 g/km (ICCT, 2018). The present analysis of the fuel economy of Nepal is lower than the world average fuel economy. Since Nepal imports most of the vehicles and fuel from India, and most of them are of small capacity, the average fuel economy of Nepal is also comparatively lower than the world average. The estimated average fuel economy of Nepal is 5.89 Lge/100km[1], and CO_2 emission 137 g/km in 2016. The lower fuel economy value is primarily due to the use of lower capacity vehicles.

The world average fuel economy in 2005 was 8.8 Lge/100km and has improved to 7.2 Lge/100km in 2017 at an annual improvement rate of 1.7%. However, the required improvement rate is 2.8% to achieve the GFEI target. GFEI has set the target to improve the fuel efficiency of light-duty vehicles fuel economy by 50% for all the new vehicles by 2030 from the 2005 baseline (GFEI, 2019). It sets the target of 4.4 Lge/100 km by 2030. The fuel economy of emerging countries was 8.6 in 2005 and enhanced to 7.5 in 2017 at an improvement rate of 1.2% per annum. However, the fuel economy of Nepal was 6.98 Lge/100km in 2005 and enhanced to 5.89 Lge/100km in 2016 at the improvement rate of 1.9% per annum. At this rate, the fuel economy of Nepal will be 4.45 Lge/100 km by 2030, which almost meets the GFEI standard. Since the automobile market in Nepal depends upon the international markets, mainly the Indian market, the fuel economy is prone to fluctuate based on imported vehicles.

1 Average FE value of 5.89 Lge/100 km was obtained in 2016 using 2014 as past year in FEPIT and this value slightly differs from the calculated value of 5.81 Lge/100 km in 2016 from the actual data in the Baseline study.

1.4 Objective

The principal purpose of this study is to develop a baseline scenario with the current trend in improvement in fuel economy of LDVs and to develop policy scenarios with the changes in fiscal policies such as changes in registration tax, and possible market entry of battery electric vehicles (BEV) in the Nepal automobile market using FEPIT with the target year of 2030. Besides, the study also investigates the other various fiscal policies for the improvement of FE and reduction of CO_2 emissions in order to meet the GFEI targets by 2030.

CHAPTER 2: METHODOLOGY

2.1 Methodology of Fuel Economy Policies Implementation Tool (FEPIT)

FEPIT is an excel based policy analysis tool. The objective of FEPIT is to estimate the impact of various policy measures on the fuel economy. The output of the tool is based on input data provided by the users and on several elasticities based on literature data. However, the results from FEPIT is used to study the magnitude of the impact of policy measures rather than exact forecasts.

Moreover, FEPIT focuses mainly on short and medium-term policies. The initial data for the base year and the representative past year provided to the tool forms the initial assumption. Most of the analysis is then carried out based on this given initial condition. So, if there are significant changes in this condition, there arises the problem of the validity of FEPIT projections (GFEI, 2015).

2.2 Policy measures covered by FEPIT

FEPIT covered following four policy options to assess the impact on fuel economy

- GFEI fuel economy target
- CO_2- based vehicle registration tax
- CO_2- based vehicle circulation tax
- Fuel taxation

2.2.1 GFEI fuel economy target

GFEI has set the global average fuel economy target to reduce LDVs' fuel consumption by 30% in 2020 and 50% by 2030 through the improvement of fuel economy and vehicle technologies (IEA, 2019). The target is to improve the fuel efficiency of all new LDVs by 50% by 2030 and all vehicles by 2050, preferably known as "50 by 50" campaign compared to the 2005 baseline levels. The GFEI targets to double the efficiency of all new vehicles from 8.8 Lge/100 km in 2005 to 4.2 Lge/100 km in 2030. The corresponding drop in CO2 emissions from an average of 180 g/km to 90 g/km (GFEI, 2018). The required annual improvement rate to achieve this target is -3.1% from the 2005 baseline. The policy options in FEPIT allow fuel economy to match the GFEI fuel economy target of 2030, by considering the corresponding GFEI average global improvement rate. It also estimates the fuel economy based on the average of GFEI global target and GFEI average global improvement rate and user defined fuel conomy.The methodology followed is as per FEPIT user guide (GFEI, 2015).

2.2.2 CO_2- based vehicle registration tax

The registration tax of the vehicle is the fee paid for the vehicle before it enters the market for the first time. The vehicle registration tax is calibrated based on the specific fuel consumption of the vehicle. FEPIT also provides the rebate options for the vehicles having fuel consumption levels below the threshold. It assumes that all vehicles under each category of fuel consumption pay the same registration tax. As per the Department of Transport Management of Government of Nepal, the registration tax was same for all the vehicles imported irrespective of its engine capacity till 2018. So in base year 2016, the constant registration tax of $7 is provided baseline input data and assumed to remain same throughout the analysis period. Since registration tax is paid once at the time of vehicle registration, the registration tax remains zero in measure 2 of projection input in FEPIT.

However, the government recently imposed a new registration tax system as road construction fees in the Fiscal Year 2019-20. The new system imposed the registration tax based on engine capacity. The registration tax for vehicles with an engine capacity lower than 2,000 cc is imposed with 8% of its vehicle price, and vehicles with engine capacity higher than 2,000 cc is imposed with 10% of its vehicle price (DOTM, 2019a). Since this new registration tax is imposed from FY 2019-2020, after the base year 2016, the impact of this new system is analyzed as a separate scenario in FEPIT. So to see the impact of this new registration tax, measure 2 of projection input in FEPIT is activated, and the results are analyzed.

2.2.3 CO_2- based vehicle circulation tax

The circulation tax is an annual fee paid by each registered vehicle irrespective of its use or unused. FEPIT considers the circulation tax based on the fuel economy of the vehicle. However, in Nepal, the tax is based on engine capacity. Thus, the circulation tax is calibrated based on fuel economy at first. FEPIT also provides the policy option to rebated the fee to the vehicles below the threshold value. The circulation tax is as per the 2019 tax basis set by the Nepal government. Since it is annually paid fee, over time, the value may change. However, the analysis limits itself to the starting value given at the time of calculation.

2.2.4 Fuel Taxation

Fuel taxes are duties paid on the quantity of fuel purchased. Since there is no fuel tax, the average pump price of the vehicle and the share of fuel composition of registered vehicles are the only input in FEPIT in this segment of the tool.

2.3 Structure of FEPIT

2.3.1 Baseline Input

The base year is 2016, in which all the initial data refer. The past year used is 2014, in which all the past data refer. The vehicle composition of all the registered vehicles for both base year and the representative past year is given as baseline input in the tool. Also, the fuel consumption thresholds that the tool will use to identify different segments of registered vehicles are given. The initial and past year data are based on the baseline study of the fuel economy of LDVs of Nepal submitted to UNEP in 2019. The vehicle composition, according to the fuel economy for 2016, is as shown in Table 2.

Table 2 Vehicle composition according to fuel economy in 2016

Fuel Economy lge/100km in 2016	Vehicle composition
ICE < 4.0	1%
ICE 4 -5.0	32%
ICE 5-6.0	28%
ICE 6-7.0	15%
ICE >7.0	24%
Fuel Economy lge/100km in 2014	**Vehicle composition**
ICE < 4.0	0.1%
ICE 4 -5.0	25.4%
ICE 5-6.0	23.8%
ICE 6-7.0	14.0%
ICE >7.0	36.6%

The average fuel economy of the newly registered vehicles for each segment for the base year and the past year is also included in baseline input in the FEPIT tool. The average fuel economy of the newly registered vehicles for the base year and the representative past year is as shown in Table 3.

Table 3 Average fuel economy of vehicles in each fuel economy segment in 2016 and 2014 (Lge/100 km)

Fuel Economy lge/100km in 2016	Average fuel economy
ICE < 4.0	3.85
ICE 4 -5.0	4.44
ICE 5-6.0	5.48
ICE 6-7.0	6.47
ICE >7.0	8.05
Fuel Economy lge/100km in 2014	**Average fuel economy**
ICE < 4.0	3.36
ICE 4 -5.0	4.63
ICE 5-6.0	5.35
ICE 6-7.0	6.22
ICE >7.0	7.88

The information provided in the representative past year is used by the FEPIT to estimate an endogenous baseline trend for the fuel economy of each segment. It is an optional data provided to the tool. Otherwise, the tool will assume a constant fuel economy throughout the period.

The average registration tax and circulation tax for each segment are estimated based on documents provided by the Department of Transport Management (DOTM). The registration tax for vehicles is Rs. 800 for all the vehicles as obtained from DOTM. The circulation tax is as shown in Table 4. Both the taxes are based in the Year 2016 are converted into USD.

Table 4 Average circulation tax in each fuel economy segment as per the existing rate (USD)

Fuel Economy lge/100km in 2016	Average circulation tax
ICE < 4.0	170.08
ICE 4 -5.0	170.08
ICE 5-6.0	196.62
ICE 6-7.0	316.33
ICE >7.0	489.85

The fuel prices at the pump for gasoline and diesel are obtained from the pump stations. The average price is then calculated based on the weighted average of the fuel composition shares of each fuel consumed by the registered vehicles under consideration. The average fuel price is $0.86/litre in Nepal. There is no fuel tax on the pump price. All the taxes are included at the customs entry points (the prices include customs, VAT, infrastructure development tax, road maintenance and repair charges, and pollution taxes). Finally, the split of newly registered vehicles between gasoline and diesel is provided to estimate the CO2 emissions level corresponding to the average fuel economy of the newly registered vehicles. Gasoline composes 68% of total fuel share in new registration of the vehicles, and the rest are diesel vehicles.

2.3.2 Projection Input

The year 2030 is chosen as the projection year for which all the results are evaluated. The impact on policies is analyzed based on changes compared to the baseline conditions provided in the base year. The targeted policy options, as in baseline input, are selected for projection input as well. Four policy alternatives of average fuel economy are analyzed in scenarios.

GFEI global target on average fuel economy chooses 4.2 lge/100km as a target fuel economy in 2030 with an annual average improvement rate of -3.1%. In the third policy option, an average between GFEI global fuel economy target and global improvement rate is assumed for projecting fuel economy to 2030. In the user-defined policy option, the annual improvement rate of -1.8% is used as per the baseline study of the fuel economy of LDVs in Nepal.

CO_2-based vehicle registration tax and CO_2-based vehicle circulation tax, as described in baseline input are provided as an input. For fuel taxation, the average fuel price increment of 9% is used based on historical data of NOC prices.

The composition of the new vehicle registration trend in a future year is determined by different alternatives selected. The alternatives are the endogenous changing composition of new vehicle registration based on past trend, constant base year composition, exogenous changing composition: faster development, and slower development. FEPIT also considers the fuel consumption for emission projection. The alternatives provided are endogenously changing fuel consumption according to past trend, constant base year fuel consumption, exogenous changing fuel composition: faster and slower development. In this study, the endogenous changing composition of new registration according to past trend and endogenous changing fuel consumption of new registration according to the past trend is activated for projecting vehicle composition in projection year.

Based on the baseline inputs and policy options chosen for projections, results are analyzed. There are three significant outputs obtained from FEPIT.

- New registration composition
- Average fuel economy of the new registration
- Average CO_2 emissions per km

2.4 Baseline Scenario

2.4.1 New registration composition in 2030

The new vehicle composition in the baseline scenario based on the endogenous changing composition of new registration according to the past trend is as shown in Figure 1. It shows that vehicle category with fuel economy (FE) greater than 7 lge/100km threshold gradually decreases, and correspondingly registration of the vehicle with FE lower than 4 lge/100km is observed over 20 years. Results show that new vehicles with FE 4-6 lge/100km dominate the auto market.

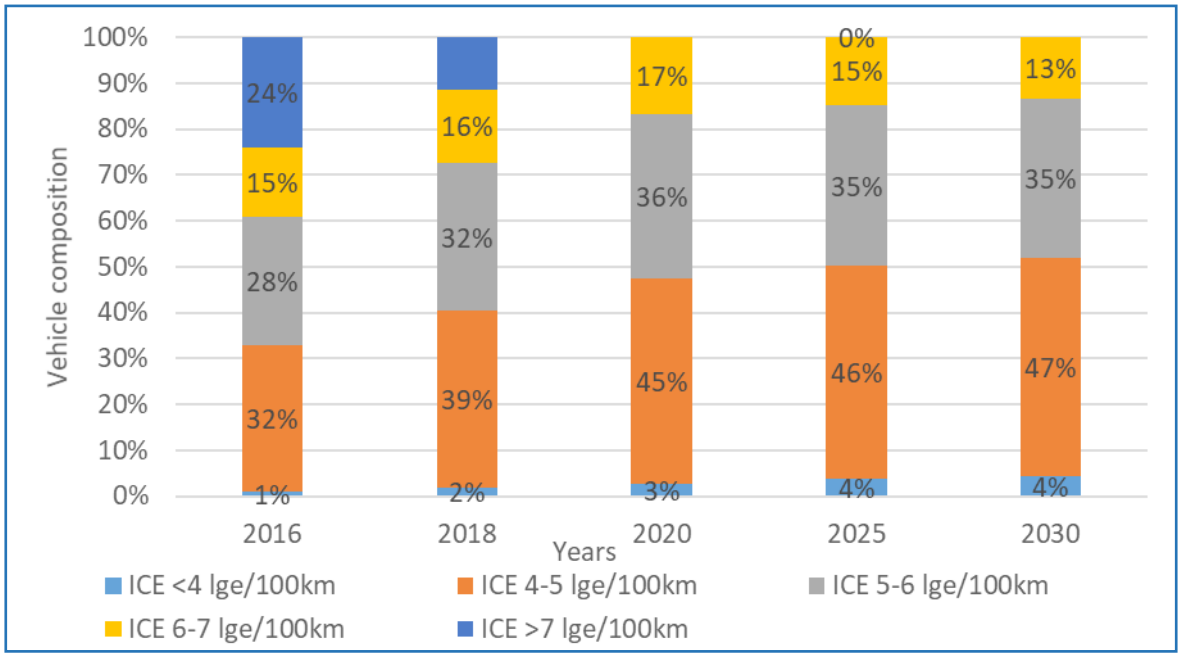

Figure 1 New vehicle composition in the baseline scenario

2.4.2 Baseline average fuel economy of new registration in 2030

According to the baseline fuel economy input in the base year and the past year, the fuel economy of new registration is estimated up to 2030, as shown in Figure 2. The fuel economy improved from 5.9 Lge/100km to 5.1 Lge/100km based on past trends. There is an improvement of -0.8% in fuel economy in the baseline scenario when no policy intervention is done. As per the GFEI target, the fuel economy should improve by 50% from the 2005 baseline, or the target value should be 4.2 Lge/100km. The fuel economy value in 2030 is still 22% higher than the GFEI target value. It is evident that in order to reduce fuel consumption and reduce dependence on imported petroleum fuels for transport, it is crucial to make initiatives in improving fuel economy through various plans and policies.

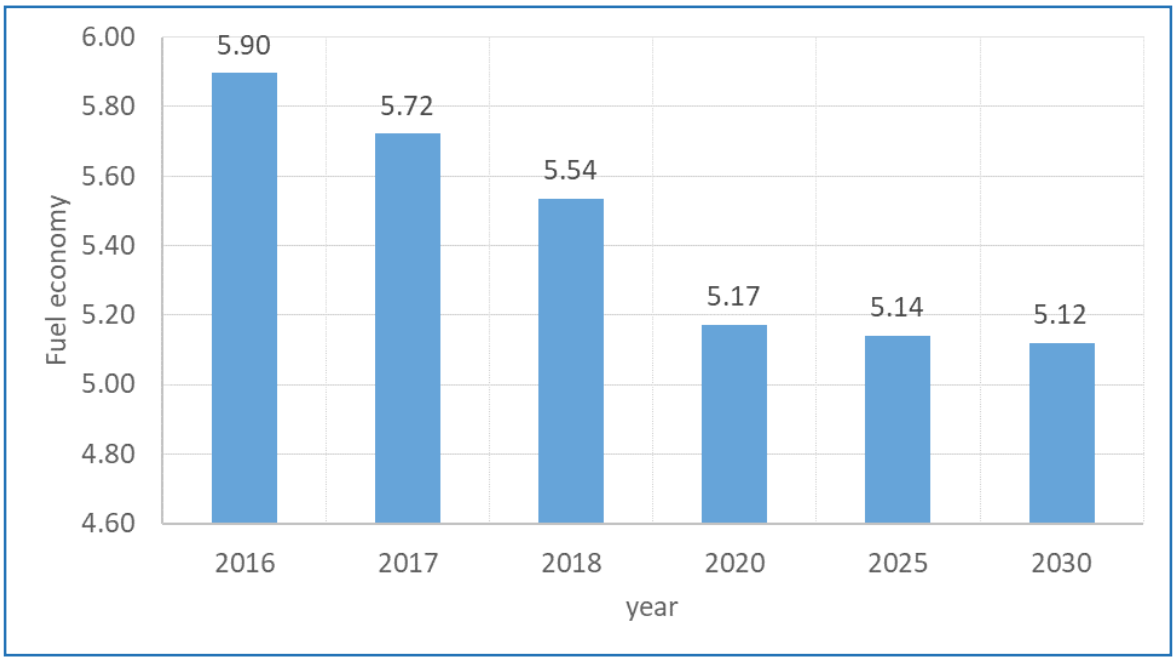

Figure 2 Average fuel economy of new registration in the baseline scenario

2.5 Policy Scenario

The impact of registration tax on the composition of new registration is almost invariant to base year composition. Since registration tax is nominal, its impact on registration composition is also minor. Also, the circulation tax virtually plays no significant role or a minor role in the composition of new vehicle registration in future years. The new composition of the vehicle after the application of fuel tax is slightly changed from the base year as shown in Table 5.

Table 5 Impact of tax on the composition of new registration in projection year (2030)

	Composition of new registration in projection year (2030) due to tax		
	Registration tax	Circulation tax	Fuel tax
ICE <4 lge/100km	1%	1%	2%
ICE 4-5 lge/100km	32%	32%	33%
ICE 5-6 lge/100km	28%	28%	28%
ICE 6-7 lge/100km	15%	15%	14%
ICE >7 lge/100km	24%	24%	23%

2.5.1 Composition of new vehicle registration in projection year

One of the outputs from FEPIT is the new registration composition of the vehicles as a result of the combined policy scenario in the target year 2030. The composition of registration of the vehicles in the base year 2016 and projection year 2030 as a result of the combined policy and baseline scenarios is as shown in Figure 3. It shows that there is a significant change in the fuel economy composition of new registration in combine policy scenarios compared to baseline trends. There is a reduction of 46% vehicle registration in the vehicle category of fuel economy 4-5 Lge/100km in 2030. Similarly, the reduction potential of 27% can be observed in vehicle category 5-6 Lge/100km. However, the vehicle under the category of fuel economy >7 Lge/100km has increased abruptly in 2030 in the policy scenario. The baseline trend is based on endogenous changing of the composition according to the past year data (2014), whereas the composition in policy scenario is the result of the effect of tax imposed on vehicles in the base year.

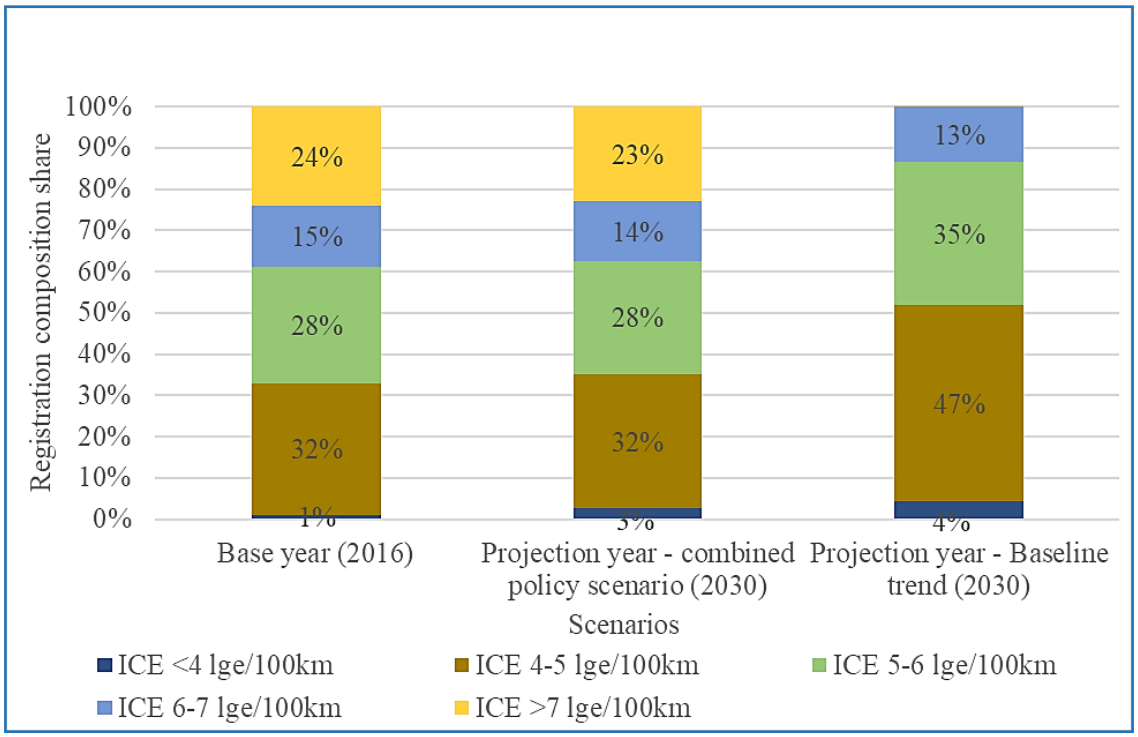

Figure 3 Composition of new registration in the base year 2016 and projection year 2030 in different scenarios

Since the registration tax is the same and is very nominal, virtually there is no effect of registration tax on the new composition. Nevertheless, for a policy implication for improving fuel economy, registration tax can be restructured in such a way that registration tax is lower for fuel-efficient vehicles. Also, the rate of registration tax can be raised such that there is a visible impact on the new composition of the vehicles. Recently government announced the new registration tax system based on engine capacity. Vehicles with engine capacity lower than 2000cc and higher than 2000cc are imposed with the tax based on its vehicle price. There is a substantial increase in the registration tax of vehicles. The new vehicle composition as a result of the new policy is, as shown in Figure 4.

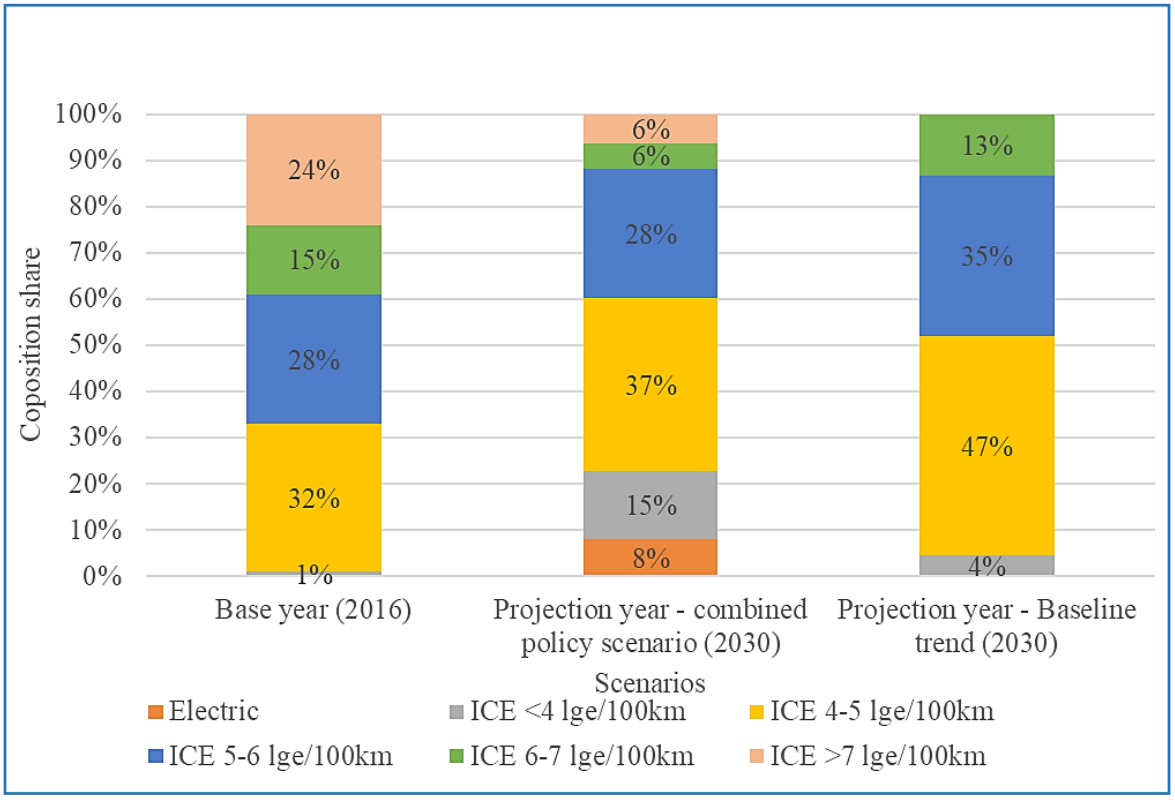

Figure 4 Composition of new registration after restructuring registration tax

2.5.2 Average fuel economy of the new registration

The inclusion of circulation tax, registration tax, and fuel tax alone has the potential to enhance fuel economy to some extent. However, the impact of the existing tax system on fuel economy is minimal. There is a variation of only -1.2% from base year value. The fuel economy of new registration will be 5.83 Lge/100 km in 2030, which was 5.9 Lge/100 km in 2016 (Figure 5). Since the current registration tax is based on the vehicle category and is the same for all, the impact is insignificant. However, an introduction of fiscal policies based on fuel economy, i.e., higher tax for the vehicle with lower fuel economy, can affect fuel economy improvement in the future.

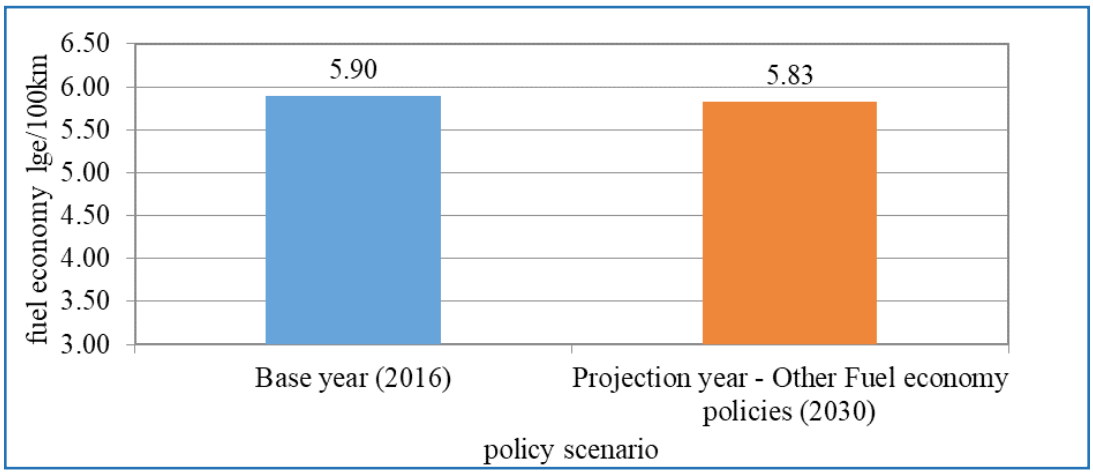

Figure 5 Average fuel economy of new registrations in the policy scenario

Since the registration tax, circulation tax, and fuel tax remains invariant in projection year, their impact is also minimal. Thus the target options to improve the average fuel economy through four different policies available in the FEPIT tool are analyzed in this study. The impact of each option in the fuel economy in the projection year (2030) is analyzed individually.

The first option is the global average GFEI target scenario. GFEI targets to retain 4.2 lge/100km by 2030. The result in this scenario shows that setting the GFEI target has a significant impact on fuel economy. There is a significant improvement in fuel economy by -30% from base year value. Thus to attain this target, policymakers need to focus on alternatives fuel sources in the transport sector rather than relying on conventional fuel sources. The result in the combined scenario considers the impact of tax along with the fuel economy policy option. The result shows that the fuel economy in 2030 will be 4.15 lge/100km, an improvement of -30% from the base year. The impact of policy on different policy scenarios is as shown in Figure 6. Compared to baseline trend FE in 2030, the fuel economy in the projection year 2030 in this policy is 23% lower.

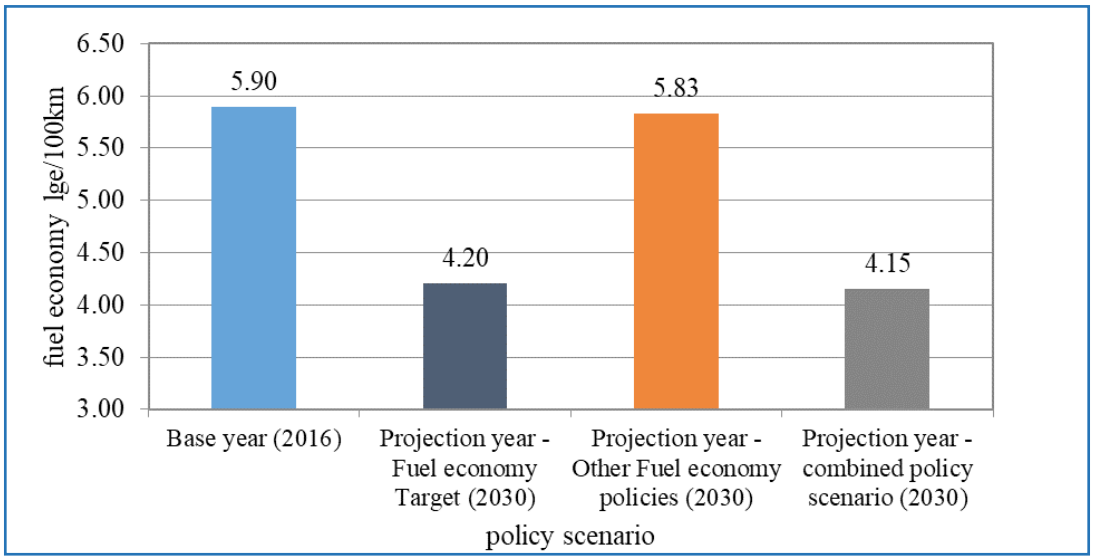

Figure 6 Impact of GFEI target on fuel economy in different scenarios

The second target option, i.e., GFEI average global improvement rate, has an even higher impact on fuel economy improvement since it required an annual improvement rate of -3.1%. At this improvement rate, the average fuel economy of newly registered vehicles in 2030 will be 3.79 Lge/100 km (Figure 7). It is an improvement of 35.7% from the base year value. Also, in combined policy, i.e. considering the impact of tax along with this policy option, fuel economy in 2030 will be 3.74 Lge/100 km, an improvement of 36.4% from the base year value. Moreover, this value is 37% lower than the fuel economy in baseline (5.12 Lge/100 km) in the year 2030. Such an improvement is possible only by shifting to electric mobility since electric vehicles have excellent fuel economy compared to conventional vehicles. Electric vehicles are gradually becoming popular as the government of Nepal also focuses on promoting electric vehicles in both public and private vehicles. The government has set the target to increase the fuel share of electric vehicles as well. It helps in promotion of electric vehicles in Nepal's auto market. However, due to slightly high investment costs and new technology, people are still hesitant to jump into electric vehicles.

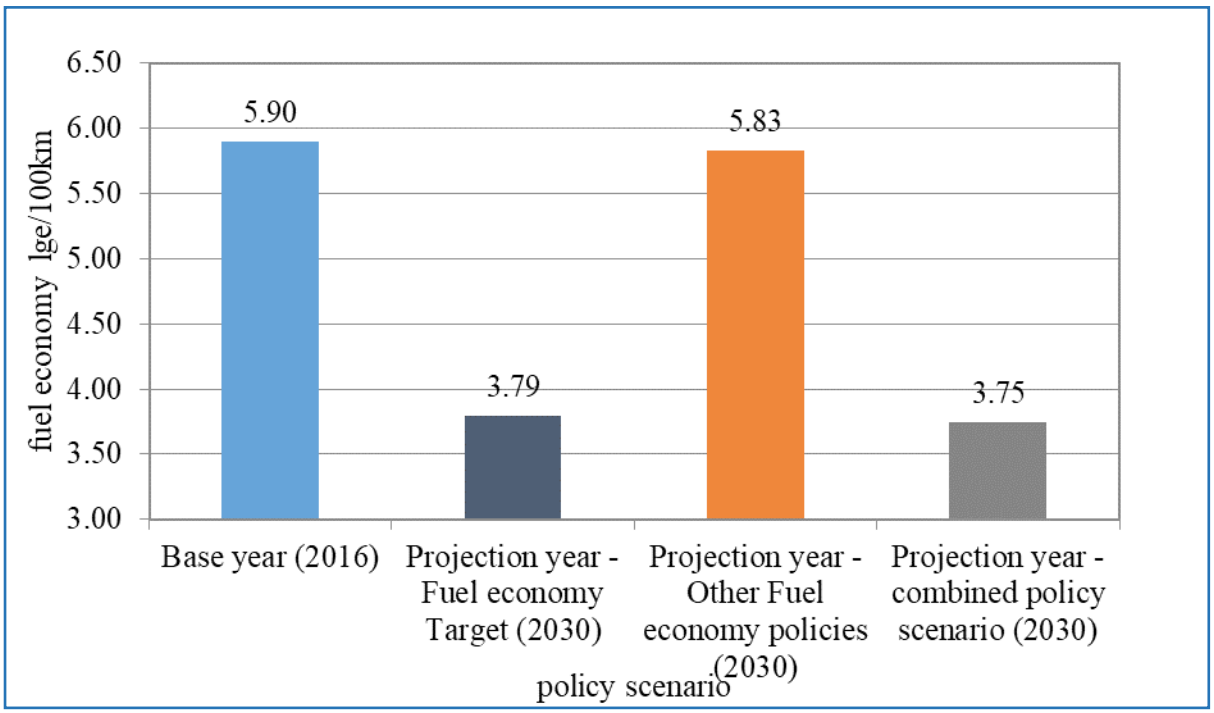

Figure 7 Impact of GFEI average global improvement rate on fuel economy in different scenarios

The third policy option is the average of GFEI global target and GFEI average global improvement rate. Results in this scenario show significant improvement in fuel economy by -32.3%. The average fuel economy of newly registered vehicles will be 3.99 Lge/100 km in 2030, as shown in *Figure 8*. Furthermore, in combined policy, i.e., considering the impact of tax along with this target option, the fuel economy in 2030 will be 3.94 Lge/100 km, an improvement of 33.2% from the base year value. However, compared to the baseline trend, the fuel economy in this policy option is 30% lower in the projection year 2030.

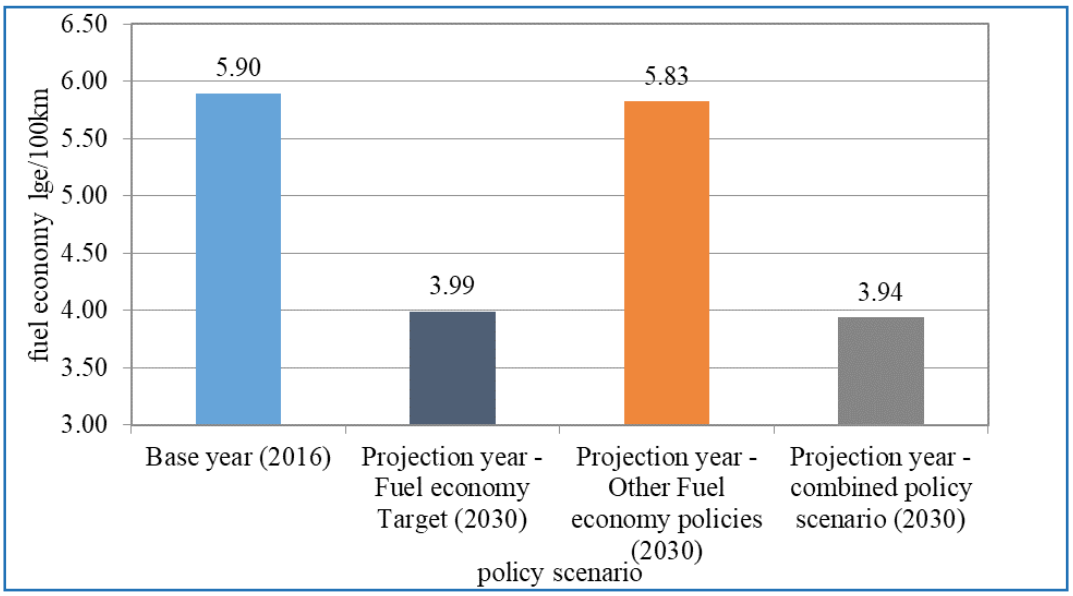

Figure 8 Impact of the average of GFEI target value and GFEI average global improvement rate on fuel economy in different scenarios

In the user-defined target scenario, the historical improvement rate of fuel economy is analyzed. Based on the baseline study of the fuel economy of LDVs from 2005-2016 at a periodic difference of two years, the weighted average fuel economy improvement was observed to be -1.89%. Since Nepal depends entirely on imported automobile markets, the gradual improvement of the fuel economy of LDVs in the international market is also observed in Nepal, without any policy intervention. At this improvement rate, the fuel economy of Nepal in 2030 is estimated to be 4.5 Lge/100km (*Figure 9*). It is an improvement of 23.4% from base year value, which was 5.9 Lge/100 km in 2016. In a combined policy scenario, there is a potential improvement of the fuel economy to 4.46 Lge/100 km in 2030. It is, however, an imrpovement of only 15% from baseline trend value in the projection year 2030 that is generated by the tools by endogenously changing the composition and fuel economy according to the past year (2014) input data.

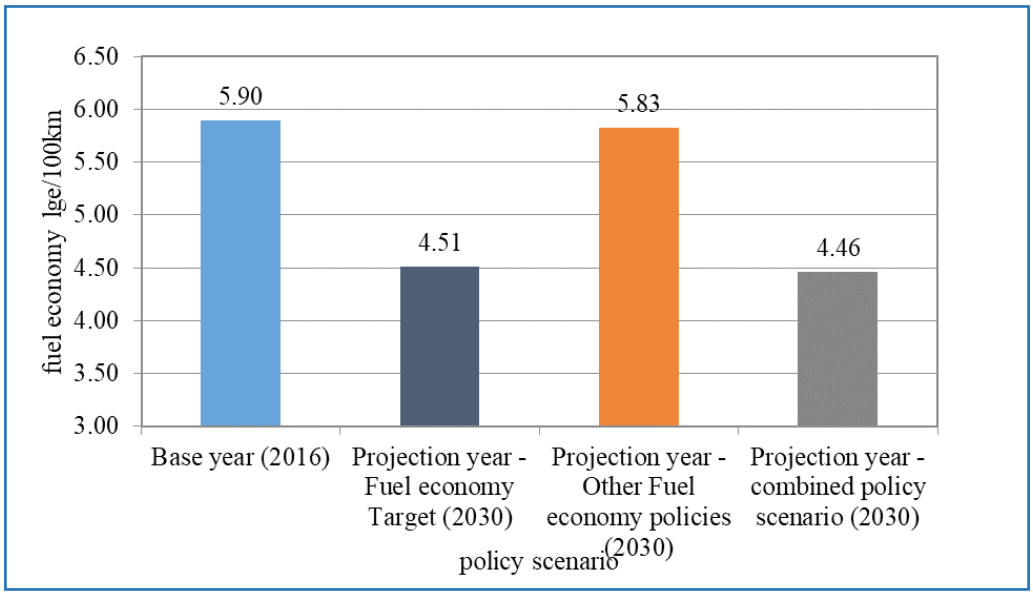

Figure 9 Impact of user-defined option on fuel economy in different scenarios

The impact on fuel economy as a result of an increase in registration tax based on engine capacity shows a considerable improvement in fuel economy. The fuel economy in 2030 due to the new registration tax system is 4.35 Lge/100km, which is 26.2% improvement from the 2016 baseline value. The combined policy scenario shows that there is a substantial improvement in fuel economy of 48.5% in 2030 from the 2016 baseline value. The fuel economy will be 3.03 Lge/100 km in 2030 in combined policy. This FE is more than 50% lower than 2005 baseline fuel economy (6.89 Lge/100 km). Thus, by increasing registration tax, fuel economy of vehicles can be enhanced to the GFEI target value. The summary of FE due to change in registration tax is as shown in Table 6.

Table 6 Average FE and CO_2 emission per km in different scenarios as a result of imposing new registration tax

FE Lge/100km				
Policy Scenarios	**GFEI target**	**GFEI improvement rate**	**Average of GFEI target and improvement rate**	**User defined target**
Base year (2016)	5.90	5.90	5.90	5.90
Projection year - Fuel economy Target (2030)	4.20	3.79	3.99	4.51
Projection year - Other Fuel economy policies (2030)	4.35	4.35	4.35	4.35
Projection year - combined policy scenario (2030)	3.03	2.72	2.87	3.28
Projection year - Baseline trend (2030)	5.12	5.12	5.12	5.12
CO_2 emission g/km				
Base year (2016)	139.85	139.85	139.85	139.85
Projection year - Fuel economy Target (2030)	99.62	89.99	94.69	107.06
Projection year - Other Fuel economy policies (2030)	103.24	103.19	103.22	103.29
Projection year - combined policy scenario (2030)	71.96	64.44	68.11	77.78
Projection year - Baseline trend (2030)	121.39	121.39	121.39	121.39

2.5.3 Impact on average fuel economy due to the penetration of the electric vehicle

Nepal government has formulated the number of polices linked to electric vehicles. In the Environment-Friendly Transport Policy, 2014, a specific provision for clean transport services is mentioned that sets the target to achieve a 20% share of vehicles to be environment-friendly. In Nationally Determined Contributions (NDC) submitted at the 2015 Paris Climate Conference (COP21), in a bid to reduce dependency on fossil fuel, Nepal aims to increase the share of electric vehicles by 20% by 2020. Moreover, to reduce further dependency, a target is set to reduce 50% of petroleum dependency on the transport sector through mass public transport and electric vehicles by 2050.

So a scenario is analyzed outside the FEPIT model, with 30% electric vehicles in LDV segment in 2030 and its impact on fuel economy. The weighted average fuel economy was calculated exogenously using the historical data from 2005-2016 as per the baseline study of LDVs in Nepal

for petrol and diesel vehicles. The share for electric vehicles was linearly interpolated to achieve a 30% EV share by 2030. The average fuel economy of electric vehicles is assumed to be 2.3 Lge/100km (CleanTechnica, 2018). Then the weighted average fuel economy was calculated till 2030. The result shows that the weighted average fuel economy of newly registered LDVs will be 3.72 Lge/100km in 2030, as shown in Figure 10. Compared to the baseline trend value of 5.12 Lge/100km in 2030, there is a 38% improvement in fuel economy in this scenario. The introduction of EV improves the annual average fuel economy by -3.1% between 2016-2030. It indicates that the introduction of electric vehicles has enormous potential for FE improvement such that the global average GFEI target can be achieved in 2026, ahead of its timeline. However, even at this rate, the fuel economy in 2030 is 6% lower than the GFEI specific target of 50% reduction by 2030 from the 2005 baseline. In order to enhance fuel economy by 50% from the 2005 baseline value, the fuel economy should come down to 3.48 Lge/100km. Literature shows that in order to enhance the fuel economy below 4 Lge/100km, robust measures of hybridization and electrification are required.

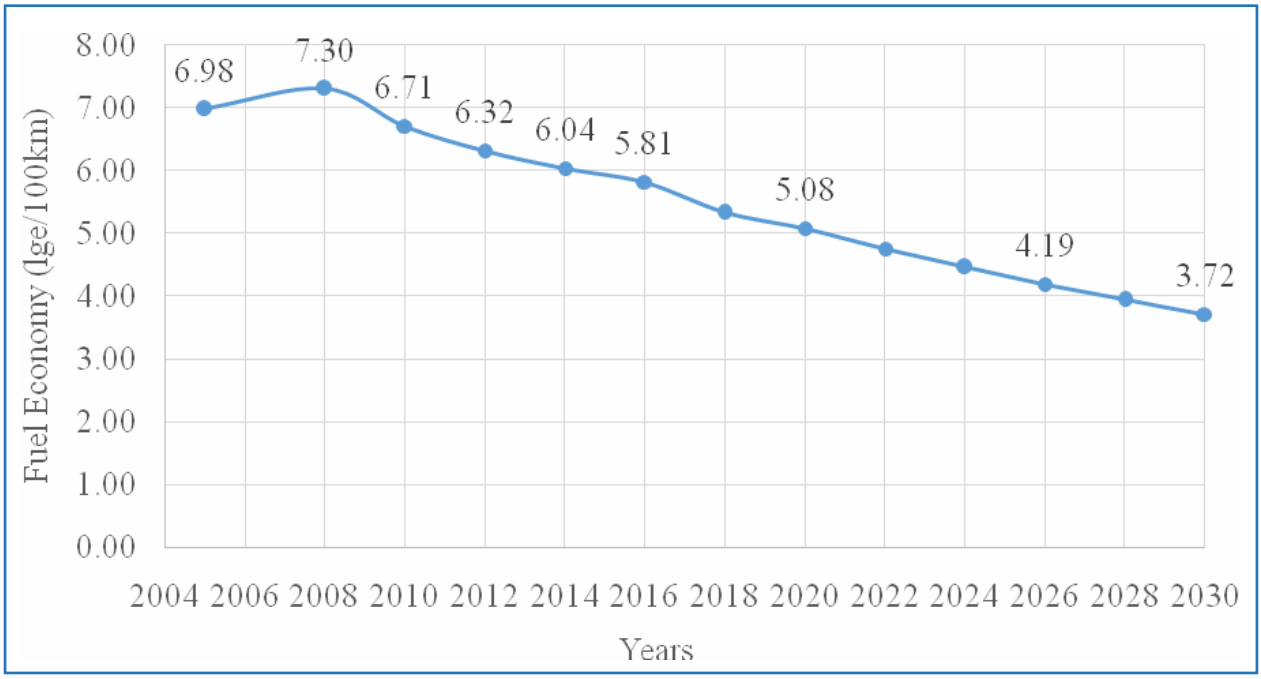

Figure 10 Weighted average fuel economy after penetrating electric vehicles by 30% in 2030

2.5.4 Average CO_2 emissions per km

The CO_2 emission from vehicles is based on fuel type and fuel economy of the vehicles. Based on different policy options of improving fuel economy, the impact on CO_2 emission was also analyzed. The impact of tax imposed on vehicles has minimal impact on emission reduction, similar to the impact on fuel economy. The average CO_2 emission per km in 2030 will be 138 gCO_2/km, which was 140 gCO_2/km in 2016. There is a reduction of merely 1.3% in the emission as a result of the tax imposed on vehicles.

CO_2 emission per km is also analyzed in the four different scenarios of fuel economy. The emissions in the four different scenarios are indicated in Table 5. In the user-defined scenario, the CO_2 emission per km in 2030 is 44% less than its value in 2016 and 36% less than the baseline trend value in 2030.The emission in the combined scenario of 78 g/km in 2030 is almost commensurate with the GFEI target of 77 g/km in 2030.

2.5.5 Impact on CO_2 emission due to the penetration of the electric vehicle

Though the number of Battery Electric Vehicles (BEV) plying in the streets of Nepal is very insignificant, but the interest among consumers on BEVs is increasing at a rapid pace. Technology advances in electric vehicle and battery manufacturing, and charging infrastructure are delivering substantial production costs (IEA, 2019a). Hence, the impact of CO_2 emission on LDVs due to electrification in the transport sector is also analyzed. The analysis is based on data collected for the baseline study of the fuel economy of LDVs in Nepal from 2005-2016. The historical data shows a decreasing trend of CO_2 emission as a result of the import of fuel-efficient vehicles from the international market, particularly from India. The analysis was further carried to view the impact of electric vehicles in overall emission. The baseline trend provides average CO_2 emissions without any policy intervention. After introducing electric vehicles and targeting to increase the share to 30% by 2030, there is a significant reduction of CO_2 emissions from the baseline trend. The result shows that the weighted average CO_2 emission reduces from 158 g/km in 2005 to 77 g/km in 2030. The emission factor in 2030 in the electric vehicle scenario is lower than the GFEI improvement rate scenario. By 2030 average CO_2 emission meets GFEI target of reducing emission to half of its emission from 2005 baseline (79 g/km). The average CO_2 emissions from 2005-2030 are as shown in Figure 11.

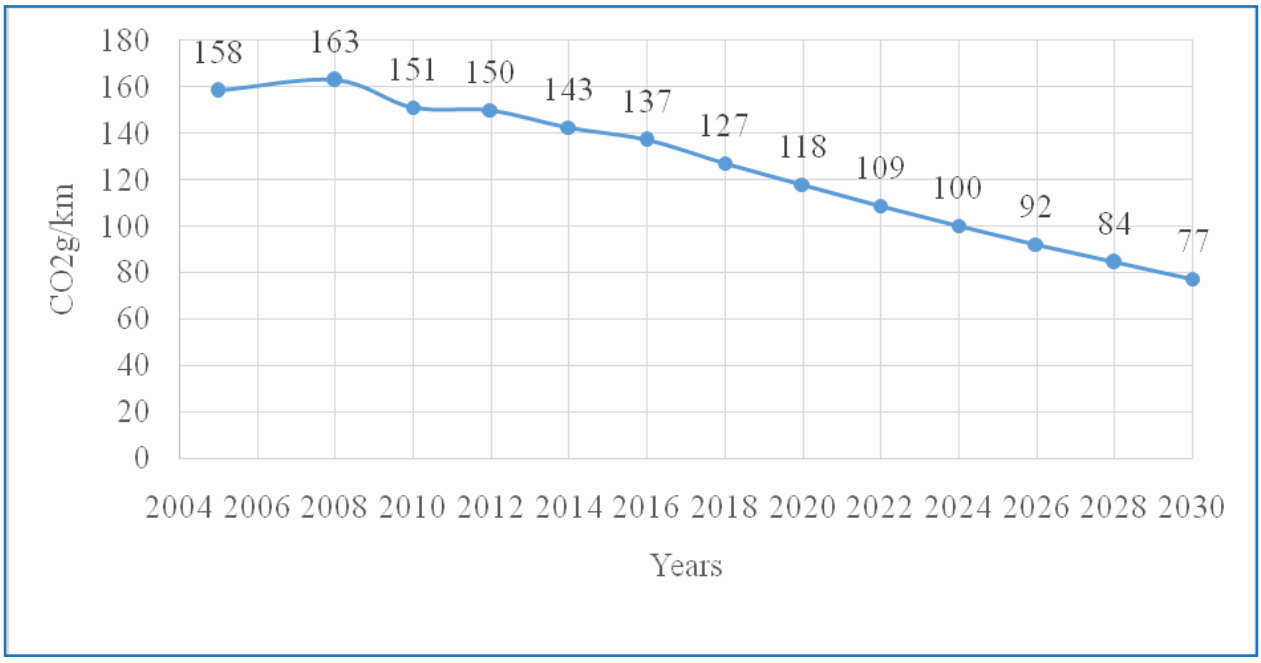

Figure 11 Weighted average CO_2 emission in electric vehicle scenario

The assumption of 30% of new electric vehicles in the LDV segment of the transport sector in the above scenario is based on proposed strategic plan of Province 3 of GoN for electric mobility in joint collaboration with Global Green Growth Institute (GGGI) that is being currently developed and the EV 30@30 Scenario of IEA for 30% market share of EVs in 2030 (GGGI, 2019; IEA, 2019a). Nepal's electricity is generated with almost zero emissions as it is developed from the rivers flowing from the Himalayas.

2.6 Discussions

The baseline trend is obtained as a result of an endogenous change in registration according to past trends. It shows that the new registration composition of the vehicle will have a fuel economy between 4-7 Lge/100km in 2030.

Under policy options, the results from FEPIT show that there is a nominal impact of circulation tax and fuel tax on new composition at an existing tax rate. The registration tax of vehicles is insignificant such that it does not affect at all in policy scenarios. The average fuel economy target option has four additional options that impact fuel economy in the target year, i.e., 2030. The FEPIT result shows that to obtain the GFEI target fuel economy in 2030, a reduction of 23% from the baseline trend is necessary. Further, at the GFEI global improvement rate of -3.1%, a reduction of 37% is desired in 2030 from its baseline trend value. However, when the average of GFEI target and GFEI improvement rate is assumed as an effective policy option, there is a need for a 30% reduction in 2030 from the baseline trend. The final policy option is the user-defined target option, where an improvement rate of -1.89% is assumed based on the historical trend obtained from the baseline study of the fuel economy of LDVs. In this policy option, there is a reduction of fuel economy by 15% from its baseline trend in 2030. A similar reduction is observed in CO_2 emission as well. However, by increasing registration tax from the present rate as per the planned policy (DOTM, 2019), it shows a significant impact on fuel economy as well as fuel registration. Fuel economy in all four policy options under this registration tax rate is lower than the GFEI target value. However, FE to attain FE lower than 3 Lge/km requires substantial policy implications.

Another policy scenario was analyzed in which electric vehicles share is gradually increased to reach 30% by 2030. It was analyzed exogenously using the growth rate of fuel share and fuel economy of the newly registered vehicles from 2005-2016. This scenario shows that in order to improve the targeted fuel economy, the penetration of electric vehicles plays a significant role. The weighted average fuel economy of newly registered improved from 5.9 in 2016 to 3.7 lge/100km in 2030. Data shows that Nepal can achieve the global average GFEI target ahead of time. Moreover, to achieve the country-specific fuel economy target of 50% reduction by 2030 from 2005 baseline, 30% penetration of EV by 2030 is not sufficient as the targeted fuel economy is 3.49 Lge/100km, 7% lower than the projected value.

Various scenarios discussed indicate that Nepal may not be in a position to develop its own FE and emission standards as it does not have virtually any automotive manufacturing base, and its possibility looks dim due to economies of scale. It has to adopt FE and emission standards of neighboring countries especially India as share of imports of LDVs from India is quite large. However, Nepal can undertake several policy measures in enhancing FE and reducing CO_2 emissions in order to meet GFEI fuel economy and emission targets.

CHAPTER 3: FISCAL POLICY OPTIONS

There is a range of fuel economy policy options available such as fiscal, regulatory and other fuel economy policy options. There is a strong impact on improving fuel economy and reducing CO_2 emissions if both the consumer as well as manufacturer – targeted fuel economy policy measures are combined (ASEAN, 2019). There are three categories of policy options – (a) Monetary (Fiscal), (b) Regulatory, and (c) Consumer Information or fuel economy labeling (Figure 12).

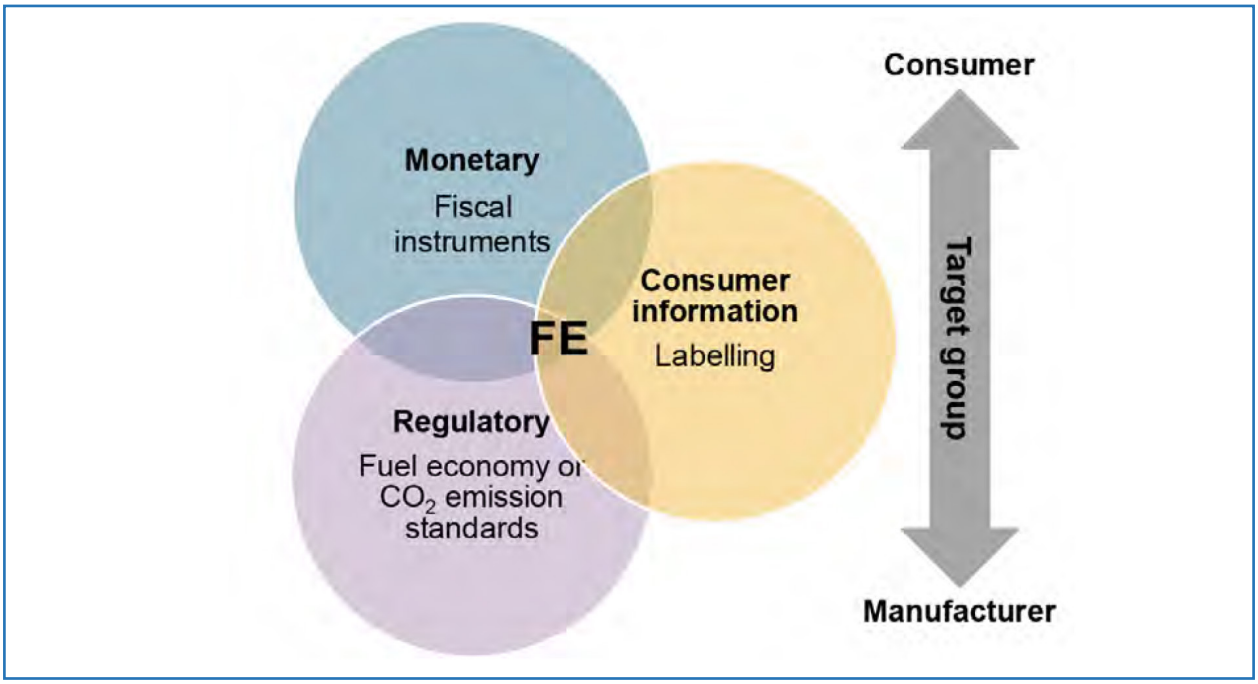

Figure 12 Overview of fuel economy policy measures categories (ASEAN, 2019)

Regulatory policy measures such as fuel economy and CO_2 emissions standards are targeted to vehicle manufacturers, and oil refineries and Nepal do not have both these manufacturing bases. Monetary and fiscal policy measures can be instrumental in achieving the required fuel economy and emission targets of GFEI. Consumer awareness can be enhanced toward fuel economy and CO_2 emissions through sufficient consumer information and labeling by the manufacturers or at the sales and distribution points.

As Nepal is a landlocked country, road transport plays a vital role in the economic development of the country. Motorization density is low compared to other South Asian countries, but motorization rate, especially in the LDVs segment, is growing at a higher rate of 15% annually in the past decade (DOTM statistics, 2018). Hence, transport fuel economy and reduction of emissions in the transport sector no doubt offer major challenges and opportunities in both the economy and the environment sectors of Nepal. The automotive manufacturing base is almost

dormant in Nepal, and due to economies of scale its development can hardly be expected also in future. Consequently, Nepal must adhere to fuel economy standards or policy across the border especially India, as a significant share of LDVs is imported from there. However, it is very encouraging to note that Government of Nepal has taken positive fiscal policies in recent years to improve FE and to reduce CO2 emissions in the country.

3.1 FE regulation standard

Studies have shown that fuel economy standard regulation has a direct impact on the penetration of electric vehicles in the market. Fritz, Plötz, and Funke (2019), in their study, shows that there is a significant increase in Plug-in electric vehicles as a result of imposing fuel economy standards. FEPIT results show that despite 30% penetration of electric vehicles by 2030, the FE target is still 6% lower than the GFEI target. In order to meet the GFEI fuel economy target, it is essential to promote more electric vehicles in the market. Since there is considerable impact of fuel economy standard in the promotion of Plug-in electric vehicle, policies focusing on setting fuel economy standard needs to be formulated. The baseline fuel economy trend shows that the fuel economy of LDVs in Nepal is 5.9 lge/100km in 2030. Since the automobile market in Nepal entirely depends upon imports, the international market trend determines the fuel economy of Nepal. Thus it poses an opportunity to limit the import vehicles based on its rated fuel economy as standardized in Nepal. Nepal's fuel economy and emission standards should be in line with FE standards of neighbouring countries from where major share of LDVs are imported.

3.2 Fuel price adjustment

Nepal depends entirely on imported petroleum products in transportation. India is the major exporter of Petro-products in Nepal. Oil tankers and recently Amlekhganj petroleum pipelines provide petroleum fuel across the country. The government spent a substantial amount of money on importing fuel products. However, the duty and taxes on petroleum products are lower than the country from where petroleum products are imported. Due to open border access and poor control over the market, fuel is further sold back to India as prices in India are lower than in Nepal because India has increased Excise duties on petroleum products several times since 2015 but Nepal has not adjusted the Customs Taxes on petroleum products. Such a trend will only increase the trade deficit. It is thus essential to balance the market by adjusting fuel prices in the market. Thus, there should be a mechanism to regulate the duty and taxes regularly following the international oil market.

Studies have shown that fuel price affects significantly on fuel consumption and total passenger miles traveled. Consumers shift to more fuel-efficient vehicles either by purchasing new fuel-efficient vehicles or by dumping high fuel-intensive vehicles into scrappage. Works of literature

have shown that one dollar increase in gasoline price increases fuel economy by 1.08 miles per gallon, and there is a 25% shift from fuel in-efficient SUVs to efficient one and 40% decline in the market share (Marrouch & Mourad, 2019). Thus, adjusting fuel prices is also one of the essential fiscal policies on the road to improving fuel economy standards.

3.3 Duty and Tax restructure

Registration tax and circulation tax also play a significant role in improving fuel economy standards. However, in Nepal, the registration tax is very nominal and shows insignificance in fuel economy standard. Even though the circulation tax is high, the effect is still lower on FE. There is no timely revision in Nepal's duty structure on petroleum products for the past several years. However, for promoting electric vehicles, the Nepal government has waived excise duty on electric vehicles and reduced import duty to 10% compared to higher Customs and Excise duties on other diesel and petrol vehicles[2]. Even though there is substantial waiver in duty, import duty on spare parts and accessories of electric vehicles is similar to import duties on spare parts of diesel and petrol vehicles. Thus, people are hesitant to shift to electric vehicles despite lower operating fuel prices and higher fuel economy. Therefore, a fiscal policy targeting reduction in duties on their parts purchase is also crucial in increasing the electric vehicles market in Nepal. Besides, adjusting the tax structure based on fuel economy rather than engine capacity might urge people to shift to fuel-efficient vehicles as they will be aware of the benefits from fuel economy as well as tax fee. It seems that Nepal Government has recently started considering FE and emissions in vehicle imports since Excise duties have become progressive, i.e., vehicles with higher engine displacement have higher Excise duties, which were not earlier. It is understood that vehicles with higher engine displacement are less fuel-economical and produce more emissions. Nepal has highest import duties on vehicles compared to other countries. The current duty structure on imports of vehicles is given in Table 7.

Table 7 New Integrated Duties on import Prices of LDVs in percentage

Particulars	Customs Duty	Excise duty	VAT	Integrated Customs duty (India)	Integrated Customs duty (Others)
SI or CI engines vehicles below ED below 1,000 cc	80	60	13	221	225
Same as above with ED above 1,000 to 1,500 cc	80	65	13	231	236
Same as above with ED above 1,500 to 2,000 cc	80	70	13	241	246
Same as above with ED above 2,000 to 2,500 cc	80	80	13	261	266
Same as above with ED above 2,500 to 3,000 cc	80	90	13	281	286
Same as above with ED above 3,000 cc	80	100	13	301	307

SI: Spark Ignition engines; CI: Compression Ignition engines; ED: Engine Displacement

(DOC, 2019)

2 https://www.customs.gov.np/en/normal.html

Nepal Government has given preferential treatment for Battery Electric Vehicles and Hybrid vehicles since the fiscal year 2018-2019. BEVs have integrated Customs and VAT as 10% and 13% on import prices, which comes to around 24% integrated. Hybrid vehicles have 25% rebate on the usual integrated customs duties on SI and CI engine vehicles.

Besides, increasing registration tax based on the fuel economy of the vehicle encourages people to buy fuel-efficient vehicles. There is a slight change in the composition of new registration as a result of the change in registration tax.

The government also imposed an infrastructure tax of Rs. 5/ltr on import of petrol, diesel, and aviation fuel, road repair and improvement fees of Rs. 4/ltr in petrol and Rs. 2/ltr on diesel at the point of import. Also, there is a pollution control tax of Rs. 1.5/ltr charged in petrol and diesel fuel[3] , which was Rs 0.5/ltr before. The Nepal Government has also started taking Road Construction fee of 8% and 10% on market prices for vehicles below 2,000 cc and above 2,000 cc engine displacement respectively at the time of registration (DOC, 2019).

3.4 Fuel tax

The national action plan on Short-lived climate pollutants (SLCPs) identified fuel-efficient transportation, electrification, and mass transportation as major strategic options assumed to reduce substantial emissions from the transport sector (ICIMOD, 2017). It also focused on penetrating electric vehicles by approx. 50% by 2030 in the transport sector. The result shows a 73% reduction in energy consumption in the transport sector by 2030. Also, the introduction of EURO IV fuel from 2017 and EURO VI fuel from 2025 is assumed that reduces emission by 71% from the baseline scenario in 2030. Thus, significant emissions and energy consumptions can be reduced through electrification in the transport sector. From the emission point of view, diesel vehicles pollute air more than gasoline vehicles. SLCPs studies have shown that diesel consumptions emit 3.778 million metric tons of CO_2 compared to petrol vehicles that emit 0.21 million metric tons in 2030. In order to reduce CO_2 emissions and achieve the GFEI target, it is necessary to discourage the use of diesel vehicles. It can be achieved by imposing higher taxes on private diesel vehicles compared to petrol vehicles.

Nepal has to adjust Customs duties, excise duties on petrol and diesel bringing them at par with duties and taxes in India so that Nepal's domestic prices on petroleum products are slightly higher than prices across the border in India which was a couple of years before so that there is no outflow of petroleum products from Nepal due to open border.

3 http://www.nbsm.com.np/assets/kcfinder/upload/files/Publication/Nepal%20Tax%20Guide%202016.pdf

CHAPTER 4: CONCLUSIONS

Climate change has become a major challenge in the world. In total, carbon dioxide (CO_2) emissions transport sector contributes 23% in the world in 2010. Transport generates a large and growing share of anthropogenic greenhouse gas emissions, and therefore, enforceable and robust policies are needed in order to mitigate transport-based emissions. In Nepal, the unmanaged transport sector and fuel energy-related GHG emissions are the leading causes of deteriorating air quality. In this context, it has become very imperative to develop its fuel economy standards or undertake fiscal policy measures to improve FE and reduce fuel-related CO_2 emissions in line with the targets from GFEI. This current study tried to focus on the assessment of FE policies by use of the Fuel Economy Policies Implementation Tool (FEPIT) from the base year 2016 to 2030. The literature review was also conducted on various fuel economy policies, emissions standards both in developed and in developing countries. Baseline study on fuel economy and emissions of newly registered LDVs from 2005 to 2016 was also done. However, the fuel economy of Nepal was 6.98 Lge/100km in 2005 and enhanced to 5.90 Lge/100 km in 2016 at the improvement rate of 1.9% per annum. The annual average CO_2 emissions were 159 g/km in 2005, and it went down to 140 g/km in 2016.

FEPIT showed the impact assessment of four policy options such as GFEI fuel economy target, CO_2- based vehicle registration tax, CO_2- based vehicle circulation tax, and fuel taxation based on the fuel economy inputs of different categories of newly registered vehicles in 2014 and 2016. The major three outputs are the new registration composition of LDVs, average fuel economy of the new registration, and average CO_2 emissions per km. In the Combined User-Defined Scenario with the imposition of Road Construction fee at the registration time of new LDVs, the fuel economy would be 3.28 Lge/100 km in 2030, which would be 44% lower than fuel economy of 5.90 Lge/100 km in 2016. It is 36% lower than fuel economy of 5.12 Lge/100 km in 2030 in the baseline trend scenario. Average CO_2 emissions in the Combined User-Defined Scenario would be 78 g/km in 2030, which is highly lower than emission of 140 g/km in 2016. It is also significantly lower than 121 g/km of Baseline Trend Scenario in 2030. A fiscal policy such as emission-related Road Construction fee at the time of registration introduced from 2019 would have a positive impact on fuel economy and CO_2 emissions of the new LDVs.

Apart from the above, the introduction of 30% BEVs in the newly registered LDV segment of transport sector was also analyzed outside the FEPIT model. It showed that the weighted average fuel economy of newly registered LDVs would be 3.72 Lge/100km in 2030, which is lower than 5.12 Lge/100 km of the Baseline trend scenario in 2030.

There are three categories of fuel economy policy measures, such as fiscal, regulatory and consumer information. Nepal does not have a manufacturing base for the vehicles yet, and

there are fewer possibilities of having manufacturing establishment of vehicles in Nepal due to economies of scale. Therefore, in order to achieve GFEI fuel economy targets Nepal should adopt fuel economy and emissions standards in line with neighbouring countries and fiscal policy measures based on fuel economy and reduction of emissions. The current integrated customs duties, Road Construction taxes, and increased pollution taxes Nepal has undertaken are in the positive direction in achieving GFEI targets in 2030 and 2050.

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