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# MOTORIZATION MANAGEMENT IN ETHIOPIA

## MAIN REPORT

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## Table of Acronyms

| | |
|---|---|
| AITP | African Association of Public Transportation |
| AMCE | Automotive Manufacturing Company of Ethiopia |
| CBD | Central Business District |
| CKD | Complete Knock Down |
| CCT | Conditional Cash Transfers |
| COP | Conformity of Production |
| CRSP | Current Retail Selling Price |
| DTC | Diagnostic Trouble Codes |
| DPOS | Dynamic Profile of Standards |
| ESC | Electronic Stability Control |
| EASI | Enable Avoid Shift Improve |
| ELV | End of Life Vehicles |
| EPSE | Ethiopian Petroleum Supply Enterprise |
| FTA | Federal Transport Authority |
| GFUV | Generalized First-Use Vehicles |
| GFEI | Global Fuel Economy Initiative |
| GHG | Greenhouse Gas |
| GDP | Gross Domestic Product |
| HDV | Heavy Duty Vehicles |
| I/M | Inspection and Maintenance |
| IATP | International Association of Public Transportation |
| CITA | International Committee on Vehicle Inspections |
| ICCT | International Council on Clean Transportation |
| KNPC | Kuwait National Petroleum Corporation |
| KEBS | Kenyan Bureau of Standards |
| KADRA | Korean Automobile Dismantlement and Recycling Association |
| KARCO | Korean Automotive Recycling Cooperative |
| LDV | Light duty vehicle |
| MSFUV | Market-Specific First-Use Vehicles |

| | |
|---|---|
| MVIMS | Motor Vehicle Information Management System |
| NTSB | National Transportation Safety Bureau |
| NZTA | New Zealand Transport Agency |
| NMHC | Non-methane Hydrocarbon |
| OBD | On-Board Diagnostics |
| OECD | Organization for Economic Cooperation and Development |
| OEM | Original Equipment Manufacturers |
| NOx | Oxides of Nitrogen |
| SOx | Oxides of Sulfur |
| PM | Particulate Matter |
| PPM | Parts per Million |
| PEMS | Portable Emissions Monitoring System |
| PPP | Public Private Partnership |
| PSV | Public Service Vehicles |
| SHV | Second-hand vehicles |
| SCR | Selective Catalytic Reduction |
| SUV | Sport Utility Vehicles |
| SDG | Sustainable Development Goals |
| TVM | Tonne-Value Movement |
| TIMS | Transportation Information Management System |
| TA | Type Approval |
| TRANSIP | Transportation Systems Improvement Project |
| UAE | United Arab Emirates |
| UNECE | United Nations Economic Commission for Europe |
| VAT | Value Added Tax |
| VIMM | Vehicle Inspection Management Module |
| VKT | Vehicle Kilometers Traveled |

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# I. Introduction

1. Across Africa, governments are struggling to manage the effects of rapid motorization and urbanization. In the past two decades, Africa has been the fastest urbanizing region in the world, growing at 3.44 per cent on average which is much higher than the rate of other rapid developing regions, such as Asia and Latin America[1]. Given that Africa remains the least developed region, the rapid urban growth pace will likely accelerate motorization development and challenge the limited resource base to meet the demand of the growing urban populations. Africa hosts the smallest proportion of the world vehicle fleet (only 42.5 million in-use vehicles) with the lowest vehicle penetration rate (32 light-duty vehicles per 1000 population). The light duty vehicle fleet size is projected to grow significantly at more than 6.1 per cent annually over the next few decades according to projections by the US Energy Information Administration[2]. That means that by 2040, there will be nearly 137 million more light duty vehicles in Africa than in 2015, a growth of nearly 400 per cent, representing the compounding effects of a 67 per cent growth in population, and a 183 per cent growth in the number of vehicles per 1000 population.

2. While this motorization potentially means that more African people will be able to claim the benefits of improved access to opportunities and mobility, it raises alarming questions about the sustainability of this future. Will countries be able to build and maintain infrastructure to accommodate these vehicles? Will the quality of the vehicles support African development goals and the region's ability to meet the Sustainable Development Goals and climate obligations? Most countries on the continent are primarily import-driven in their automotive industries, with only two (South Africa and Nigeria) currently having any vehicle emissions standards. In addition, a high percentage of imported vehicles are second-hand (85 per cent in Ethiopia, 80 per cent in Kenya and 90 per cent in Nigeria in 2015)[3] from Europe, Japan and nearby countries, many of which are older than 10 years, mainly because of low capacity of local vehicle assembly and manufacturing, and limited disposable income to purchase new vehicles burdened with high tariffs and other taxes.

3. Motorization and managing the growth of the motor vehicle fleet represents only one dimension of the sustainable transport challenge for African countries, but it is an important one, because of the multiplicity of impacts it brings and the enormity of the challenge, the institutional, organizational and managerial capacity addressing these impacts implies. Among these impacts are fossil fuel consumption (a substantial challenge to a continent where many countries struggle to maintain Balance of Payments), excessive pollution emissions, poor road safety, and growing congestion in major cities even at relatively low motorization levels.

[1] United Nations Habitat. 2016. "Urbanization and Development: Emerging Futures". World Cities Report 2016, pp. 6.

[2] US Energy Information Agency.

[3] Deloitte Consulting. 2016. "Navigating the African Automotive Sector: Ethiopia, Kenya and Nigeria". Deloitte Africa Automotive Insights.

4. The speed with which Africa is expected to motorize over the next few decades is both a challenge and an opportunity. While African vehicle fleets reflect that the continent has served as a "dumping ground" for old, obsolete vehicles from much of the rest of the world, the speed of growth of the fleet means that those vehicles will be only a small proportion of the vehicle fleet, even if they remain in use for an excessively long period of time compared to their use in the global North. Governments have a window of opportunity now, therefore, to effect motorization policies that can shape the motor vehicle fleet in Africa for decades.

5. How to do so effectively, however, is not fully clear, since motor vehicle manufacturing (and even assembly) as well as purchasing power in African countries is so far behind other world regions that importation of second-hand vehicles is likely to remain the main driver of motorization for many years or decades to come. Ethiopia has carried out the study focused on fuel economy aspects of the light duty vehicle (LDV) component of its motor vehicle fleet. Under the auspices of the Global Fuel Economy Initiative (GFEI), the recommendation report from 2012 pointed out the needs to set up fuel economy standard for different classes of vehicles given that old second-hand vehicles have very low fuel economy. It also encouraged Ethiopia to adopt fuel standards of lower sulfur content to keep up with the implementation of more stringent vehicle emission standards, while introducing new vehicle technologies to promote fuel efficiency and reduce tailpipe emission with incentives packages and maintenance support. To facilitate implementation, it was recommended the task force shall be formed by all stakeholders including Ministry of Transport, ERCA and FTA to continue the study on ambient air quality, revising vehicle registration database, computerizing vehicle inspection database, and strengthen the capacity of research and assessment.

6. The present report builds on this previous work, by considering a broader set of policy objectives and outcomes, and by looking at the specific implementation mechanisms available to obtain such outcomes. The approach is being labeled motorization management, implying an effort to factor in a broad range of impacts and outcomes associated with motorization as a whole. The assessment has been conducted by a multi-sectoral team of experts, under the guidance of a technical committee of international experts, comprising different areas of expertise about motorization, including:

- Sustainable transport policy
- Road safety
- Vehicle emissions and technology
- Fleet growth, and fiscal impact modeling
- Motor vehicle trading industry and
- Public sector institutional development

7. **The objective of this technical assistance is to help the government of Ethiopia understand what a fully integrated and comprehensive program of motorization management would look like in terms of breadth and scope, and to identify the specific programs that need creation or strengthening in order to effect such a program.** The objective is not to make specific policy recommendations or to suggest which specific outcomes, among the

myriad of plausible outcomes, should be the focus of government policy. These are inherently national choices, which need to be made on the basis of broad national policy goals and specific political economy conditions. Indeed, the recommendations made in this report are sequentially counterintuitive: we believe that, where motorization is concerned, *implementation programs to effect policies should be put in place even before the policies themselves are developed*. Which policies are plausible or likely to be effective will depend on the implementation mechanisms, so it makes sense to work to develop those implementation mechanisms even if the policies are not known or decided.

8. That said, this report will lay out some plausible motorization policies that could be implemented by the government of Ethiopia. These have been identified as plausible by the team following extensive discussions over three workshops. We urge against interpreting any of these specific, plausible policies as "recommendations" of the World Bank team. The implementation programs themselves, and the breadth of scope that policy should take into account, comprise this report's substantive "recommendations." The plausible policies discussed in this report, rather, are evoked in order to work through the logic of the implementation framework so as to ground the discussion in real societal benefits.

9. **The objective is to map out implementation programs to simultaneously address four challenges of motorization: tailpipe pollution, fuel consumption and efficiency, vehicle road safety and the pace of growth of the overall vehicle fleet, while being cognizant of the fiscal impacts of potential changes.**

10. We begin with Chapter II which provides a diagnostic of the current situation with respect to vehicles and how they are managed in Ethiopia. It provides a description of the current vehicle fleet in Ethiopia, followed by a discussion of current policies and practices which *de facto* define how motorization is managed in Ethiopia currently. Results of the modeling exercise developed for this technical assistance are then presented to show how the vehicle fleet is projected to develop through 2040 under a Business-as-Usual scenario, highlighting the challenges that will be created for Ethiopia's economic and environmental growth if motorization is not managed differently. Chapter III introduces the concept of motorization management as an integrated approach, and provides some basic definitions and scope. The next two chapters form the core of the team's recommendations. Chapter IV discusses what we believe to be the core programs that would comprise a comprehensive motorization management program at maturity. Chapter V lays out some common principles that the team believes should form the basis for a comprehensive approach to motorization management together with examples of plausible policies for the country situation. Where possible, we try to provide indicators of costs, but the objective of this study has been to lay out the broad outlines of a comprehensive motorization management approach, rather than provide detailed design, costing, and feasibility analysis of the individual programmatic components of that approach. The last chapter, Chapter VI, presents the impact assessment where fleet modeling of potential policy scenarios is possible. This chapter highlights the positive impacts on the trajectory of vehicle fleet size, composition, travel activities and corresponding implications for fuel consumption, greenhouse gas emissions and generation of local air pollutants for policy interventions.

# II. Country Diagnostics of Motorization Management

## A. Current vehicle fleet in Ethiopia

11. Ethiopia is the fastest growing economy in Africa (GDP growth at 9.6 per cent in 2015) and it hosts the second largest population in the continent. Its total vehicle penetration rate, however, is among the lowest in the world, only 6 vehicles are owned per 1,000 population (excluding special vehicles such as tractors and fork-lift trucks)[4] in 2016. Without domestic automobile manufacturing industry, Ethiopia has been importing all types of vehicles from other developed regions and over 85 per cent are second-hand vehicles. The driving factors behind this are income levels (GDP per capita 486.3 USD in 2015[5]), high taxes placed on vehicle import and also that the country has relatively low levels of urbanization; only one in five Ethiopians live in urban areas.

12. According to the vehicle registration records by Federal Transport Agency (FTA), and as shown in Figure 1 by 2015 Ethiopia's national vehicle population is estimated to be 552,000, of which 37 per cent are freight vehicles and 63 per cent are passenger vehicles, including 36 per cent cars (including field vehicles and dual-purpose vehicles), 16 per cent motorcycles (including two- and three-wheelers) and 11 per cent buses and minibuses. There is a high proportion of commercial vehicles in Ethiopia, including freight vehicles, vans, buses, minibuses and taxis (representing about 1/3 of cars). The size and pace of growth of the fleet is constrained by the lack of foreign currency, high tariffs and taxes mentioned earlier, and low household income. However, despite these headwinds, the overall vehicle population has increased about 57 per cent compared with five years ago (351,700 units including motorcycles in 2010). The fleet has been expanding at over 10 per cent annually in the past five years and the growth has been observed across all types of vehicles, particularly motorcycles with 25 per cent growth per annum.

[4] Team calculations, based on modelled fleet, which takes FTA vehicle fleet database by 2015 and new registration data by 2016.
[5] Word Bank open data. The number is in constant 2010 USD.

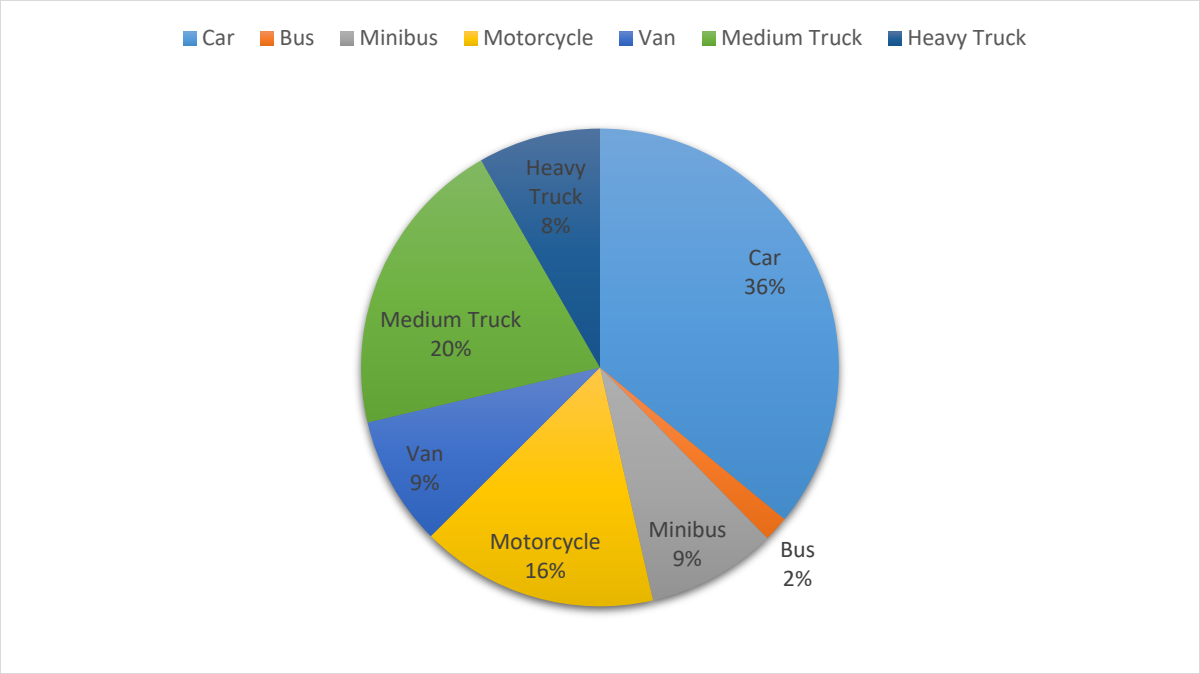


*Figure 1. Vehicle Fleet Constitution in Ethiopia 2015 (Total Stock: 552,000 units)*

Data source: Ethiopia FTA.

13. The GFEI study in 2011 highlighted an aging fleet in the country. Registration data shows that newly registered vehicles fall into two almost distinct categories, either being brand new, or upwards of 8 years old, as shown in Figure 2 below.

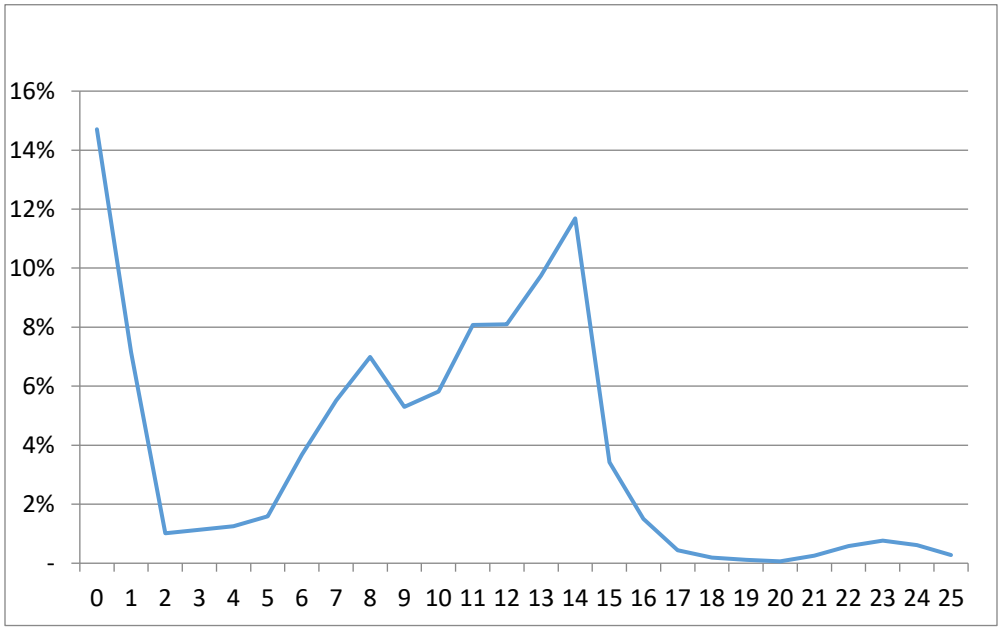


*Figure 2. Age of imported private vehicles (2015)*

Source: FTA vehicle registration data

14. The high cost of vehicle import encourages extended in-service life, meaning that survival rates of older vehicles remain very high. The estimated age profile of the private vehicle fleet is shown in Figure 3 below:

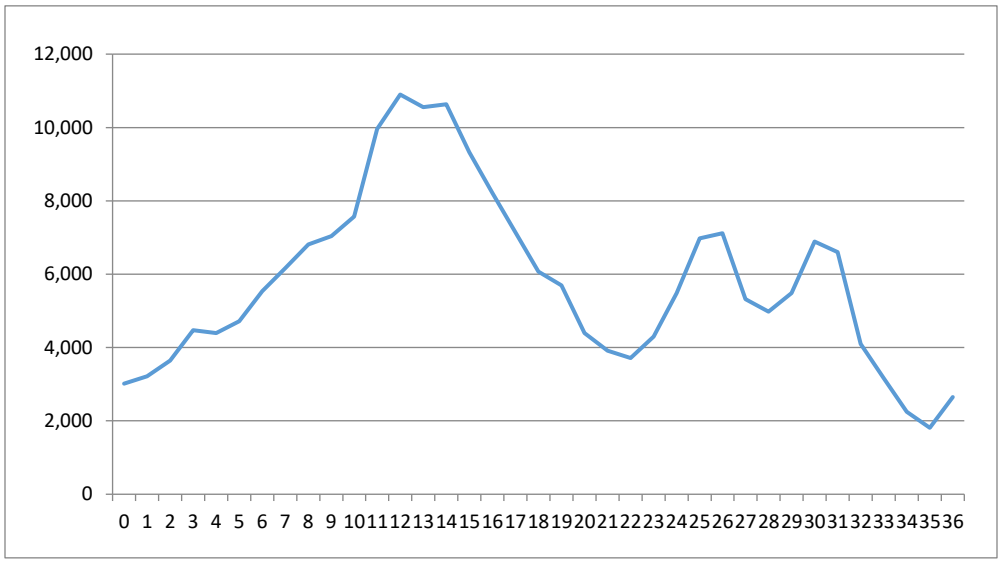


*Figure 3. Age profile of private vehicles in Ethiopia in 2016*

Source: Bank team estimate

15. About 70 per cent of cars powered by petrol engine were pre-1995 models[6], which are over 20 years old now. Over half of them were built between 1982 and 1989. About 99 per cent of motorcycles were two-stroke. Diesel vehicles, however, show a slightly younger fleet with only 50 per cent pre-2000 models[7]. However, without systematic programs for end-of-vehicle life, these aged and high polluting vehicles may potentially form part of the vehicle fleet for years to come. The average age of vehicles in use is estimated to be in excess of 14 years old.

16. The rate of growth in the vehicle fleet and the import of older vehicles, combined with the extreme longevity of the in-use vehicles, highlight the importance of managing not only the number of vehicles entering the country, but also the quality of vehicles being imported.

[6] Registration database from FTA shows 49 per cent of gasoline cars are pre-1995 models. The team believe the FTA data may not have taken into account vehicles scrappage.
[7] Registration database from FTA shows 39 per cent of diesel cars are pre-2000. 25 per cent pre-1995. The team believe the FTA data may not take scrappage into account.

## B. Current motorization policies and practices in Ethiopia

17. This section provides an overview of the factors and policies influencing the growth and use of the motor vehicle fleet in Ethiopia, first with an overview of the local manufacturing capabilities (or more precisely, local assembly), then the vehicles entering into the fleet (which we refer to as "entry vehicles" in this report, whether by import, local manufacture, or assembly from kits), and finally, the use of the fleet in the country. *Table 1* presents an overview and comparison of these main features with Kenya, which is the other country participating in this pilot.

*Table 1. Key characteristics of current vehicle management practices in Ethiopia and Kenya*

| | Ethiopia | Kenya |
|---|---|---|
| **Market characteristics** | Imported, mostly second-hand, LDVs. Imported new engine – chassis system for HDVs, for with nascent local assembly (e.g. HDV bodies) | Imported second hand vehicles, local assembly for 2 and 3-wheelers |
| **Entry filters** | None | 8 years age limit and pre-shipment inspection with defined standards |
| **Technical visits in use** | Yes, for all vehicles | Only for commercial vehicles |

### *1. Heavy Duty vehicles in Ethiopia*

18. Heavy duty vehicles are partially assembled in Ethiopia. The second-hand market in Ethiopia for trucks from Europe has largely dried up, since most of the available second-hand vehicles are now Euro IV or higher, and **they could not tolerate the high sulfur levels in blended diesel in Ethiopian pumps (over 1200 PPM**). Rather, the common means by which trucks enter the Ethiopian market is through importation of new Euro 0 Chassis – Engine systems, with the bodies assembled locally.

19. For example, AMCE is the exclusive importer for Iveco trucks, which are manufactured for the African market in Spain (chassis are imported, but the body is built in Ethiopia). It currently imports between 1200 and 2000 units per year. According to AMCE, full-scale assembly of trucks in Ethiopia is not yet competitive because the relative difference in excise duty rates between fully assembled units and CKDs (currently 5 per cent) is not sufficiently large to make local assembly economically attractive. There is currently no local manufacturing market for the spare parts, and imported parts are both expensive (because of the current tariff and VAT regime) and scarce (because of challenges of hard currency availability).

20. Ethiopian Petroleum Supply Enterprise (EPSE) is mandated to import and supply petroleum to the domestic market in Ethiopia through distribution companies. EPSE determine the

standard of refined petroleum products available in the country, since it is responsible for negotiating the quality specifications of the fuels imported. Currently, EPSE sources over half of its diesel and kerosene / jet fuel from Kuwait under a three year term contract with Kuwait National Petroleum Corporation (KNPC). Current sulfur levels imported are at 2000 PPM, but KNPC is upgrading two of its refineries under a Clean Fuel Project, **which aims to enable these refineries to produce 50 PPM sulfur diesel by the end of 2017**. EPSE also sources **just under half its diesel from annual contracts with traders, primarily from the Sudan, with a fuel sulfur content of about 500 PPM**. This means that the current blend of diesel at the pump is about 1250 PPM, but this could drop to about 225 PPM by end of 2017. Depending on how EPSE manages its Sudan-sourced diesel products, therefore, **operation of Euro IV HDVs may become viable beginning in 2018**. This could lead to a reduction in the importation of new HDVs in favor of second-hand HDVs. Gasoline is also primarily sourced from Sudan with fuel sulfur content of about 75 percent 150 PPM, and 25 percent 50 PPM.

## *2. Light duty vehicles in Ethiopia*

21. There are very few concessionaires selling new cars. Toyota, the main one, sold only 2,300 vehicles in 2015. Second hand cars are generally sourced from continental Europe, Japan, and the Middle East, with buyers usually purchasing from available stocks brought in on spec by relatively small dealers; there are very few specific orders for second-hand vehicles[8].

22. In Ethiopia, newly registered vehicles essentially comprise of new and used imported vehicles, of which the market is heavily skewed for used cars (85 per cent) as a consequence of unusually high taxation on new imported vehicles. For the above reason affordability of private cars is geared towards 10-15 year old cars.

## *3. Market structure in Ethiopia*

23. As of mid-2014, the total Ethiopia fleet was 520,000 vehicles, with an annual inflow of 30,000 imported vehicles and around 8,000 vehicles assembled locally (trucks, cars and buses). Cars represent the major part, and the new car market is around 10 per cent of the total vehicle imports. Importation of trucks fluctuates between 1,500 and 2,000 trucks a year, with half locally completed by AMCE. Imported vehicles are routed through the port of Djibouti.

24. Cars sold by motor vehicle importers, many of whom operate at very small scales and lease space on consignment from larger importers, tend to be old – mostly 10 years old, but up to 15 year old vehicles can be imported. The older vehicles tend to be used for buses and taxis – that is, high mileage uses – while newer cars and vans tend to be imported for personal use.

25. High tax rates and scarcity of forex play a strong role in shaping the market for vehicles in Ethiopia. The high level of taxation on imported vehicles in Ethiopia which tends to favor import of old cars (with lower retail value, leading to lower overall taxation), is structured as follows:

- VAT as related to imported goods including vehicles: rate: 0 per cent or 15 per cent

[8] The Team learned from the interview with second hand vehicle dealers during the first mission.

- Customs Duties for all imported vehicles, rate: 10 per cent or 35 per cent based on capacity of vehicles
- Excise Tax, rate: 30 per cent;60 per cent; and 100 per cent depending on engine displacement volume
- Import Sur Tax, rate: 10 per cent, if applicable
- Income Tax, import related, withholding tax rate: 3 per cent in all cases

This structure means that some imported vehicles face a markup of 100 to 200 percent from taxes alone.

26. At present, there are no specific standards that filter entry of either heavy or light-duty vehicles to Ethiopia. However, the taxation, duties, and fees dis used above, as well as the scarcity of forex, have a *de facto* effect of constraining imports of vehicles generally, and probably largely explain the reasons for Ethiopia's notorious low rate of motorization, as well as the generally poor condition of the vehicle fleet: vehicle owners and operators are incentivized (by taxes) and constrained (by forex scarcity) to keeping their old vehicles running as long as possible, and even longer than possible by other countries' standards.

### *4. In-use vehicles*

27. The Government of Ethiopia has undertaken proactive measures for periodic inspection of safety performance (done annually), which is mandated for all private and commercial vehicles. The inspection tests, carried out by licensed private shops, is comprehensive and suitable for local driving conditions by including dynamic testing of brake performance and individual suspension testing among other visual tests. Around 30 inspection centers are operating in the city of Addis Ababa and another 30 in the rest of the country. At present, there is no mandated inspection of vehicles for emissions, though a number of the providers of safety inspections offer emissions inspections for customers who request them. Generally, this is offered as a diagnostic service for indications of other engine problems, rather than a concern for emissions *per se*.

28. At present, vehicles are registered in zonal offices of regional road authorities (of which there are about 75 across Ethiopia). Odometer readings are not captured as part of registration, and there is no effective requirement for periodic re-registration of vehicles. However, with the development of automated database and registration system through the investment in TRANSIP, the burden of periodic (e.g. annual) re-registration will be negligible, and should be effected.

29. High import duties and vehicle taxation mean that the purchase price of vehicles in Ethiopia, even those which are second hand, are typically upwards of $20,000. Vehicle purchase costs represent fixed costs of motoring, and after the associated duties and taxes are applied, these fixed costs are much higher than in neighboring countries. For example, a Toyota Vitz sold in Ethiopia for $16,000 would be available in Kenya for no more than $8,000.

30. Conversely, the marginal costs related to vehicle ownership in Ethiopia can be considered low by relative standards. Fuel costs of $0.80 per liter for gasoline compares to pump prices of approaching $1 in Kenya, whilst mechanic labor rates are low and costs associated with vehicle

usage such as parking charges, tolls or road taxes are uncommon in Ethiopia. The marginal cost of using a vehicle for the typical 17,000km per annum is therefore mainly driven by fuel costs which amount to around $1,150 per annum.

31. High fixed costs of vehicle ownership set against low marginal costs of usage incentive extending the lifespan of vehicles as far as possible, thus amortising the high purchase price over the maximum number of years possible. 'In use' lifespan in excess of 20 years is not uncommon, even for vehicles imported which are already second hand and considered to have reached the end of their productive life in originating countries. The value placed on even aged and dilapidated vehicles highlights this economic reality with even the oldest vehicles still commanding a value of $5,000 or more.

32. As mentioned above, the Ethiopia Petroleum Supply Enterprises (EPSE) is responsible for developing petroleum supply contracts for Ethiopia, as well as for administering and collecting the various taxes and levies on petroleum products at the point of supply. The price structure as of January 2015 is shown in Table 2, and current retail prices as of March 2017 in Table 3 below.

*Table 2. Regular gasoline and kerosene price breakdown, Birr per liter (effective January 31, 2015)*

| S/N | Description | Regular Gasoline | Kerosene | Variance in price | Variance per cent |
|---|---|---|---|---|---|
| **1** | Border price | 8.5016 | 9.323 | -0.8214 | -10 per cent |
| **2** | EPSE's margin | 0.0977 | 0.08 | 0.0177 | 18 per cent |
| **3** | Product cost | 8.5993 | 9.403 | -0.8037 | -9 per cent |
| **4** | Excise tax (30 per cent on 1) | 2.55048 | | 2.55048 | 100 per cent |
| **5** | VAT (15 per cent on 1+4) | 1.657812 | | 1.657812 | 100 per cent |
| **6** | Road Fund | 0.095 | | 0.095 | 100 per cent |
| **7** | Municipality Tax | 0.02 | | 0.02 | 100 per cent |
| **8** | Stabilization Fund | 4.2839 | 3.7286 | 0.5553 | 13 per cent |
| **9** | Total Duty | 8.607192 | 3.7286 | 4.878592 | 57 per cent |
| **10** | EPE Invoice Price (3+9) | 17.206492 | 13.1316 | 4.074892 | 24 per cent |
| **11** | Distribution Margin | 1.0059 | 0.9984 | 0.0075 | 1 per cent |
| **12** | **A.A. Retail Price (10+11)** | 18.21 | 14.13 | 4.082392 | 22 per cent |

Source: Tegegne Mekuria. October 2015. Assessment of Regular Gasoline Adulteration at Addis Ababa Fuel Stations. Addis Ababa University.

*Table 3. Fuel retail price, Birr per liter (effective March 10, 2017)*

| | | variance (gas-kero) | variance per cent |
|---|---|---|---|
| **Benzene** | 18.77 | | |
| **White diesel** | 16.35 | | |

| | | | |
|---|---|---|---|
| **Kerosene** | 16.35 | | |
| **Light black diesel** | 14.01 | | |
| **Hard black diesel** | 13.37 | | |
| **Airplane fuel** | 16.07 | | |
| **Regular gasoline** | 19 | 2.65 | 14 per cent |

Source: Ministry of Trade. http://addisfortune.net/articles/ministry-revises-fuel-retail-price-2/

## C. Forecast of Business-as-usual vehicle fleet profile

### *1. Current vehicle fleet and recent import trends*

33. Data on vehicles imported to Ethiopia has been used to construct a snapshot of the present vehicle fleet. However, the fleet size and composition is continuously evolving, driven by purchasing decisions and the lifecycle of in-use vehicles.

34. Recent vehicle registration patterns provide insight into the direction of travel. Figure 4 below shows the number of vehicles imported annually over the last decade.

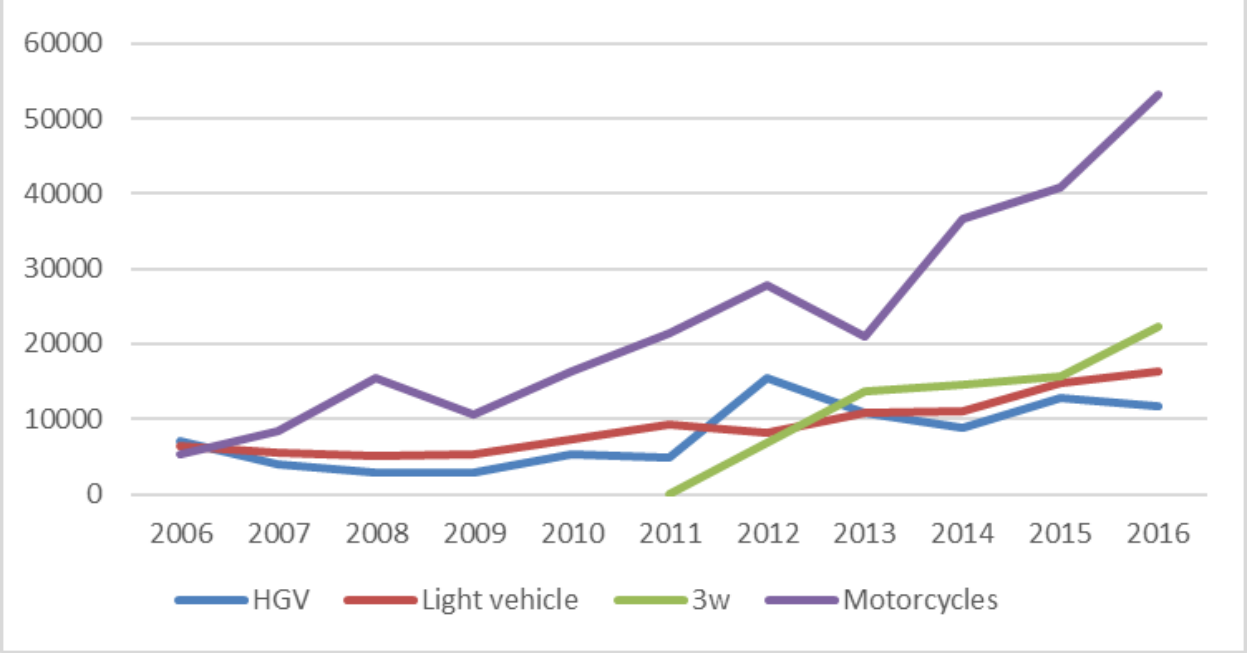


*Figure 4. Vehicles imported into Ethiopia*

Source: ERCA import data

35. In all vehicle categories, the number of units purchased exhibit an upward trend. Particularly strong growth is seen in the two and three-wheel categories. Motorcycle imports have

been increasing by over 25 per cent per annum, whilst three-wheelers, having only become prevalent in the last 5 years, are now outstripping light vehicle import figures. In aggregate, the number of vehicles entering the fleet each year result in fleet growth in excess of 10 per cent per annum.

36. The observed rate of growth in imports provides valuable insight into the trajectory for fleet size, but import records also provide valuable information on the characteristics of the vehicles being purchased, which will influence fleet composition going forwards. A snapshot of recent import records as shown in Figure 5 shows that the import of aging cars (8 years or older) is common. For goods vehicles and motorcycles, the majority are imported new of nearly new.

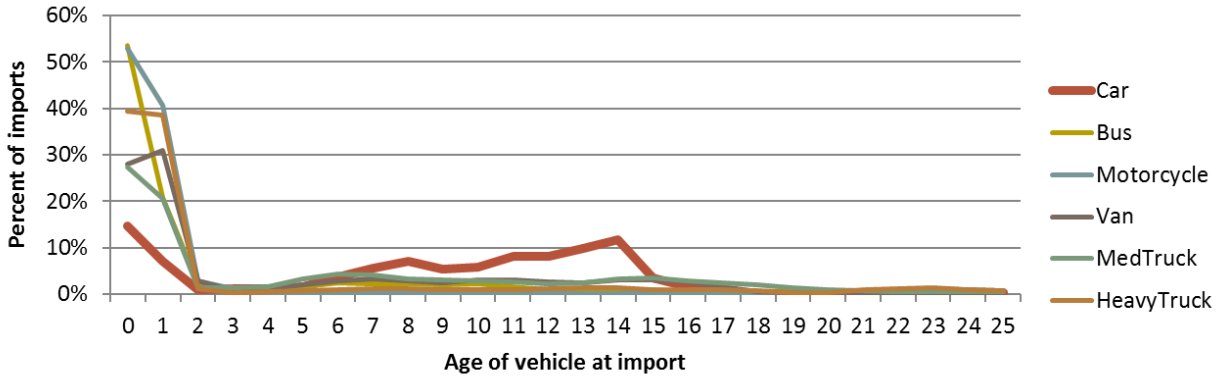


*Figure 5. Age of imported vehicles in Ethiopia in 2016*

37. Purchasing trends captured within the registration data suggest a move towards diesel vehicles in the light vehicle category, with diesel vehicles constituting 38 per cent of imported cars compared to the fleet average of 23 per cent. The typical engine size of a gasoline vehicle is 1.5l which is typical of the historic fleet, whilst the trend in diesel car purchase is towards larger engine vehicles, with the average engine size for newly imported diesel vehicles observed to be 3.7 ltr as compared to the historic 3.0 ltr average.

## *2. Future vehicle fleet modelling*

38. There are a range of different factors which have influence over the future trajectory of vehicle fleet growth and composition under the present policy framework ie. the Business as Usual scenario. These include:

- Rate of economic growth (GDP) influencing in particular the demand for goods vehicles;
- Household income growth which determines affordability of private vehicle purchase;
- Availability of foreign currency which presently has constraining impact on imports;
- Timeline for improvement in fuel quality, which presently limits vehicle technology options;
- Transport supply side conditions including quality of highway network, and the provision and quality of public transport as an alternative to private vehicle usage.

39. A vehicle fleet model has been developed and populated with the vehicle import data. Future vehicle trend projections are made by applying relationships between vehicle ownership rates, income levels and economic growth. Fleet composition changes are driven by the evolution in the vehicle technologies available for import, both on the demand side (eg fuel quality constraints) and supply side (technology standards prevailing for new and used vehicles in main markets of export).

## *3. Vehicle ownership and fleet projections*

40. Whilst the factors driving vehicle ownership are multi-fold, there is typically a strong relationship observed between income levels and ownership rates. National income (GDP) capturing the economic activity of the country has close links with the demand for goods vehicles, which for private vehicles it is household or per-capita income which is of relevance.

41. A car ownership model based on income levels has been estimated using vehicle ownership rates observed in other African countries, resulting in a Gompertz curve formulation. Ethiopia's vehicle ownership rates sit below that expected of a country with its income level, reflecting the taxation levels and wider constraints on vehicle import. Adjusting for this lower starting point, the ownership trajectory has been applied using economic and income growth projections.

42. The forecast evolution in car and vehicle ownership is shown Figure 6 below:

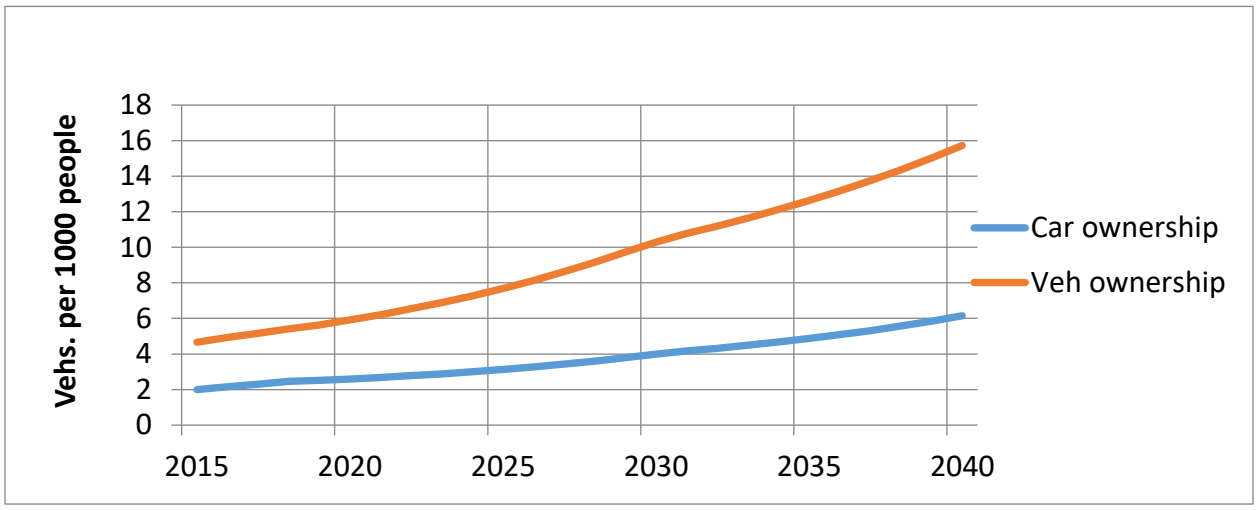


*Figure 6. Trends in vehicle ownership in Ethiopia (2015-2040)*

Source: World Bank Team

Car ownership rates are projected to increase from 2.2 cars/1,000 population (2016) to just under 5 cars/1,000 population by 2035, representing a doubling of the car ownership rate within 20 years. Vehicle ownership (excluding motorcycles) is also forecast to grow rapidly, exhibiting almost 250 per cent growth within 20 years. Motorcycle ownership is modelled separately using a similar Gompertz construction with lower ownership saturation rates reflecting evidence that motorcycle

ownership grows rapidly at lower income levels, but levels off as car ownership becomes within reach.

43. Over this time, the population is also not static, with recent population growth estimated to be in c. 2.5 per cent. The compounding effect of ownership rates and population growth on the vehicle population is shown in the figure below.

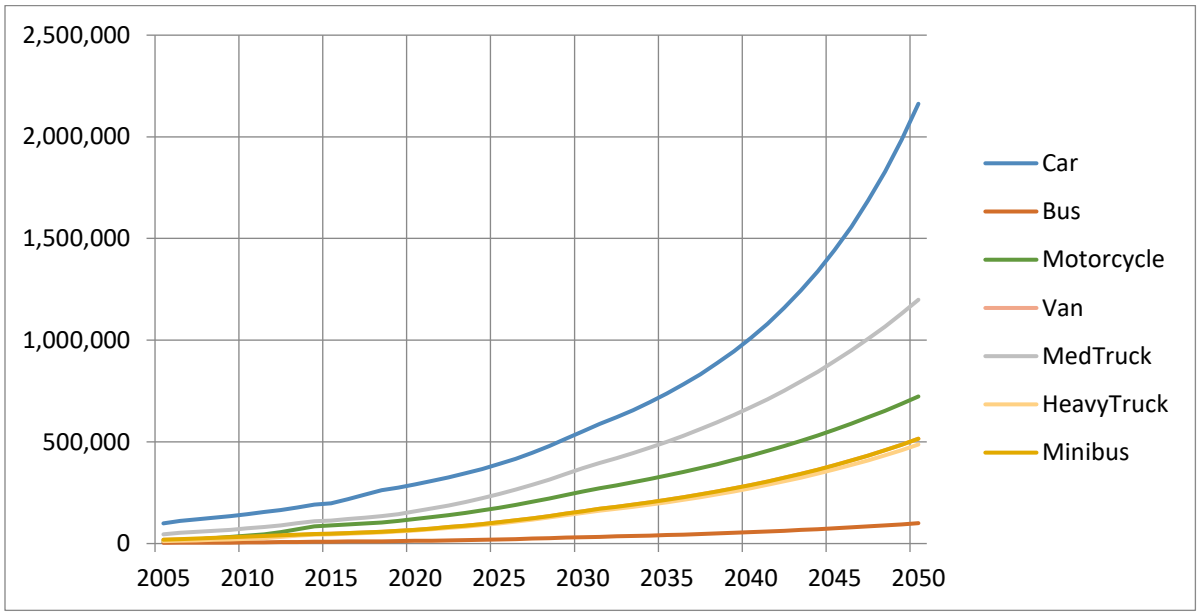


*Figure 7.Compounding effect of ownership rates and population growth on the vehicle population*

Exponential growth is observable across all vehicle types. Overall fleet size increases from 552 thousand vehicles (2015) to 1.68m by 2030, a growth of 300 per cent. The number of car vehicles is projected to grow from 219 thousand to 552 thousand by 2030, and to over 2 million by 2050.

## *4. Implications of the Business as Usual Scenario*

44. The projected growth in the size of Ethiopia's vehicle fleet based on present policy has significant implication for the country, from an economic, social and environmental perspective. From one aspect, the increase in vehicles is driven from a needs perspective, with the larger fleet able to meet people's mobility requirements and also support the economic development of the country.

45. There are however there are also negative aspects of increasing motorization rates. Increased congestion, accident rates and pollution are byproducts of greater vehicle usage, and there are also adverse economic implications of increasing fuel dependency.

46. To understand the scale of these impacts, we need to relate the increasing vehicle fleet to transport activity. Activity rates vary by vehicle type and intended usage, with commercial vehicles for example expected to have higher utilization rates than private car or motorcycles. In the absence of robust local data on typical vehicle usage (for example odometer readings during

periodic testing) utilization rates have been estimated based on evidence from a statistical review of transport operations undertaken by UITP/UATP[9]. The annual km utilization rates adopted within the model are as follows:

- Car - 17,000km/yr
- Bus - 30,000km/yr
- Minibus - 30,000km/yr
- Motorcycle - 7,000km/yr
- Van - 30,000km/yr
- Truck - 33,500km/yr

47. The differing rates of vehicle utilization mean that the pattern of overall vehicle activity and forecast future activity levels differ from fleet profile. Figure 8 below summarizes forecast vehicle activity projections.

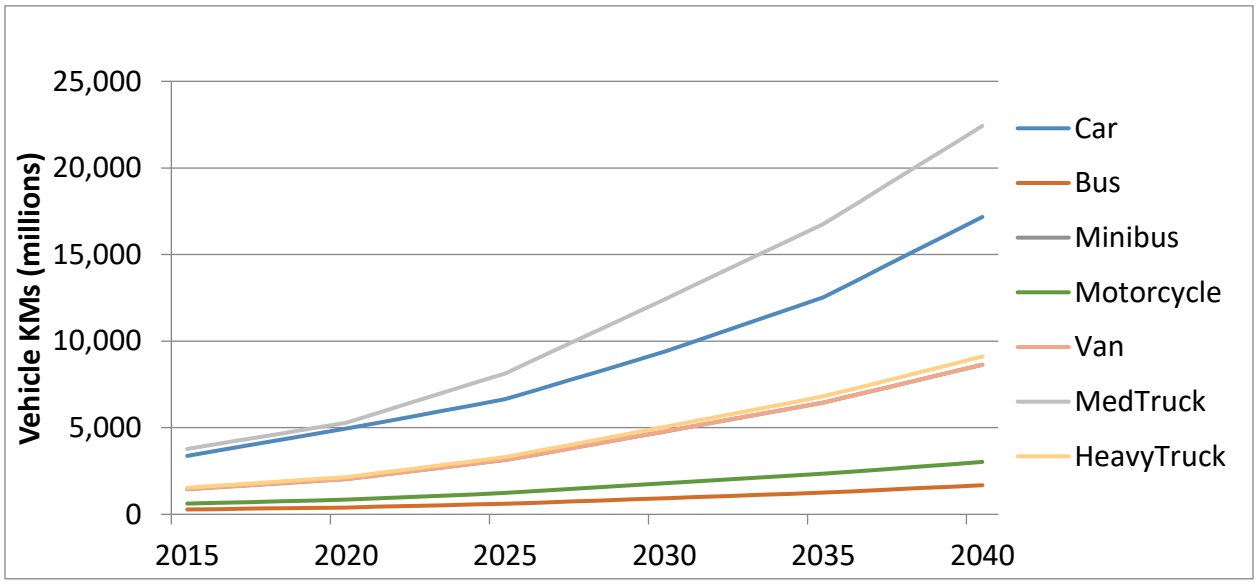


*Figure 8. Forecast vehicle usage in Ethiopia*

Goods vehicle activity appears strongly as a proportion of overall vehicle activity, reflecting the higher utilization rates.

48. As can be seen from Figure 9 below, goods vehicles exhibit a higher average fuel consumption, and hence the activity pattern presented above has important implications for fuel burden and emissions levels.

[9] Report on Statistical Indications of Public Transport Performance in Africa, UITP.UATP, April 2010

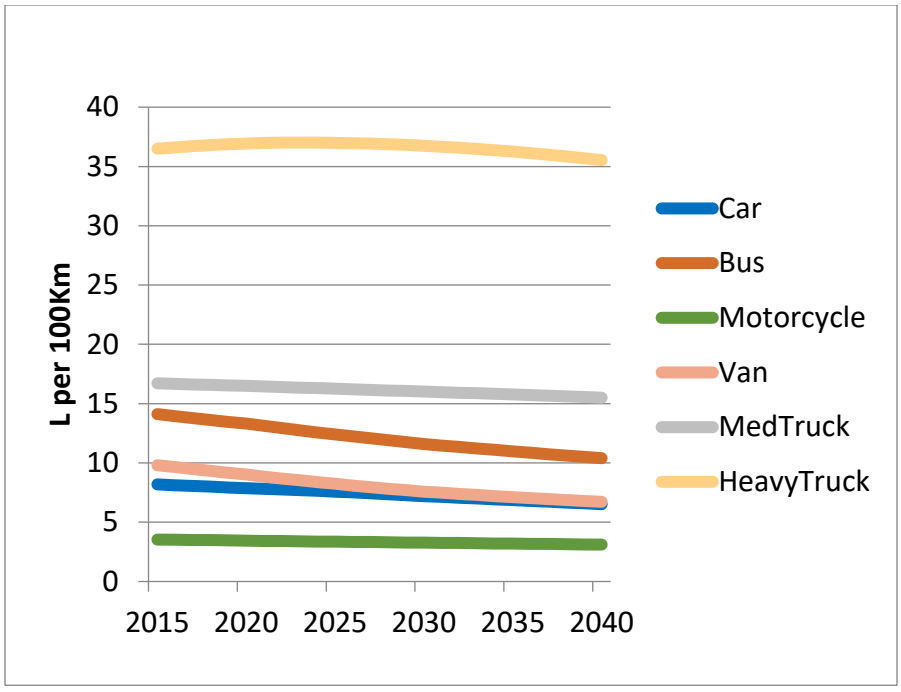


*Figure 9. Average fuel consumption.*

Source: team calculations

49. With newer vehicles entering the fleet over the forecast period, some of which being replacements for aged vehicles at the end of their lifecycle, the newer technology of these vehicles typically brings efficiency gains in terms of fuel consumptions. For light vehicles, the trend towards smaller more efficient vehicles observed in the main export markets can be expected to filter through to the types of vehicles being imported. For the heavy goods vehicles, the anticipated increase in fuel quality will allow the import of second hand Euro III/IV vehicles rather than the current limitation to Euro II vehicles. The higher vehicle standards bring significant benefits with regard to reduction in local air pollutants but this comes at a cost of a small reduction in fuel efficiency as compared to the new vehicles presently imported.

50. In aggregate, the rapidly increasing vehicle fleet and growth in vehicle activity projected of the modelled period necessarily leads to a significant increase in the fuel requirement as shown in the figure below. With fuel import placing a strain on present foreign currency requirements, this constraint can be expected to worsen going forwards.

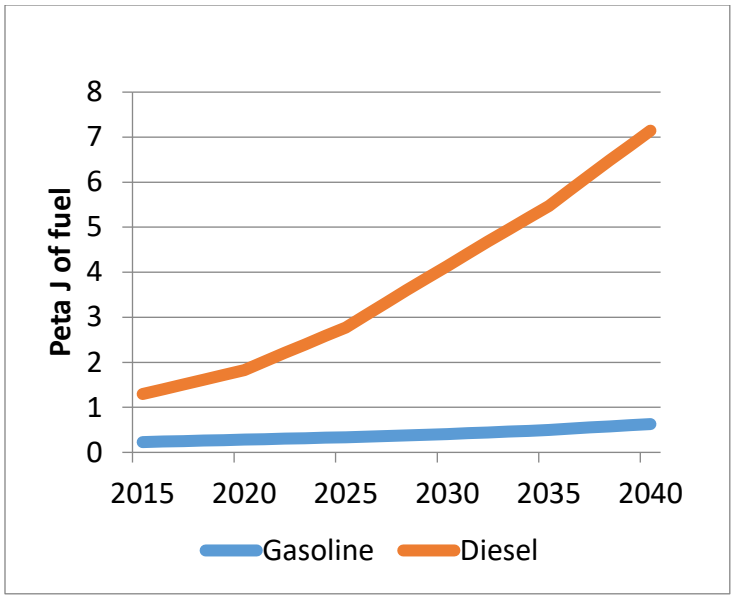


*Figure 10. Annual fuel use in Ethiopia for transport*

Source: WB team

51. Increased fuel consumption has a direct correlation with greenhouse gas emissions which are hence also predicted to grow exponentially over the forecast period, increasing by around 470 per cent by 2040, as shown in Figure 11.

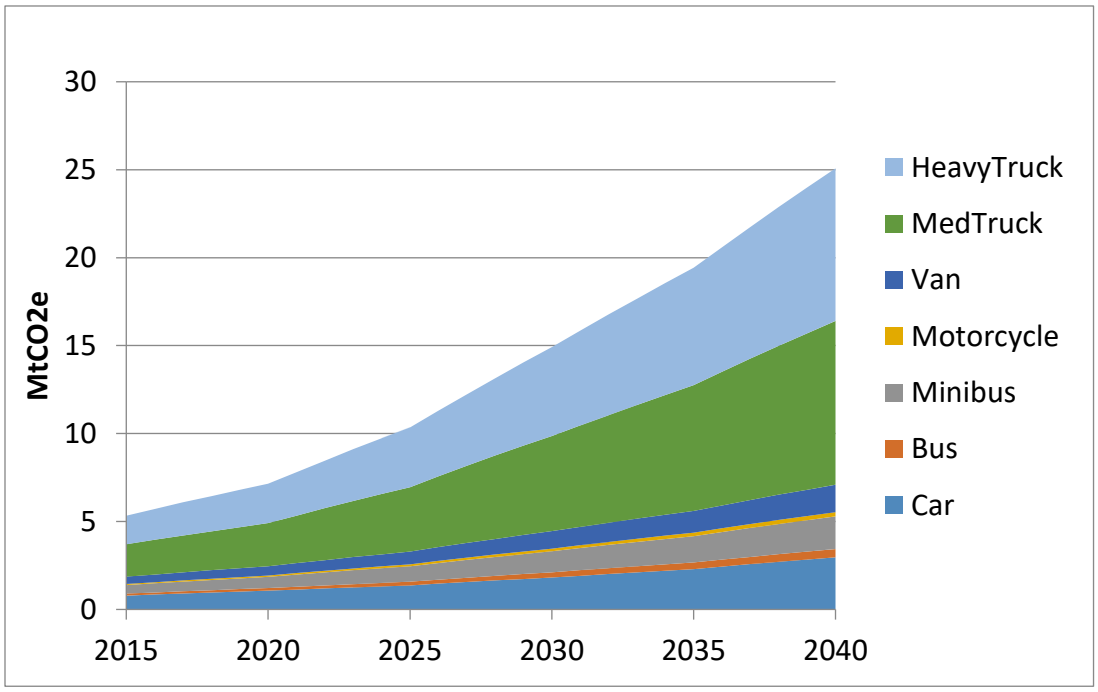


*Figure 11. Greenhouse gas emissions from transport (annual)*

52. New vehicle technologies bring the potential for significant improvements in the capture and reduction of local air pollutants. However, under the business as usual scenario, the slow 'trickle-down' of these technologies into the vehicle fleet as a result of importing already aged vehicles and also the recent trend in the shift toward larger-engine diesel vehicles means that the generation of some of the most harmful local air pollutants including particulate matter (PM) and nitrous oxide (NOx) is forecast to increase also, as shown in Figure 12 below.

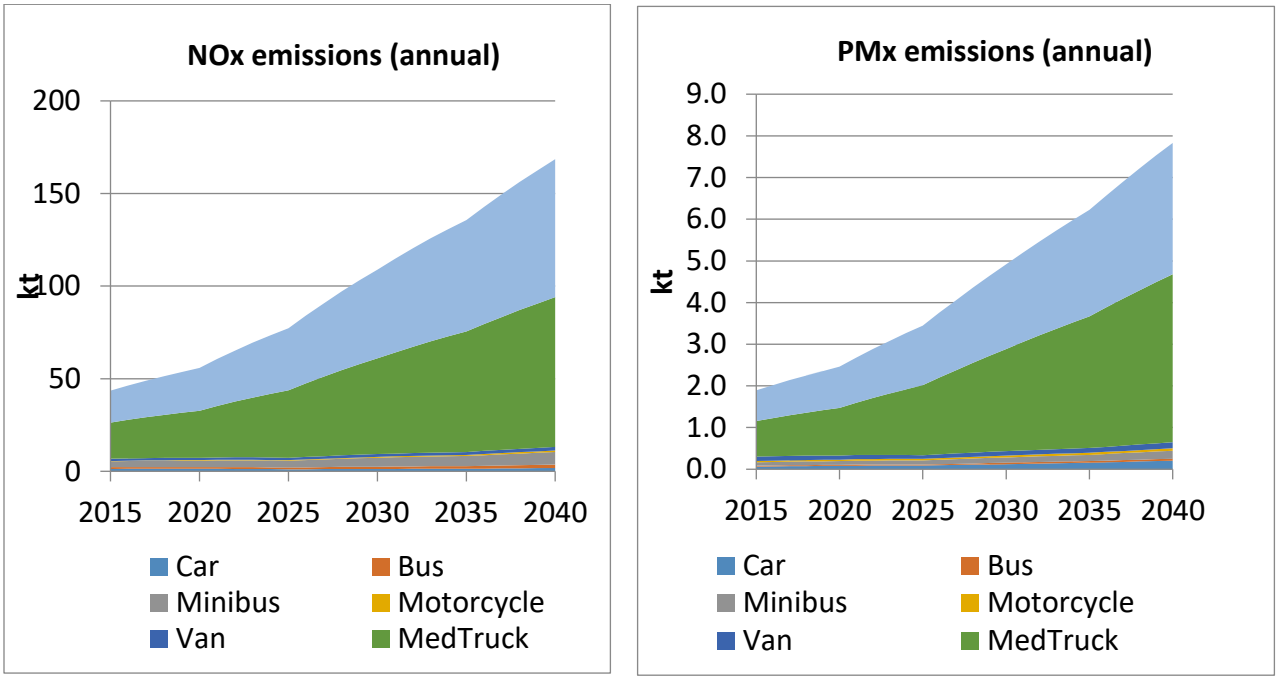


*Figure 12. NOx and PMx emissions from transport in Ethiopia*

Source: WB team calculations

53. In addition to the increase in greenhouse gas emissions and a deterioration in local air quality caused by local air pollutants, Ethiopia can expect the growth in motorization to lead to worsening congestion, particularly in urban areas, and also a greater number of road accidents. In particular, the rapid increase in the motorcycle fleet can be expected to lead to higher numbers of accidents due to the higher casualty rate typical of this form of transport.

54. The Business as Usual scenario presented above underlines the need for a policy framework which is specifically targeted at the management of motorization growth in the country, ensuring that the number and type of vehicles being imported are those most suitable for the development of the country and that the adverse impacts related to increasing motorization and mitigated where possible.

## D. Summary of the Motorization Diagnostics

55. The discussion in this chapter has highlighted some disturbing trends that result from the way motor vehicle growth is currently managed in Ethiopia. Fossil fuel consumption is expected to increase substantially, as are emissions of key pollutants harmful to human health in urban areas. As vehicle use increases, so too will the number of serious crashes, especially if travel speeds remain as they are or, consistent with stated policy objectives, improve. That there are no regulatory standards on crash safety will increase the numbers of fatal and serious injuries as a result.

56. The rate of fleet growth is still highly constrained by the tax rates and available hard currency, and there is still a good window of opportunity in Ethiopia to effect the changes in the fleet profile and raise the bar for fleet quality for the decades to come.

57. The key takeaway messages from the above analysis are highlighted in the Spotlight box below. These messages form the basis for the proposed methodology, implementation support programs, and principles presented in Chapters III to V, and assessed in Chapter VI.

### Spotlight

#### Key Messages from the Motorization Management Diagnostics in Ethiopia:

- Ethiopia's existing vehicle fleet remains relatively small and fairly old (over 14 years old on average).
- Currently, the high tax rates and scarcity of foreign currency play a strong role in shaping the vehicle market, *de facto* encouraging imports of obsolete vehicles and an extended in-service life. The (relatively) slow growth in the vehicle fleet combined with the old age / poor emissions characteristics of the fleet result.
- Any effort to encourage fleet *turnover* by changing vehicle taxation rates and / or access to hard currency would also likely encourage explosion in the motorization rates without additional policies to manage demand for vehicle ownership. These risk taxing the absorptive capacity of the existing road network.
- Notwithstanding tax rates and access to hard currency challenges, the fleet as a whole has grown at 10 per cent annually over the past five years, while motorcycle ownership has growth 25 per cent annually. This has strong implications for deterioration of road safety if this trend towards motorcycles continues.
- Deterioration in local air quality, with substantial increase in NOx and PM emissions, is projected under the BAU scenario without more stringent emissions control efforts from both new and in-use vehicles
- There is no entry filter at all, neither age-based nor performance-based, for Ethiopia vehicles. It is important to design and apply entry filter that balance the rate of fleet growth with attention to the fleet characteristics (i.e. vehicle safety, tailpipe emission

and fuel economy). The absence of such filters for vehicle emissions and crash safety will mean that unsafe and dirty vehicles can still be oriented to and sold in Ethiopia.

- Fuel quality in Ethiopia remains an outstanding issue. Not lowering mandated fuel sulfur levels in fuels constrains the country's ability to continue to import recent vintage vehicle models into the country and to mandate more stringent vehicle emissions standards, and exposes the country to targeting of low-quality fuels by unscrupulous traders.
- Purchasing trends captured in registration data suggest a move towards diesel cars in light vehicles and a preference for larger engine size. This has strong implications for fuel economy and pollution emissions such as PM.

# III. Concepts and scope of motorization management

58. This chapter addresses some of the core principles behind the concept of motorization management. The objective is to lay out a vision of managing motorization that is generally more comprehensive, far reaching, and coordinated than traditional policymaking has pursued, not only in Ethiopia and Kenya, but also in many developing countries primarily dependent on imports of used vehicles as a source of fleet growth. This vision requires broad buy-in by actors across government at the national and sub-national levels, but most immediately and prominently, from the Ministry of Finance if it will be successful.

59. At the core of the motorization management concept are a series of implementation programs designed to work in harmony to effect policy change toward commonly understood and agreed-upon policy goals. While we urge that the goals and the specific measures adopted to reach them take into account the key findings of the diagnostic of the last few chapters, it is not the explicit intent of this report to recommend specific goals, measures, nor methods for attaining agreement on them. These are considered to be fundamentally national policy questions. However, the series of programs that are meant to form the core of the recommendations of this report are intended to provide guidance on resolving the implementation challenges likely to be associated with any policy.

60. Before discussing the 12 recommended implementation programs, which were discussed extensively during workshops with stakeholders, this chapter provides some context of broader motorization management concepts. We begin with some definitions.

## A. Common definitions

61. There is need for consistent definitions of terminology can help clarify expectations. The key definitions used throughout this report are presented below:

- *Motorization* – process by which a country adopts and uses motor vehicles
- *Vehicle penetration rate* – number of vehicles per 1000 persons at a given point in time. This can be given as:
    - Light duty / car penetration rate
    - Total vehicle penetration rate
- *Motorization rate* – rate of change of vehicle penetration rate
- *Saturation level* – expected vehicle penetration rate at end of motorization process (asymptote)
- *Market-Specific First-Use Vehicles (MSFUV)* – vehicles produced (domestically or abroad) for explicit first-use in the country in question
- *Generalized First-Use Vehicles (GFUV)* – vehicles introduced for first-use into country in question, but not explicitly produced for use in that country
- *Second-hand vehicles (SHV)* – vehicles which have been registered and used in another country prior to arrival in subject country for transportation use
- *Complete Knock Down (CKD)* – vehicles assembled domestically on the basis of designs developed and parts manufactured elsewhere, usually imported as kits

- *Entry vehicles* – the sum of all vehicles being added to a country's vehicle fleet in a given time period with the expectation of being used. This can include any of the above: MSFUVs, GFUVs, SHVs, and CKDs.
- *Retired vehicles* – the sum of all vehicles that stop being used in a given time period, usually because of either obsolescence or incapacitation
- *Net change in national vehicle fleet* – the difference between entry and retired vehicles over a given time period
- *Type Approval (TA)*– procedure by which each vehicle type produced for the particular market is determined to meet all the technical and administrative requirements established in a given regulatory regime in place
- *Conformity of Production (COP)* – related process to Type Approval which confirms that each vehicle is manufactured in accordance with approved specifications
- *Vehicle kilometers traveled (VKT)* – the sum of all kilometers traveled by all vehicles over a given time period.
- *Passenger trip* – movement of a person to a destination for the purpose of carrying out an activity of inherent value to the traveler
- *Tonne-value movement (TVM)* – displacement of a given unit of ton-value (e.g. value per ton) in a manner that adds discrete and measurable value to the good(s) unit in the production / consumption chain.

## B. Concept of motorization management

62. Motorization is a technology diffusion process, and as any such process, it tends to follow a logistic distribution over time. This is portrayed abstractly in Figure 13 below.

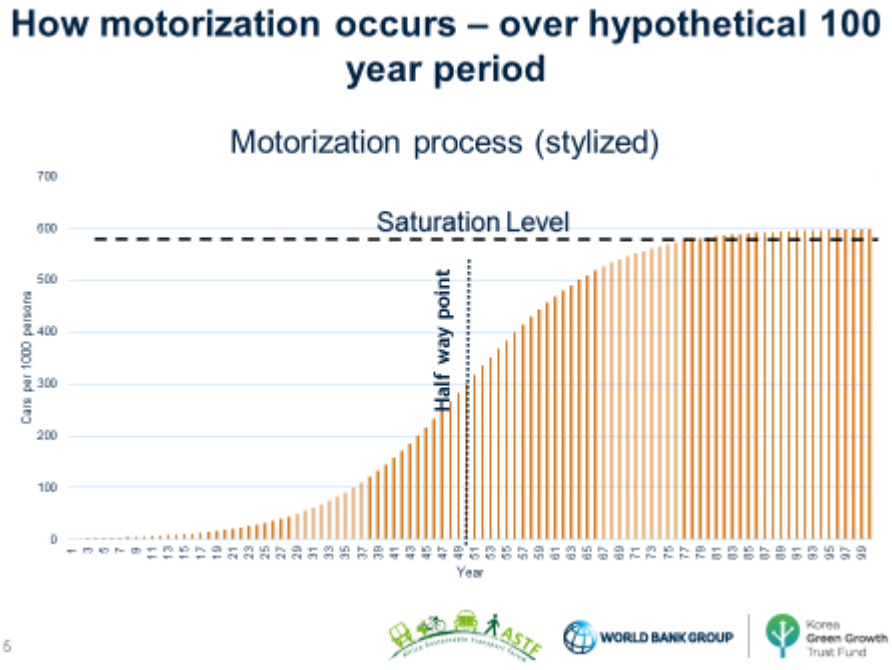


*Figure 13. Stylized motorization process*

Vehicle adoption begins relatively slowly, but then progressive rapidly at the steepest point in the slope, before tapering off as the society approaches a hypothetical "saturation" level, which, in the above figure, is identified around 600 cars per 1000 people, on the order of magnitude of North America. In 2016, Ethiopia only had about 6 vehicles per 1000 people, placing it on the very left side of the motorization curve before the inflection point toward the steep slope.

63. At its most basic level, motorization management is the process of shaping, through public policies and programs, the profile, quality and quantity of the motor vehicle fleet as it progresses through the above process. It is based on the premise that not only can the quality of vehicles can be influenced by public policy, but so too can the shape of the curve portrayed in Figure 13. The need to do so is premised on the assumption that the amount of investment in road and vehicle storage facilities that would be required to accommodate the steep growth implied by the central part of the curve in the figure would be both fiscally straining and economically inefficient in terms of resource use for a developing country, so public policy needs to try to "bend" that curve as much as possible.

64. Two mutually supportive and complementary strategies to do so include both trying to delay or draw out the process of motorization (that is, "flattening" the steep part of the slope in the above figure so that the rate of change is not as big), and working to reduce the "saturation level" asymptote to which the motorization process tends. Broadly, the first of these methods can be driven by putting in place policies that favor more shared transportation and non-motorized accessibility, while the second approach would seek to innovate a new paradigm of infrastructure investment and transport pricing different from that pursued in OECD countries, particularly in North America and Australia. These are demonstrated graphically in **Error! Reference source not found.** and 15 below.

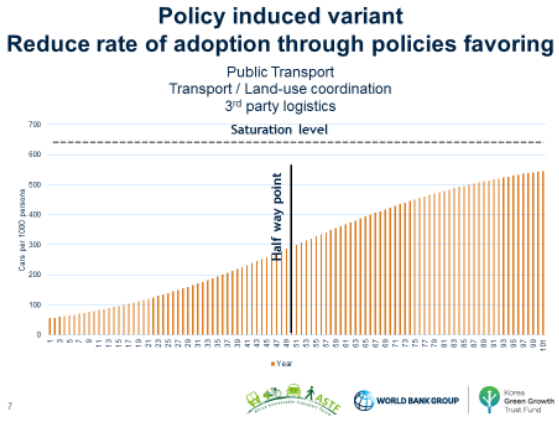


*Figure 14. . Policy variant case 1*

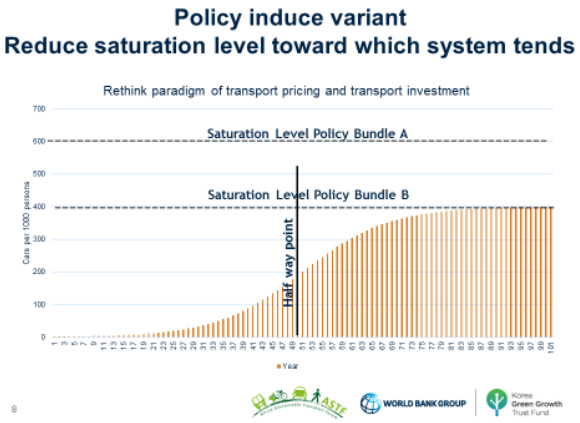


*Figure 15. . Policy variant case 2*

*Text Box 1. Motorization, pricing, and investment*

Investments and policies can affect motorization rates, particularly by altering the trajectory "saturation" level to which the system tends. This occurs by affecting the system of costs which motorists and potential motorists are subjected. This system of costs includes:

Shadow costs: the set of costs that may not be paid out-of-pocket by motorists, but nevertheless define some *de facto* willingness-to-pay differential based on the implied costs of the options. A primary public policy determinant is the type and quantity of infrastructure developed. In environments with substantial investments in public transport and minimal investment in road space for private cars, (e.g. Tokyo) the shadow-cost of car-use might be quite high. On the other hand, in a country with substantial investment in road space for private vehicles but minimal investment in public transport (e.g. Phoenix), the shadow-cost of public transport use is quite high.

Fixed costs: the set of out-of-pocket costs paid by motorists on a one-off basis, such as purchase costs (including taxes, import duties, etc.) or periodic basis, such as registration fees, insurance, vehicle storage, etc. Primary public policy determinants include taxation rates and import duties on entry vehicles, costs of registration and frequency requirements for renewals, insurance requirements, etc. Some jurisdictions also require Certificates of Entitlement to own or lease vehicles, and in these cases, the costs of these certificates would also be part of the fixed costs.

Variable costs: the set of out-of-pocket costs paid by motorists as they use the vehicle, such as fueling costs, parking costs, tolls, and wear-and-tear (i.e. maintenance / depreciation) on the vehicle. Primary public policy determinants include fuel taxes or subsidies, parking management approaches, especially in cities, and tolling or road pricing policies, if they exist.

These mechanisms are summarize in Figure 16 below.

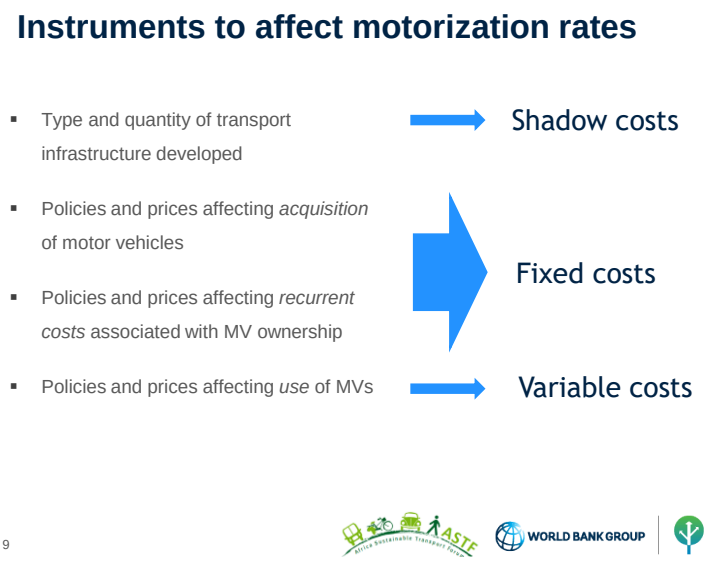


*Figure 16. Instruments to affect motorization rates*

65. Motorization management as we understand the concept focuses primarily on vehicles, but it is important to remember that what matters for safety, emissions, fuel consumption and broader transport policy objectives such as limiting the extent and impact of congestion, is how those vehicles are *used*, that is, the characteristics of vehicle kilometers traveled (VKT) as a whole in a country or city; VKT drives these negative impacts, efforts to reduce the total amount of VKT and the negative effects of each VKT are both required. In other words, understanding and influencing the profile of the vehicle fleet is only part of an integrated motorization management approach; it is also important to understand and influence how those vehicles are used.

66. In broad terms, VKT is understood as a *cost* – both private and social – while trips and tonne-value movements (TVM) are proxies for the *benefits* from transport. VKT imposes costs on individuals and society as a whole. For individual vehicle owners, VKT requires expenses to own and operate a vehicle or to purchase services from an operator, while for public authorities, it requires expenditures on transport infrastructure, creates hard currency pressures to meet current and future hydro-carbon supply requirements, and demands politically challenging management of negative impacts that affect society as a whole, such as exposure to traffic hazards, air pollution, and recurrent, but often random, network congestion.

67. The *benefits* from transport for individuals and societies, on the other hand, stem from increased *accessibility* to opportunities, including employment and labor markets, social services, wholesale and retail markets, raw materials, and social and recreational activities. Person trips and TVM provide a convenient and easily measured proxy for such accessibility, and are thus considered to represent the benefits from transport. In this understanding, a sustainable transport policy broadly aims to maximize social welfare by maximizing the ratio of trips to VKT and/or the ratio of TVMs to VKT, and by minimizing the negative externalities associated with VKT. Motorization management, therefore, can be understood as the public policy approach specifically to accomplish the latter, that is, improve the *quality* of VKT – that is, minimize the negative externalities associated with VKT.

## C. Scope of integrated motorization management

68. Efforts to improve the quality of VKT need to be approached comprehensively. They need to address the full range of problems or costs that are associated with VKT, alluded to in the discussion above, and they need to do so at all phases of the vehicle's lifecycle within the control of a given country's policies, from the moment the vehicle may potentially enter the country's fleet to the process by which it is discarded at the end of its life. The scope for action is potentially enormous, but real world limitations bound the analysis. We identify these limitations as related to three characteristics: tradeoffs in desired outcomes, possible points of influence, and implementation viability. Otherwise stated, these limitations relate to policies, politics, and practicalities.

69. On one level, desired policy outcomes can pursue multiple objectives which sometimes are mutually reinforcing, and sometimes conflicting. For this reason, we believe that policies discussions should encompass all of the following five key attributes:

- Minimizing tailpipe emissions (making vehicles cleaner);
- Minimizing vehicular energy consumption, particularly of non-renewable hydro-carbons (making vehicles more efficient);
- Minimizing motor-vehicle related fatalities and serious injuries associated with sub-standard vehicles and poor maintenance practices (making vehicles safer);
- Keeping growth of overall vehicle fleet in line with national and metropolitan aspirations and intended quantity and quality of infrastructure investment (taming rampant growth of fleet); and
- Managing the fiscal impact accompanying the motorization process (keeping the budget balanced).

The first four of these represent key policy objectives, while the fifth represents an impact that needs to be measured, planned for, and, as necessary, mitigated against.

70. Note that the team does not include mitigating climate change (limiting GHG emissions) in this list. This omission has been done explicitly, not because GHG emissions reduction is not considered to be a worthwhile goal in its own right, but rather because: 1) from the standpoint of the national government, the goal of limiting hydrocarbon hard currency expenditures is a more compelling short-term economic need, and would also concomitantly reduce GHG emissions by involving largely the same measures (namely, improving efficiency of internal combustion engine vehicles and moving away from dependency on internal combustion engines over the long run); and 2) it is common for non-experts to confuse measures to reduce pollution emissions with those to improve fuel economy (they are not only not the same, but often require different kinds of policies to enact them), and the team finds that any discussion of GHG or $CO_2$ emissions reduction can often just exacerbate this confusion. It is simpler to talk about emissions on the one hand, as a phenomenon of pollution, in terms of Particulate Matter (PM), Oxides of Nitrogen (NOx) and Sulfur (Sox), Non-methane hydrocarbon (NMHC), carbon monoxide (CO) etc., and on the other about vehicle fuel economy.

71. On a second level, who can be influenced to do what is also an important limitation that needs to be taken into account in any motorization management strategy. Careful selection of inflection points is important: vehicles entering the fleet, vehicles in-use, vehicles whose use should be ramped down or phased out, and broader policies that condition the attractiveness of vehicle use are all potentially important questions in thinking of a broad motorization management policy. (See Figure 17)

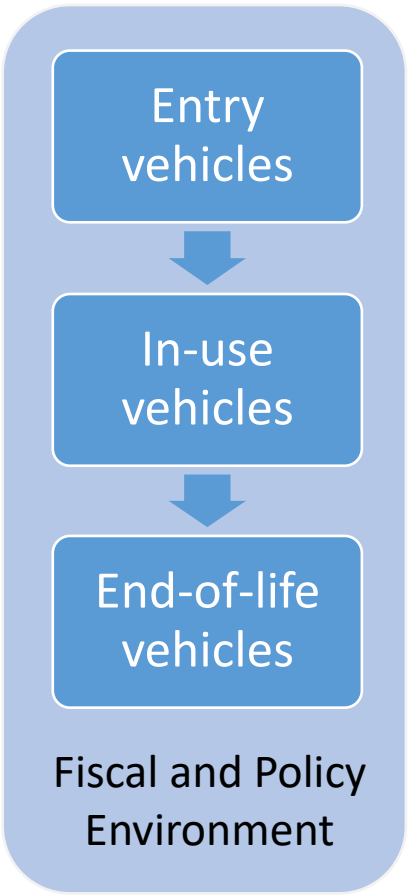


*Figure 17. Lifecycle approach to motorization management policies*

- Quality of the vehicles entering the fleet, including general first-use vehicles, market-specific first-use vehicles, knock-downs, and, particularly important for Ethiopia and Kenya, second-hand vehicles;
- Maintenance and performance standards of in-use vehicles;
- Reduction in the use, and eventual removal, of obsolete vehicles – that is, vehicles that impose a high environmental or safety cost on society for each vehicle kilometer traveled; and
- Effective fiscal policies that govern and send the right signals about vehicle usage generally, including:
  - Appropriate relationship among costs of vehicle acquisition, ownership, and use;
  - Revenue-raising methods;
  - Vehicle use pricing, e.g. parking management, road tolls, area cordons, etc.;
  - Fuel consumption pricing, e.g. externality taxes, subsidies, feebates, etc.;
  - Fuel tax rate parity regarding gasoline, diesel and kerosene;
  - Complementarity with broader set of measures intended to minimize VKT with respect to trips and TVM (see, for example, the proposed EASI conceptual framework[10]) that can minimize vehicle use and fuel consumption; and
  - Competitive approaches to ownership entitlement.

72. On a third level, the implementation potential (programmatic viability) of doing anything within the professional, institutional, and social capacities available in Ethiopia constitutes another important limitation to motorization management policy, and is the key focus of the remainder of this report. Programmatic viability really refers to four very practical questions related to implementation of measures to meet public policy objectives:

- Are there practicable, implementable programs that can manage specific challenges associated with motorization?
- Is the scope of the policies identified to address challenges of motorization broad enough to be effective?
- Do the necessary regulatory and legal authorities exist to enable program and policy implementation?

[10] SSATP- Africa Transport Policy Program. 2015. "Policies for Sustainable Accessibility and Mobility in Urban Areas of Africa". The EASI Conceptual Framework is referred to as Enable, Avoid, Shift and Improve.

- Is the institutional capacity of the institution(s) charged with implementing the various programs of the strategy sufficient to ensure success?

## D. Change Management

73. An integrated program of motorization management would entail a substantial modification of how motor vehicles are acquired, maintained, and disposed of in Ethiopia compared to the present case. Of course, any of the policies or programs discussed in the next two chapters could be picked up and adopted on a piecemeal basis with some benefit for the country, but if the recommendations in this report were adopted in a comprehensive way, then change management as a process should also be taken seriously and designed into the overall program.

74. "Change management" refers to meta-measures that are necessary to ensure that the complex web of principles, specific policies, implementation programs, institutional and regulatory enablers, and stakeholder understanding about all of these things come together in a productive way. Each of the 12 proposed secondary measures or programs discussed in Chapter **Error! Reference source not found.** of this report can, in and of itself, require a sophisticated project management approach to effect. Each would also have a different natural "home" agency in which it should be embedded. At the same time, citizens and motorists would see a series of changes in the way they acquire vehicles and interact with the government to legalize those vehicles. Coordinating these complex projects, institutional interactions, and public messaging and preparation requires a centralized team, empowered from and coordinated out of the highest offices. If there is intention to adopt many elements of the program recommended here, serious consideration should be given to developing a team directly under the Prime Minister's office, with full-time staff to coordinate the actions and public communications of the various ministries, and with key high level support from MOFEC and the Ministry of Transport in particular.

# IV. 12 Implementation support programs

75. This chapter presents more detailed and contextual discussion of the 12 compliance support measures introduced in Chapter IV. These are presented in the order of importance, in the team's assessment.

## A. Program 1: Motor Vehicle Information Management System (MVIMS)

76. A Motor Vehicle Information Management System (MVIMS) is a comprehensive digital platform that integrates databases for vehicular registration, licensing, inspection, and enforcement in a standardized, electronic and regularly-maintained manner. Typical structure of the models of MVIMS is shown in Figure 18. One of the integral modules of MVIMS is the database for vehicular inspections also known as Vehicle Inspection Management *Module* (VIMM).

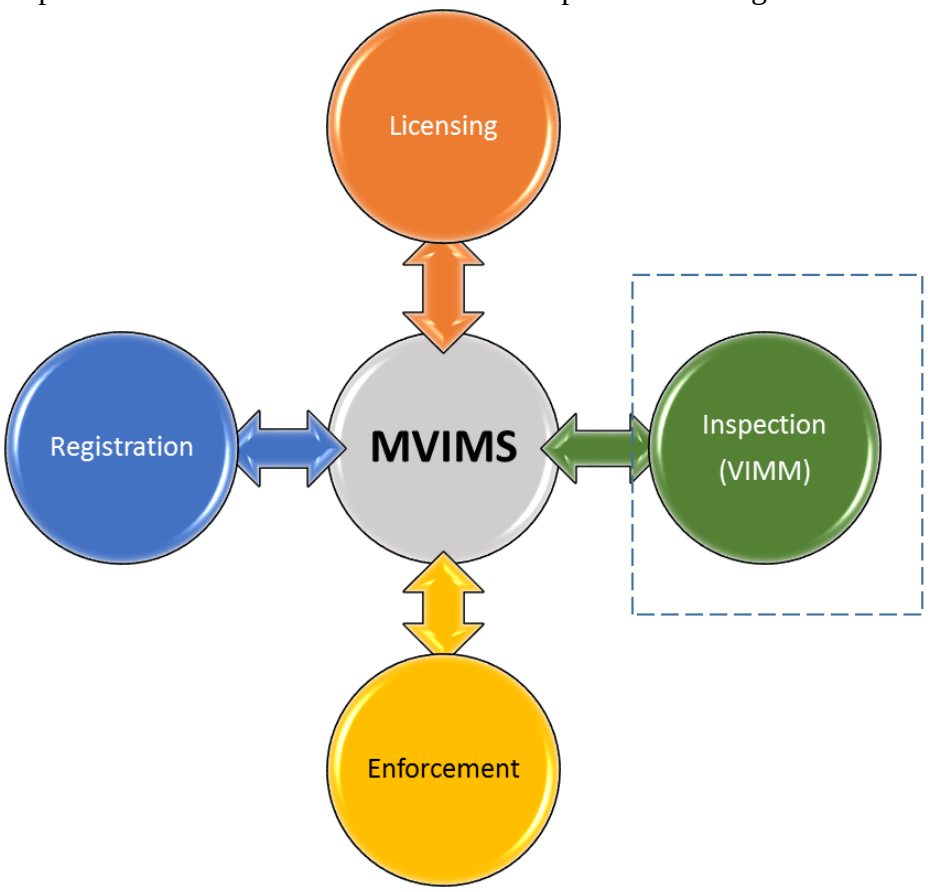


*Figure 18. Typical structure of MVIMS*

77. The VIMM will consist of a collection of digital components that would enable the capture, tracking, analysis, and dissemination of data related to vehicular inspections. The VIMM will ensure timely and accurate data on vehicle inspections is captured and maintained in a centralized repository.

## *1. Objective and Scope of VIMM:*

78. The primary objective of VIMM should be to help relevant stakeholders continuously manage the inspection process throughout the vehicle's lifetime thus ensuring maximum compliance with roadworthiness, road safety, and environmental standards.

79. The VIMM should also integrate seamlessly with the other modules in the MVIMS and contribute to enhancing the efficiency of the inspection process. While facilitating vehicle specific inspections that take into account OEM standard system fitments, the design of VIMM will ensure the inspection test procedures administered across all inspection centers in the country are harmonized. Furthermore, the design of VIMM should facilitate exchange of relevant data between other components of the MVIMS (e.g. Vehicle Registration, Vehicle Licensing, and Enforcement) and offer specific and statistical data for benchmarking and research purposes.

## *2. Components of VIMM*

80. A typical VIMM implementation will consist of three key components as shown in Figure 19.

81. *Database* - The VIMM database will be a repository of complete inspection data for all vehicles actively operating on the roads. In addition to containing the inspection data corresponding to first-time locally manufactured, assembled vehicles, the database will be updated with information coming out of periodic inspections ( e.g. Annual, biennial, etc.) as stipulated by the national inspection regime. In many countries, all road vehicles are subjected to inspection carried out by an authorized government body before importation. For example, all vehicles exported to Kenya must meet the specifications encapsulated in the Kenya Bureau of Standards KEBS 1515 2000. The VIMM database should be designed to support the codification of country-specific regime for safety, fuel economy, and environmental standards.

82. Although this database could be implemented as a standalone repository, in situations where the design for a larger, more comprehensive MVIMS exists already, it is recommended that the MVIMS database be utilized to incorporate features of this database. In terms of storage of data, the VIMM could either have its dedicated archival area or could leverage the centralized storage used by MVIMS.

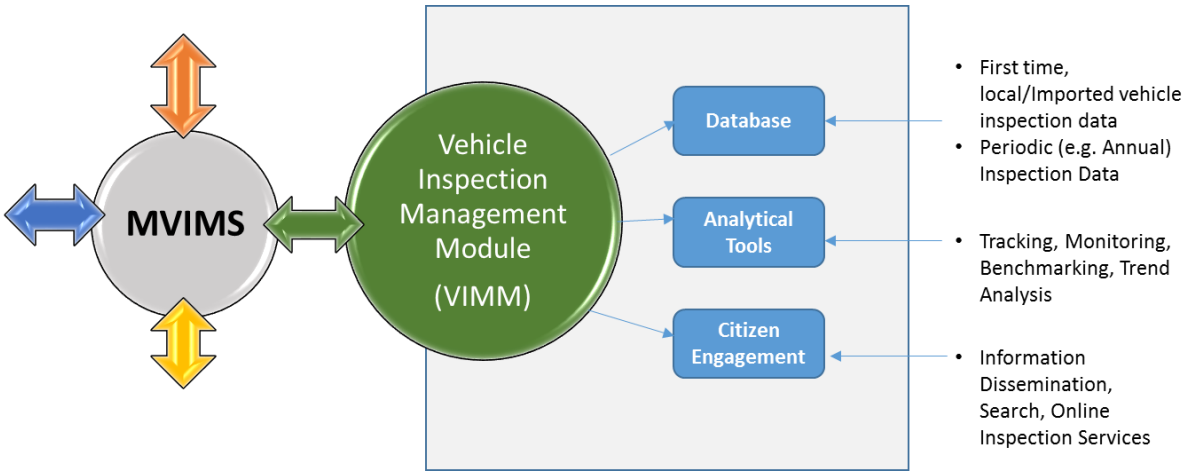


*Figure 19.Structure of vehicle inspection management module (VIMM)*

83. *Analytical Tools* - This module within VIMM will consist of tools and applications that will harvest the structured data stored in the VIMM database to help users of VIMM track, monitor, benchmark, and perform a wide range of analytics on the inspection data. Besides generating a variety of standard and customized reports for multiple stakeholders, the analytical tools will also compile a dashboard of compliance, generate alerts, and present enforcement trends taking into account the different parameters comprising the inspection regime. As an example, the analytical tools could be used by relevant stakeholders to generate reports on the number of vehicles that failed inspections and reasons for failure per year, growth in the number of imported vehicles of a particular brand that failed emissions test in the first year, number of vehicles with inspection defects or deficiencies that have subsequently been corrected per year etc. Analytic tools can also help to statistically identify vehicles that may have been subjected to odometer tampering.

84. *Citizen Engagement* - This public-facing module could be implemented as a web site with a supplemental Mobile or Smartphone App. This module will form the bridge between the supply side and demand sides of the inspection process. Through messages and explanations on inspection regime, standard procedures for inspections, benefits of compliance, penalties for non-compliance, and via FAQs, this module will emphasize user awareness and changes to consumer behavior required for successful compliance. Consumers will be not only be able to search for inspection records but also request inspection services online via the Web site or the App. Furthermore, this module will incorporate grievance management features as well to capture complaints and suggestions from the consumers.

## *3. Users of VIMM:*

85. The various users of VIMM could be identified based on the modules they would most likely use, as illustrated in Figure 20 below.

86. *Database* - The primary users for the database would include the Federal and regional Road Transport Authorities, and Inspection Centers. While Transport Authorities responsible for first-time and annual or biennial inspections will have the privileges to enter, modify, and delete data,

the authorized inspection centers will be able to only deposit and read data. In case of imported vehicles, the Transport Authorities will also be responsible for uploading pre-shipment certificates and other related documents into the database.

87. When inspection data is captured by multiple authorized inspection centers, it would be advisable to consider a tight integration between inspection centers and the central repository for VIMM so that the data captured by the geographically dispersed centers could be exchanged digitally and in real-time with the central database thereby ensuring data integrity.

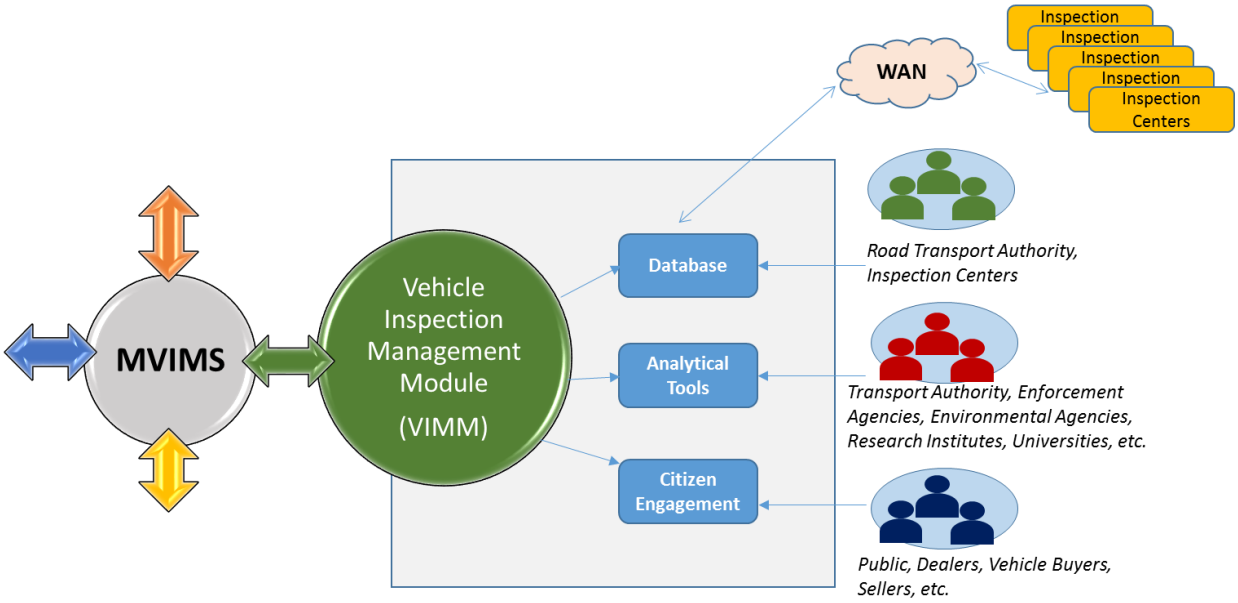


*Figure 20. Key users of VIMM module*

88. *Analytical Tools* - This module in VIMM will typically be used by the Transport Authority, Inspection Enforcement Agencies, Traffic Police, Environmental Agencies, Research Institutes, Universities, and other stakeholders that might be interested in the vehicular inspection data. One of the ways in which the Enforcement Agency could utilize this tool would be to identify vehicles delinquent on inspections and those that have failed inspections but are still operating ion the roadways.

89. *Citizen Engagement* - The primary purpose of implementing this module is to inform consumers about the ecosystem of vehicle inspection with a view to changing consumer behavior towards compliance. The key users of this module will be the driving public, vehicle dealers and importers, vehicle buyers and sellers.

## *4. Additional Factors to Consider:*

90. The following factors should also be taken into account in design of the VIMM system

- The vehicle inspection database should be designed such that it becomes a master copy of technical record of each vehicle across its entire lifecycle from the time it is imported into the country or is first sold in the market until it is no longer driven on the roads.

- The VIMM should be seen as a mechanism to capture, track, analyze, and modify all pertinent vehicle records during each vehicle's useful life.
- In addition to text data, the VIMM database should be designed to support media-rich formats such as high-res photos and videos from the inspections.
- It will be important to design the data structure of the repository in VIMM such that it encompasses all parameters defined in the vehicle inspection regime and fully supports the business processes associated with vehicle inspection and certification.
- In terms of implementation, the VIMM could either be a standalone repository or could be embedded in a larger MVIMS system. Where an MVIMS or a similar system exists already, the VIMM should integrate seamlessly into the larger MVIMS comprising of other modules for vehicle registration, licensing, and enforcement. It is important to recognize that the typical functions in a MVIMS could be implemented in a system known differently or under a different brand (such as in a larger TIMS or DVLA systems).
- The agency responsible for implementation of VIMM (see next section below) should ensure there is buy-in and a strong commitment at the highest levels of the organization to not only using the system data but also enforcing the governance.
- With a view to leveraging advances in computing technologies, it would be useful to consider a web-enabled, cloud-based implementation of the VIMM and hosting it at the State or National Data Center.
- By incorporating robust Cybersecurity features, the data transacted in the VIMM should be protected from data leakage, tampering, or hacking.
- When inspection of vehicles is done at multiple locations through a network of independent and authorized inspection centers, it is recommended that the ICT systems driving the test equipment at the inspection centers be networked securely with the centralized VIMM database via Wide Area Network (WAN). Such an integration will enable the inspection reports from all inspection centers to be deposited at the centralized VIMM database in real-time and according to the required formats thereby ensuring that the inspection data is authentic and tamper-proof and that the entire data capture process is harmonized.

91. In addition to the above considerations, it should be noted that the Governance of the information in the VIMM is of critical importance and should be established taking into consideration the various departments that may have access to and will use the information. A robust Governance protocol is required to ensure the inspection workflow is managed unambiguously and that the roles of different actors in the system are defined clearly for data inputs, analysis, information security, reporting, and decision-making (i.e. a role-based access policy). The Governance mechanism should include standard operating procedures and protocols to manage the privileges to access, create, modify, or delete data. Specifically, the VIMM platform through its user interfaces should enable the primary custodian of the system to administer the governance effectively.

## *5. Who should implement VIMM?*

92. VIMM will be a comprehensive Inspection Management System and will be critical in ensuring all vehicles operating in the roadways are certified roadworthy and compliance with environmental and safety standards established by the Federal Transport Authority. The same

agency or department that has the mandate to implement national DVLA systems will have the responsibility to define, design, and deploy the VIMM. Therefore, in Ethiopia, the VIMM will be implemented by the Federal Transport Authority (FTA) under the Ministry of Transport.

93. In Ethiopia, the Vehicle inspection division within FTA is currently responsible for permitting vehicle modification requests as per RTA specifications. The division is also responsible for determining the size and weight of newly imported and locally constructed vehicles as per relevant laws and directives of the country and for regulation and oversight of annual inspection of vehicles registered under the federal government.

94. The participation of the authorized inspection centers in the VIMM through digital integration should be mandated by the respective implementing agencies. The FTA should mandate that the inspection centers deposit the inspection data accurately and in a timely manner as required by the VIMM architecture as part of the authorization process or when the permits/licenses are issued to the inspection centers.

## *6. Implementation Strategy:*

95. In Ethiopia, the Federal Transport Authority (FTA) is currently developing a new MVIMS as part of the Transport Systems Improvement Project (TRANSIP) funded by the World Bank. One of the main components under the TRANSIP project will support the development of a national level licensing and vehicle permitting systems, including improvement to driver training and testing regimes, to improve compliance with traffic regulations and foster a safer transport environment throughout Ethiopia. A secure, unified and national system to issue licenses, vehicle registration and inspection certificates and record driver history will minimize the opportunities for fraudulent and corrupt practices among drivers, thereby facilitating law enforcement of dangerous traffic behavior, while improved training and testing regimes will improve the quality of drivers.

96. Specifically, the TRANSIP project will replace the current manual systems with an ICT-based vehicle processing and management system. A secure, clean and universally accessible database for vehicle registration will be established which will be implemented to provide various web applications and services for driver's license registry and management, vehicle registration and inspection, penalty management at Federal, regional and zonal Levels.

97. The existing Transport Information Management System (TIMS) platform in Kenya, as illustrated in Figure 21, can be used as a reference and a template to develop a full-fledged MVIMS in Ethiopia that incorporates the desired features of a VIMM. The TIMS platform in Kenya currently handles Motor Vehicle registration, Motor Vehicle Inspection Booking, Motor Vehicle Record Search, Transfer of Ownership, and Driver Licensee issuance. An important consideration here would be to incorporate the VIMM so as to include all the relevant parameters required to ensure a robust administration and enforcement of the vehicular inspection regime.

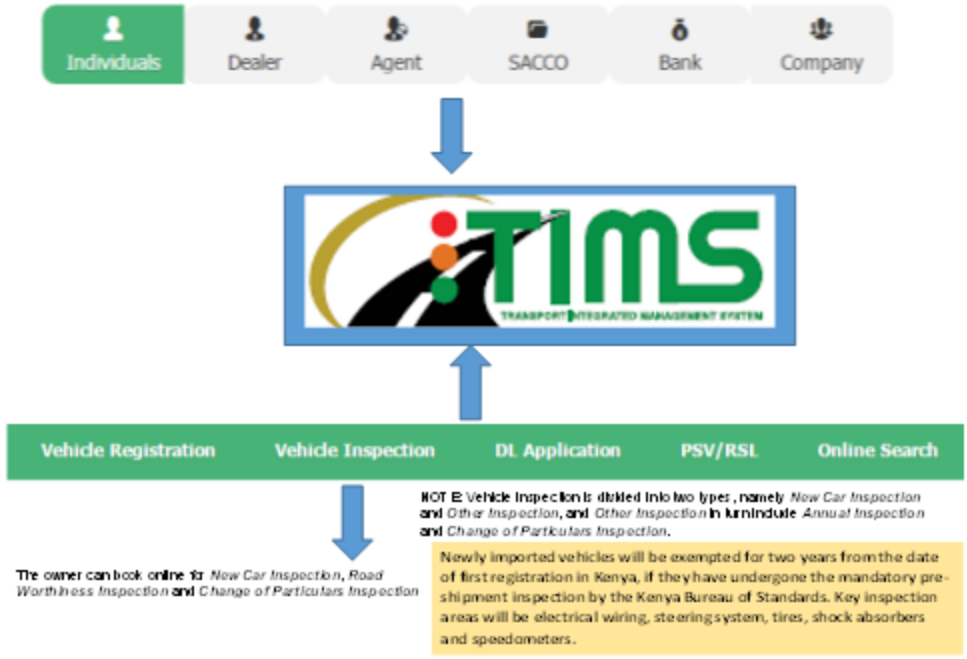


*Figure 21. Illustration of TIMS platform as used in Kenya*

98. As FTA embarks on the implementation of TRANSIP project to improve and modernize the driver licensing, motor vehicle registration and inspection systems, there is a clearly an opportunity to influence the design of new inspection system such that it incorporates the core features of VIMM and considerations discussed in this chapter.

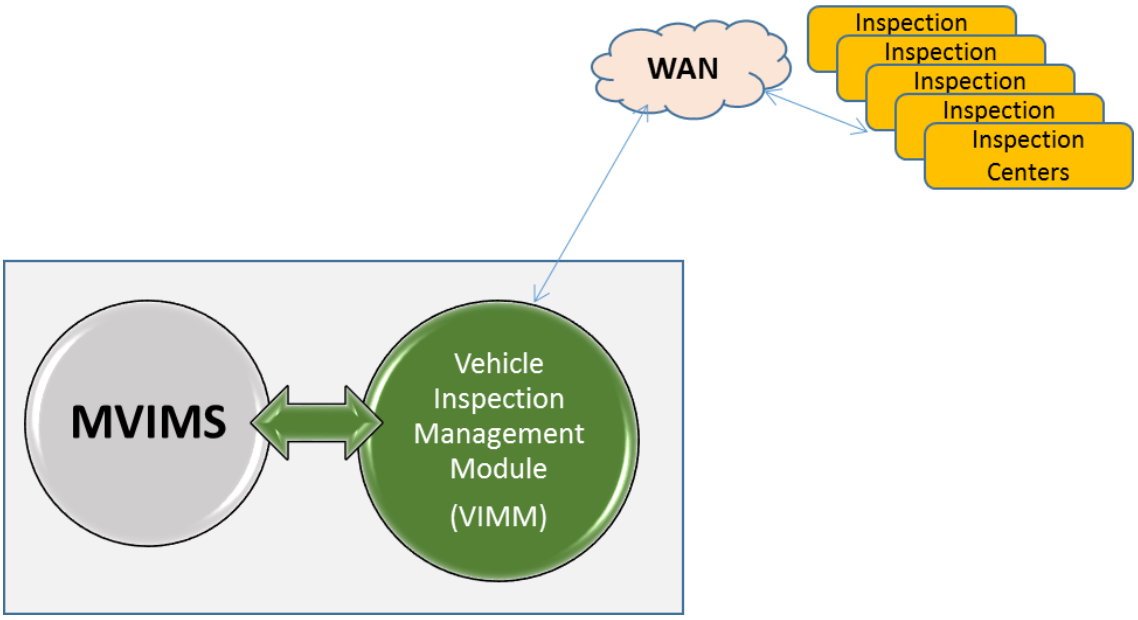


*Figure 22. Proposed FTA System for modernization of Driver Licensing & Vehicle Registration*

99. In moving to a digital system, the FTA should seek to ensure the design of the proposed inspection system is sufficiently flexible to support functions required to implement not just the newly adopted recommendations but all the future inspection regimes. The implementation plan

for the overall modernization project that will develop the MVIMS could inform a phased deployment of the new inspection system. Finally, FTA should also consider migrating all legacy inspection data to the new MVIMS.

## B. Program 2: Public engagement to sensitize citizens at all levels of the motor vehicle lifecycle

100. Public awareness of any product, program, project, or procedural change is created through *communication*, which can be virtually anything that describes, explains, or otherwise discusses or engages the motorization management program with the public. The point of strategic communication is to influence and control the conversation that will inevitably take place about motorization management – a conversation that will happen whether it is planned or not. A good communications strategy can mitigate risk and improve outcomes.

### *1. Mitigating risk*

101. People are likely to hear about proposed changes to the motorization regime and, in the absence of reliable and sanctioned sources that result from a planned communication effort, will fill information voids through alternative means. The information obtained may not be true, but it could quickly become part of the set of beliefs forming about the program. The risk is that those obtaining information from unauthorized sources could be wrong, could be misinformed, could have their own agenda, and, in the worst case, could tell their friends, colleagues and associates, spreading misinformation like wildfire.

102. A well-planned communication program is therefore imperative to the successful introduction of managed motorization in Ethiopia. Communication will happen; it is in the best interests of program success to accept that as reality, and plan for it, rather than risk being excluded from the conversation.

### *2. Consultation improves outcomes*

103. In addition to mitigating risk, managed communications using public involvement techniques can strengthen program implementation in several ways. Engaging people in the development of the roll-out, and involving them in its planning, can improve outcomes. Proactively reaching out to sensitize the public to planned changes and giving them an opportunity to respond helps to create buy-in and trust among target populations. This is especially the case if some people are likely to be unhappy about the plans. Ultimately, the citizens of Ethiopia will be the beneficiaries of managed motorization, but the program will not be equally beneficial to all stakeholders; consulting at the earliest stages will bring to light issues and concerns that can be managed early to anticipate and potentially diffuse points of opposition that may emerge once implementation begins.

104. Decision-making around implementation can also be informed through public involvement and consultation. Engaging those who are part of the social contract involved in managing motorization can provide insight and inform implementation plans. Even if they do not contribute,

public consultation builds respect for the program and process. At its best, consulting with the public can contribute meaningfully to successful program implementation and engender community pride.

## *3. Factors to be taken into account*

105. The rules for successful communication are founded in the science of human behavior and involve four interlinked and mutually dependent dimensions: understanding stakeholders, information sharing, marketing, and branding.

**Understanding stakeholders**

106. There are many ways of conveying information. A clear understanding of the audiences receiving that information will help to identify the best way. The starting point for shaping communications, therefore, is identifying the full list of stakeholders who have an interest in or are affected at each stage of the vehicle lifecycle from purchase to disposal. Of critical importance is understanding what is relevant to them:

- Who will have an interest and/or be affected?
- How are they affected?
- What are their agendas/interests?
- What do they want?
- What do they fear?
- How can they be reached?

The more that is known about stakeholders and their interests, the more relevant communication planning will be. Stakeholder analysis will help determine what information must be shared and provide insight into the most compelling ways to describe the project and disseminate messages to various audiences.

**Information Sharing**

107. Information sharing is one of the core objectives for most communication efforts. The goal is to create a consistent understanding of the motorization management program throughout Ethiopia.

108. Information sharing can be carried out in a wide variety of ways, depending on what information is being conveyed, who needs to hear it, and local circumstances. It may include everything from one-on-one meetings or phone calls, to mass media television advertising. Most communication efforts include a wide range of approaches to sharing information, depending on the audience. Communication needs and methods will also change over time through the various stages of program implementation.

109. Outreach can take any number of forms:

- television or radio advertisements or radio talk shows
- flyers/leaflets handed out to shops, homes, schools or at busy intersections or gathering places

- hosted public meetings, forums or special events
- information booths or kiosks in markets where people congregate
- displaying posters at known gathering places throughout the community
- information materials disseminated by third parties with existing distribution channels
- sharing on social media channels popular with key audience segments (particularly youth who are otherwise often difficult to reach)

The specific outreach method is chosen on a case-by-case basis, depending on how to best reach the target for communication. This can include using language and images that are understood by, and relatable to, the audience being addressed.

110. The media also plays an important role in information sharing. Where budgets are tight, the media can be a key partner in disseminating critical information to broad audiences. Developing good relationships with media partners, and ensuring they have full information to report, is important to maximizing this opportunity. Questions to consider about the media include:

- What do they know/understand about the program?
- What information is available/suitable for their use?
- Where can they obtain additional information about motorization management?

Including a specific section for media on the program website is often useful to facilitate information sharing.

**Marketing strategy**

111. Marketing refers to the disciplined implementation of a communication plan. It is the *how* and the *what* of communication. A marketing strategy is built up from layers of knowledge and information, the foundation for which is a clear vision of what this program will do for the community – how it will change or help the community. The vision explains clearly and concisely the core ideals of motorization management and its benefits to the people of Ethiopia once it is implemented. Stemming from this vision are the program objectives that describe what it must achieve, for example, emission reductions, improved safety outcomes, lower fuel expenses, reduced environmental footprint etc.

112. These core program principles guide the development of the marketing strategy, which describes how the vision will be communicated to the public to meet the program objectives. The marketing strategy is comprised of several layers, including:

- *Environmental scan* – Based on a collection of relevant data and information, the environmental scan provides a clear understanding of the existing situation and everything that impacts it. Some of this environmental scan has been carried out as part of the present pilot project, such as understanding existing vehicle ownership patterns, types of vehicles, and relevant policies, while other aspects may require further work, such as understanding attitudes of vehicle and fleet owners.

- *Communications objectives* – Describe what communications must achieve e.g. inform the public and relevant stakeholders, obtain public buy-in, assist with political buy-in, and persuade people to participate on an ongoing basis.
- *Audience segmentation* – Identify all audiences affected at each stage of the vehicle lifecycle, from purchase to disposal. Segment audiences by type according to demographics, lifestyles, interests etc., to gain a clear understanding of the aspirations, needs and concerns of each segment, and match audience segments to appropriate communication channels for outreach.
- *Key messages* – Reflect the stakeholder information and communications objectives. Key messages must connect the dots between the program objectives and what is required of the various audiences, e.g. help translate the notion that vehicle owners have a social obligation to comply with the new program requirements; that there are things they will be required to do, when and how those things need to happen. Effective messages are:
    - Benefit-focused (address the question "What's in it for me?" for each target audience);
    - Honest;
    - Clear;
    - Simple;
    - Consistent; and
    - Repeated.
- *Tactical deployment* – The range of approaches to reaching each audience segment where they are most likely to receive the message, e.g. advertising, events, social media etc. There are many tools and techniques for getting the message out. The key is finding what's right for the circumstances and to effectively reach the various audiences through staged campaigns.

**Program branding**

113. Creating a brand for the program will significantly help communicate the package of new requirements under a single umbrella that is more easily understood by the public. It provides the opportunity to name and describe the program in a positive way and facilitates consistency and understanding of messages. It simplifies communication both for the audiences and for those deploying messages.

Energy Star program

114. The Energy Star program was founded in the United States in 1992 as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. It recognizes appliances, buildings and other products that use 20 per cent to 30 per cent less energy than required by law, and allows industry to promote the Energy Star rating of its products using the sanctioned blue label. The program's emphasis on testing, third–party review, and compliance screening bolsters its integrity and ensures that consumers can trust Energy Star certified products, homes, and commercial facilities to deliver the energy savings promised by the label. Now adopted by Australia, Canada, Japan, New Zealand, Taiwan, and the European Union,

it continues as a voluntary program that helps businesses and individuals save money and protect the climate through superior energy efficiency.[11]

115. The US Environmental Protection Agency estimates that in 2012, the Energy Star program saved businesses, organizations, and consumers $24 billion, and over the last 22 years, it has helped save more than $362 billion on utility bills and reduced greenhouse gas emissions by more than 2.4 billion metric tons in the US alone.[12]

116. As the most successful voluntary energy efficiency movement in history,[13] the Energy Star program has helped spread the widespread use of efficient fluorescent lighting, power management systems for office equipment, and low standby energy use.[14]

117. Several key learnings from the success of the Energy Star program can be adapted to the introduction of managed motorization in Ethiopia:

- **Develop a recognizable brand** – The Energy Star blue label has become a symbol of consumer trust. Today, 85 percent of Americans recognize the blue Energy Star label, and of the households that knowingly purchased an Energy Star certified product, some 75 per cent credited the label as an important factor in their decision.[15] Creating a recognizable brand for the motorization management program will help communicate consistently and create meaning.

- **Create value for all participants** – The program creates a benefit for both manufacturers and consumers. Creating a value proposition attractive to participants in the motorization program will help to create buy-in.

- **Maintain integrity** – Third-party party review, and compliance screening created consumer trust for Energy Star. Finding ways to demonstrate the integrity of the motorization management program will

**Behavior nudging**

118. Canada is the first country in the world to create a national app on a mobile platform that rewards its citizens for making healthier lifestyle decisions. The "Carrot Rewards" app motivates Canadians to eat better, exercise more and live healthier lives by rewarding them with various types of points tied to loyalty programs of their choosing. Once the app is downloaded to their mobile device, participants receive their choice of loyalty points for engaging in specific healthy activities that target the common risk factors associated with maintaining healthy weights and combating chronic diseases.

[11] https://www.energystar.gov/about/history
[12] https://www.energystar.gov/about/why_energy_star
[13] https://www.energystar.gov/about/why_energy_star
[14] https://www.energystar.gov/about/history
[15] https://www.energystar.gov/about/origins_mission

119. The policy objective of the program is to reduce healthcare costs by encouraging Canadians to live healthier lives. The idea behind the app was to completely reinvent sustainable behaviour change on a mass scale. Participants earn rewards by taking quick quizzes and accomplishing personal walking goals and challenges.

120. By harnessing the popularity of loyalty points and the prevalence of smart phones, Carrot Rewards is seeing unprecedented levels of engagement that will have tremendous social impact and help to create a healthier nation. In a recent statement, the government said that people engaged in a rewards program increased their physical activity by 110 per cent and were active 2.8 times per week, up from 1.3 times per week.

121. The opportunities for developing incentive programs like Carrot Rewards should be explored to support the adoption and implementation of the social contract associated with motorization management. Behaviour can be changed in support of broad public policies by using incentives that tap into an appropriate reward valued by the local population; the incentive was identified as points, in the Canadian example, but in Ethiopia, the reward would need to be clearly tied to local interests, i.e. opportunities to gain benefits valued by Ethiopian.

## *4. Recommendations for Ethiopia:*

a) As part of the core team which might be empowered to coordinate actions in furtherance of a motorization management strategy, include a role for a communication lead whose job is to manage public and stakeholder communications over the life of the motorization management program. This role would manage all aspects of communication including media and public relations, provide program talking points for politicians and project leaders, and support internal teams interacting with the public in the day-to-day rollout.

b) Develop a detailed stakeholder matrix that describes all audiences, and for each audience, identifies specific issues and interests, key messages, and optimal methods for reaching out and engaging. Stakeholders include those implementing the program such as FTA, public and private sectors users of vehicles, vehicle and fleet owners/leaseholders, mechanics etc.

c) Develop a meaningful and recognizable brand for the program to help position the motorization management positively and consistently across the country over numerous and varied communication channels.

d) Develop a communication strategy to articulate the steps needed to ensure all stakeholders are considered and appropriately informed and engaged.

e) Develop terms of reference to engage a communication agency to assist with the creative development and deployment of messages through campaigns that are relevant, timely, engaging, and provide information to audiences where and when they need it in a form that will be well received.

f) Develop briefing documents that clearly describe needs and outcomes for each element of the communication program.

g) Establish benchmarks for measurement against which to track the progress of communication efforts and identify gaps so the communication program can be adjusted and corrective action taken as needed to deliver the successful implementation of motorization management.

## C. Program 3: Dynamic Profile of Standards (DPOS) for vehicle emissions and fuel quality

### *1. What is a DPOS?*

122. This section discusses development of a Dynamic Profile of Standards (DPOS) for vehicle emissions and fuel quality, and the next section discusses a similar DPOS for vehicle safety and fuel economy. DPOS as used in this report is a *policy* document that establishes a vision for how the profiles of entry vehicles should change over time, say 10 years. The DPOS can be implementation-method neutral. That is, it defines how the profiles of entry vehicles should change, but need not specify that such change should be effected or implemented (for example, through regulation or pricing incentives). However, it must be dynamic – that is, show the profile of standards over time – both because the private sector needs to understand the rules of the game and how they will change over a reasonably foreseeable time period, and because policy making / standard setting is a time consuming and costly endeavor, so rather than go through this painful process ad-hoc every few years it is better to identify the changing profile over time in one process. This also allows for more give-and-take in negotiations with stakeholders.

123. The reasons for distinguishing two DPOS processes – one for tailpipe emissions and fuel quality, and a second for vehicle safety and fuel economy – are practical, rather than technical. In principle, there is no reason that a single DPOS covering all aspects of vehicles and fuels could not be developed. But the process will be easier to manage, and the outcome equally as desirable, if it is split it into two separate DPOS-development processes, for several reasons. Most importantly, it may be easier to come to agreement on one set than the other, and by splitting them, they can proceed on their own tracks. Second, it can often be difficult to communicate to the public and non-specialist policy makers the distinctions between fuel economy ($CO_2$ emissions) and pollution control measures, so separating the processes that help define the relevant policies with respect to them can help to keep that distinction clear. Third, some of the stakeholders might be different (e.g. stakeholders interested in improved safety may have little direct interest in issues associated with pollution control, and vice versa). However, we believe that the technical issues of vehicle safety and fuel economy on the one hand, and vehicle pollution control and fuel standards on the other, are so inextricably linked with each other that it is important to keep these pairs of issues together in the articulation of the DPOS.

### *2. Considerations for a DPOS in Ethiopia*

124. While developed countries with significant motor vehicle manufacturing industries engage in public processes for establishing and disseminating emissions standards for new vehicles, there are a few distinct characteristics for establishing a DPOS for vehicle emissions and fuel quality in import-reliant countries such as Ethiopia, which should be highlighted.

- *DPOS is not intended to address in-use vehicles.* The DPOS is intended to define the characteristics of *entry*, not in-use vehicles. There would be separate mechanisms for addressing in-use vehicles, discussed later.

- *DPOS is meant to apply to all entry vehicles, not only "new" vehicles.* The DPOS defines characteristics that are intended to apply to *all* vehicles added to the vehicle fleet in a given year, whether they be SHVs, GFUVs, MSFUVs, or CKDs. If the vehicle is intended to be registered for the first time in Ethiopia, then the DPOS should apply.

- *DPOS is not about technology-forcing, but rather usage of existing technologies.* In countries with substantial automotive manufacturing, emissions standards are often set with the intent to force technological innovation by automotive manufacturers. By contrast, the objective of the DPOS in import-reliant countries such as Ethiopia should be to constrain purchasing decisions for entry vehicles toward better-performing vehicles that already exist in other markets.

- *But there must still be buy-in from OEMs*. Notwithstanding that the objective of the DPOS is to facilitate the use of existing technology, not force innovation, buy-in and support from OEMs remains critically important, because they will still need to certify / warrant new vehicles, and in some cases, honor the certificates or warranties of second-hand vehicles. For this reason, consultation with and involvement of the OEMs in establishment of the DPOS is critical.

- *Ratcheting up of standards must realistically reflect the capacities of the maintenance and repair industries and availability of parts.* An important consideration and constraint in the development of any DPOS must be the concomitant development of the maintenance and repair industry to service the increasingly complex technologies associated with improved emissions control technology, and to have access to needed spare parts. For this reason, and given that the current challenges of access to hard currency will likely continue for the foreseeable future, the team considers that an aggressive DPOS for Ethiopia is probably unrealistic. Even if sulfur levels can be brought down substantially, access to spare parts for Euro V/5 and Euro VI/6 equivalent vehicles would probably be a substantial constraint for the foreseeable future which precludes use of these technologies.

- *Surveillance and verification programs may not need to be an integral part of DPOS enforcement.* Countries with automotive manufacturing industries often maintain substantial surveillance and verification programs, to ensure that the technology that manufacturers certify performs to a given level continue to perform at that level throughout vehicle life, assuming proper maintenance is applied. Manufacturers whose vehicles do not perform to certified levels and expectations face fines and other penalties. In the case of import-reliant countries such as Ethiopia, such surveillance and verification programs may be neither feasible nor necessary, since many of the technologies used to meet the requirements will have already been vetted through surveillance and verification programs

in the country of manufacture. Nevertheless, the aftermarket compliance of entry vehicles to the DPOS should be monitored periodically and revisited if a problem is noted.[16]

### *3. Rationale for establishing DPOS for tailpipe emissions and fuel quality*

125. Emissions from motor vehicles are associated with a host of health impacts and linked to increased premature death especially in urban areas. A 2016 report by the World Bank and the Institute for Health Metrics and Evaluation found ambient air pollution, to which motor vehicles are a major contributor, was responsible for 2.9 million deaths globally in 2013[17]. For decades vehicle-producing nations have established limits on the amount of pollutant emission released by engines and vehicles. Over time these limits have become increasingly stringent, requiring specialized technologies such as three-way catalysts for gasoline vehicles or diesel particulate filter for diesel vehicles to treat engine exhaust before it is released. These improvements in vehicle emissions have required concomitant improvements in fuel quality. Of primary importance is the amount of sulfur in fuels; fuels with too high sulfur levels can poison sophisticated exhaust after treatment equipment and degrade the operating characteristics of the vehicle as a result. Fuel quality, therefore, is a key enabler to improved vehicle performance and must be developed to match vehicle emission standards.

126. Vehicles and fuels meeting the latest emissions standards in the US, EU and Japan result in over 90 per cent lower emissions than vehicles and fuels sold in these markets the 1990's. These three markets, which up to 2009 led the world in vehicle production, have taken different pathways to establishing their standards resulting in three different emission and fuel standard systems. The European system or Euro standards are the de facto global standards as most countries – including China (today's vehicle market leader) and India – have adopted standards closely patterned on Europe's. Figure 23 below illustrates the evolution of implemented and adopted emissions standards in selected countries from 2000 to 2025.

127. Ethiopia's light duty entry vehicle market, like most markets in Sub-Saharan Africa, is primarily supplied by imported used vehicles coming from a mix of countries, including Asia, Europe, and the middle east. For most of the aughts and the early part of this decade, Dubai was a major source of used vehicle traffic to Ethiopia, but its reputation for providing substandard vehicles, deserved or otherwise, has led to a steep decline in Dubai-sourced vehicle imports in recent years. Because of Ethiopia's very high sulfur levels in fuels, emissions control equipment is usually disabled or removed (along with, very often, advanced safety equipment such as electronic stability control) prior to importation.

128. Ethiopia's heavy duty entry vehicle market is primarily supplied through new vehicle imports, whereby vehicle engines and chassis are imported as units, with the construction of

[16] Surveillance and verification program should not be confused with inspection and maintenance. The former is intended to ensure that properly maintained vehicles continue to meet their certified performance characteristics (that is, they are not defective) and liability rests with the manufacture. The latter is intended to ensure that in-use vehicles are regularly maintained in accordance with requirements and is the responsibility of the vehicle owner.

[17] World Bank; Institute for Health Metrics and Evaluation. 2016. "The Cost of Air Pollution: Strengthening the Economic Case for Action."

vehicle body occurring locally within Ethiopia, though this industry is largely unregulated. Importation of used vehicles has largely dried up, because fuel sulfur levels in Ethiopian fuels cannot support the predominantly Euro IV and higher used HDVs available from most of the source countries. Consequently, most of the new vehicles imported into Ethiopia are Euro 0 equivalent. Local assembly from CKDs has not taken off, because the differential in import duties between fully assembled vehicles and unassembled vehicle parts is not significant enough to encourage local assembly.

129. Establishing emissions and fuel sulfur standards are therefore an important part of any motorization management policy for Ethiopia, not because standards magically improve the environmental quality of the vehicle fleet, but rather because they lay a marker in the sand for the private sector and import industry about what will and will not be tolerated in the country. If OEMs, dealer/importers, or fuel providers can get away with providing lower quality products than they do in the countries in which they are based, they will do so. Numerically specific import performance standards, far more than age limitations, send a clear message to these OEMs and importers that certain standards are expected and there will be consequences for not complying with those standards.

130. Because standards provide sign posts for the private sector regarding expected performance characteristics of vehicles, it is important to establish a dynamic profile of standards (DPOS) providing a "roadmap" of how standards for entry vehicles are going to change over a 10 to 15 year period. Currently in Sub-Saharan Africa, only two countries have established emissions standards. Nigeria has set its limits at Euro 3/II levels while South Africa is at Euro 2/II[18]. But neither of these countries has established a DPOS – that is, a clear signal to the private sector as to how standards will tighten in the future.

[18] In the Euro system, light duty standards are referred to with Arabic numerals (i.e. Euro 2) while heavy-duty standards are referred to with Roman numerals.

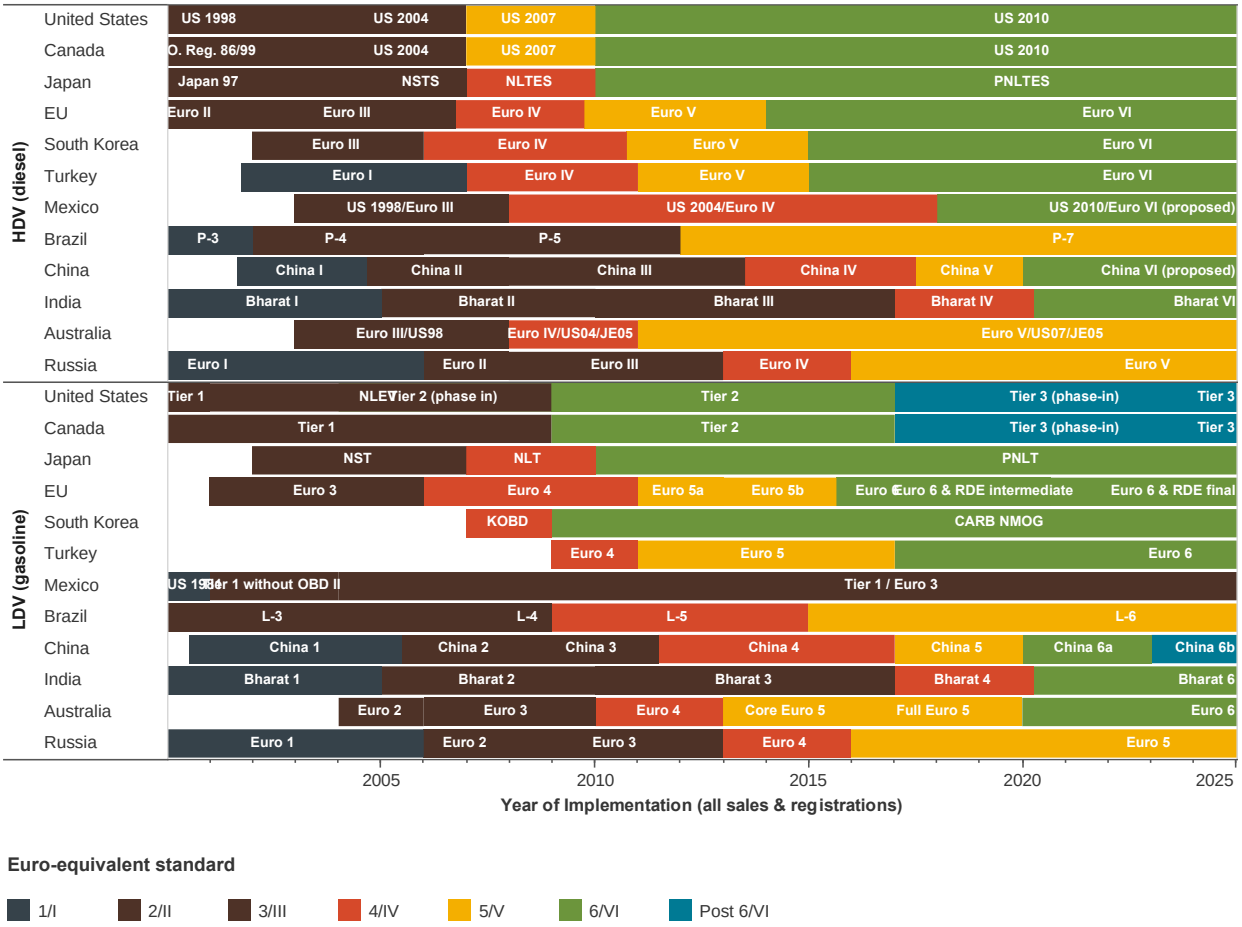


*Figure 23. Evolution of emissions standards for light and heavy-duty vehicles in selected countries*

Source: ICCT

131. What is clear from Figure 23 above, however, is that standards do change over time, and it is everyone's interest to have a clear understanding of how those standards will change in the future. Having a DPOS also provides a clear mechanism to harmonize the improvement in fuel quality with changes in the vehicle fleet; improvements in fuel quality that are not accompanied by changes in vehicle emissions control technology to take advantage of them are a lost opportunity, while improvements in emissions control technology are often not feasible without improvements in fuel quality.

## *4. Practical considerations for developing a DPOS for emissions and fuel quality.*

Given the above considerations, the team has the following suggestions regarding the implementation of a DPOS for emissions and fuel quality in Ethiopia. First, there is a need to establish a process to develop the DPOS for light and heavy duty vehicles. Because these have slightly different stakeholders, these could be managed as separate processes or a single process. There would be a need to submit the output to the National Standardization Council for approval

and implementation, but the DPOS differs from traditional standard setting both in that it should be established to cover the evolution of standards over time, and in that it should be revisited every few years in a structured way to account for changes in vehicle markets and technologies. This should be taken into account in whatever formal approval process is set up. Second, sulfur levels in gasoline and diesel should be limited to 50 PM as soon as possible. Third, importation of 2-stroke engines for on-road transport use should be banned. Fourth, a pathway in the DPOS to arrive at Euro IV equivalent level of emissions control should be developed. Developing a more stringent standard than Euro IV in the first 10-year DPOS may have decreasing returns for Ethiopia. Instead, consider technology substitution pathways via electrification of fleets in major cities / electric vehicles with solar energy in rural areas.

## D. Program 4: DPOS for vehicle safety and fuel economy

### *1. Rationale for establishing DPOS for vehicle safety and fuel economy*

132. There are numerous technical pathways to reduce average car fuel intensity, ranging from changing the size and weight mix of cars entering the fleet, to improving the efficiency of the engine and drive train, to increasing the proportion of electric drive vehicles in the fleet, but these pathways will have implications for vehicle safety, especially crash performance of the vehicle. As recommended in the 2014 GFEI study, fiscal incentives can be an effective way of incentivizing these changes, but which methods the market chooses and in which proportions can have important implications for vehicle safety, not only for the vehicle occupants, but also for other road users, particularly vulnerable ones such as pedestrians and cyclists. For these reasons, identification of DPOS for fuel economy and vehicle safety should be part of the same process.

133. In developed and automobile-producing countries, light-duty standards have increased in stringency over time and will continue to be tightened as shown in Figure 24, which provides detail on fleet-wide car fuel consumption standards in various key markets. Japan, China, the United States and Canada also regulate truck and bus fuel efficiency although their regulatory form varies enough to not be easily comparable. Importantly, the European Union does not have any heavy-duty vehicle efficiency regulation. It is expected that a mandatory efficiency type approval will be proposed in the 2017 timeframe and a standard proposal will follow shortly. Both light- and heavy-duty fuel efficiency regulations have required substantial improvements in engine and transmission technology as well as better aerodynamics and vehicle light weighting. In general, these improvements have been shown to be quite cost effective, with incremental vehicle costs covered within a couple years or so by fuel savings.

134. Unfortunately, fuel consumption in the real world is increasingly falling short of the laboratory test values during the vehicle type approval process. This discrepancy is in part due to loopholes in the test procedures. Improvements in these procedures are underway, but their impact may be diminished without adequate compliance and enforcement practices. For importing countries such as Ethiopia, it is important to track progress on real world efficiency compliance to ensure non-compliant vehicles are not dumped in their markets.

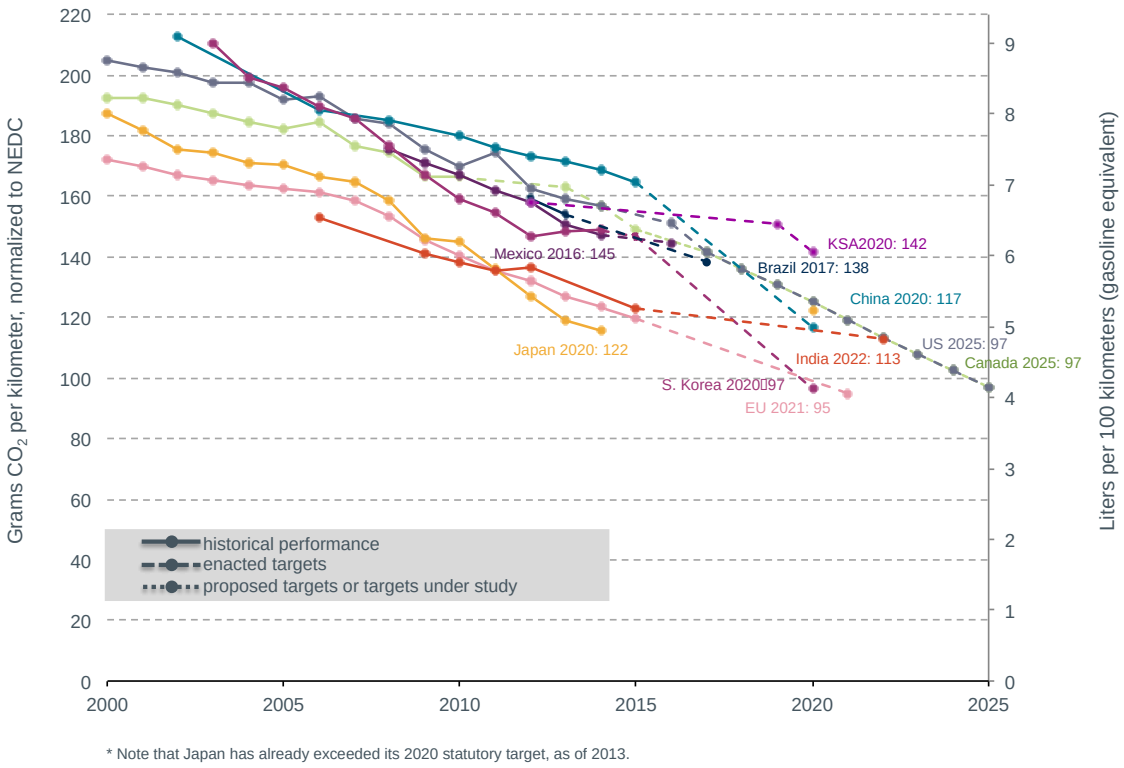


*Figure 24. Historical fleet CO2 emissions performance and current standards (gCO2/km normalized to NEDC) for passenger cars*

Source: ICCT

135. The case example of the New Zealand Transport Agency (NZTA) with its institutionalization of vehicle safety and efficiency standards, is a successful example of a non-automobile-manufacturing country improving both aspects of its vehicle fleet. New Zealand does not have a major domestic vehicle manufacturing industry and relies heavily on import of vehicles primarily from Japan, Australia and UK. About 50 per cent share of New Zealand's imported vehicles are light duty vehicles and it has one of the safest fleet ratings regarding crashworthiness. New Zealand Transport Agency has set up the import standards for all categories of vehicles.

136. The set of crashworthiness standards approved by the NZTA refer specifically to the frontal impact test performance. The approved standards include:

a) Directive 96/79/EC of the European Parliament and of the Council of 16 December 1996 on the protection of occupants of motor vehicles in the event of a frontal impact.
b) UN/ECE Regulation No. 94 Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a frontal collision.
c) Federal Motor Vehicle Safety Standard No. 208, Occupant Crash Protection in Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Buses.
d) Australian Design Rule 69, Full Frontal Impact Occupant Protection.
e) Australian Design Rule 73, Offset Frontal Impact Protection
f) Technical Standard for Occupant Protection in Frontal Collision (Japan).

137. In 2007 New Zealand put in place a mandatory vehicle efficiency labeling requirement for both new and used imported vehicles, with an exception for electric vehicles. The label design is the same for both new and used imports, however the used import label only includes the star-based rating (up to 6 stars) and not a fuel economy value. New Zealand has developed an algorithm to translate efficiency ratings from the various exporting markets into their star rating. Although New Zealand does not test vehicles, it does audit the documentation provided for new vehicle imports and compares it to international databases. A number of dealers are visited every year to ensure labels are properly displayed on vehicles.

## *2. Practical considerations for developing a DPOS for vehicle safety (crash worthiness and road worthiness) and fuel economy*

138. To realize sustained benefits in the safety performance of the rapidly motorizing vehicle fleet in Ethiopia, it is necessary that the government undertakes immediate policy interventions over the next two years alongside enforcement capacity to incrementally harmonize the safety performance standards of the total fleet (imported and existing) over a period of 5 to 10 years. Compliance to globally harmonized vehicle safety performance standards has demonstrable evidence to significantly lower the risk of road crash deaths and serious injuries for vehicle occupants and to a certain extend reduce severity of injury for non-motorized crash victims. For Ethiopia, where the incremental addition of vehicles is largely used-imports from countries which already mandate UN vehicle safety performance standards, this is a potential opportunity in the near-run for reforming national policies around standardization of vehicle safety. Other countries without local manufacturing industry and the vehicle fleet relying on imports, like New Zealand, have demonstrated the effectiveness of performance-based policy interventions on vehicle imports on the overall improvement in road injury performance for the country.

139. Vehicle safety related performance standards can be broadly categorized into two parts: vehicle crashworthiness and vehicle roadworthiness. *Crashworthiness test standards* are mainly based on crash-testing of a vehicle during the preproduction phase to determine the *crashworthiness performance* or ability to mitigate the severity of injury for an occupant or an outside road-user during a crash. Besides crash test performance this may also include presence of certain safety features such as seat-belt system, airbags and Electronic Stability Control. The definition of these standards are dictated through national-level regulatory bodies or UN agencies like the UNECE's WP29 group which is responsible for the World Harmonized Motor Vehicle Safety Standards. The *roadworthiness safety standards* address the ability of a vehicle to avoid or mitigate the severity during a crash (with timely driver intervention or automated). *Roadworthiness* is conventionally facilitated by the braking system, lighting and visibility, tires, and the steering system; features which are standard in modern vehicles, however, still need to be periodically inspected and maintained.

140. To mainstream the *crashworthiness* standards for the total vehicle fleet (imports and in-use), it is necessary to undertake a phased approach of compliance to ensure adequate policy measures are in place, enforcing agencies have been adequately established and trained and there

is awareness and consensus among several stakeholders including car dealerships, broader vehicle seller's associations, inspection centers, and consumers.

141. The *roadworthiness* performance standards are intended to ensure that all used vehicles entering the country and current fleet vehicles adhere to a minimum standard of safety performance while under operation. The testing protocol may potentially be combined with exhaust emission and noise pollution along with compliance to safety performance standards. The compliance to the vehicle testing protocol may be ensured with the issuance of a "Certificate of Safety Performance", valid for a year which must be produced at the time of registration which should ideally be renewed every year. If periodic registrations are not implemented that the Certificate of Safety Performance must be renewed annually (UN recommendation) and displayed at all time on the vehicle. The roadworthiness standard must be addresses as a comprehensive standard which may require less-frequent revisions in subsequent years. *Roadworthiness* standards should at minimum cover:

a) Tire condition and minimum permissible thread depth
b) Brake condition and operation
c) Structural conditions (including corrosion and rusting)
d) Certificate of loading and load restraints (load anchorages, towing connections).
e) Lighting (headlamps, brake lights, turning indicators, reflectors as applicable)
f) Glazing condition
g) Door operations and locking mechanisms
h) Safety belts and buckle/anchorage system
i) Airbag operations if fitted
j) Speedometer and odometer check
k) Steering and suspension
l) Fuel system integrity

142. The roadworthiness standards test could be more comprehensive including dynamic performance of braking system, wheel balancing and likewise, however, that is not recommended based on the economic feasibility of keeping the total cost (labor and equipment) of periodic roadworthiness inspection below $20-$30 must be considered. The Kenya Standard (KS1515: 2000): Code of Practice for Inspection of Road Vehicles (KBS, 2000) may be used as a template standard for period vehicle testing protocol.

143. In addition to the above considerations for crash worthiness and avoidance, the profile of standards should also consider vehicle fuel economy over the same period, in order to ensure any resulting policy design does not incentivize larger, heavier and less efficient vehicles. Most of the markets of origin for imported vehicles in Ethiopia require cars and light trucks to meet fuel economy standards. Indeed ten markets representing about 80 per cent of the global light-duty vehicle production have regulations. These regulations by and large are built on targets for fleetwide averages (based on sales for each producer), rather than \targets for individual vehicles. This means that each manufacturer is held to a fuel economy target for the weighted average efficiency of the vehicles they sold in a market in any given year. Because of the prevalence of second-hand vehicles in developing countries such as Ethiopia, corporate average weighting is not

an appropriate approach for improving fuel economy, because there is no appropriate responsible party to hold accountable.

144. Given the above considerations, the team has the following suggestions regarding the implementation of a DPOS for vehicular safety and fuel economy in Kenya. First, there is a need to establish a process to develop the DPOS for cars, covering both fuel economy and crashworthiness standards. The Ethiopian Standards Agency might be in a good position to convene and lead such a process, which could identify important incremental steps to advance toward GFEI goals. Second, there will eventually be a need to establish a similar process for heavy-duty vehicles, but an efficiency baseline and progress for HDVs is not well established, even in Europe. A DPOS for trucks, therefore, may require more time to be established, and will likely follow developments in the European Union.

145. Third, pricing considerations for the implementation method should be well thought out and evaluated for their potential impact on vehicle safety. Fourth, ensure that car and truck VKT (e.g. through odometer readings) as well as motor-vehicle fuel sales are recorded in order to be able to track real world impacts of DPOS and implementation mechanisms.

146. Finally, plausible technology pathways for improvements in fuel economy need to be considered during the DPOS process. The objective of the fuel economy DPOS is to facilitate a reduction in fossil fuel consumption per vehicle kilometer driven, but there are a number of plausible technology pathways that could lead there. These include: reduction in weight of vehicles demanded in the market (which in turn relates to the size of vehicles demanded or manufacturing materials used); improvement in engine or transmission technology; fuel substitution (e.g. use of renewables); or drive-train substitution (through gradations of electrification of vehicles, for example). This latter could be linked specifically to public investments and incentives on electrification, such as electrification for 2-wheelers in rural areas w/ solar panels, as well as buses and other urban vehicles. The Text Box below gives a brief introduction of the global context and ongoing program efforts in Africa to leapfrog to electric vehicles.

*Text Box 2. Leapfrog to electric-drive vehicles*

In the last decade, electric-drive vehicles have emerged as a real contender for the drive train of the future. Investing in plug-in hybrid, full-battery electric, and hydrogen fuel cell vehicles promises low to zero tailpipe emissions, climate change mitigation, petroleum use reduction and industry leadership. National, state and local governments have accordingly rolled out a wide range of supportive policies. Along with decreasing costs, these policies have resulted in strong increases in electric vehicle sales in the major motorized markets including the US, EU and China. Although global market share of electric vehicle is still under 1%, a few markets have seen uptake that is tenfold greater (i.e. Netherlands at 10% and Norway at 22% in 2015). China's market is particularly diverse with strong uptake in the car, bus, and two-wheeler segments. Electric motorcycles or e-bikes are ubiquitous in Chinese cities providing a cheap, convenient, and relatively clean way to bridge gaps in public transportation. The success of e-bikes in China has paradoxically not been fully embraced in the country's major cities, which are restricting their use citing safety concerns including collisions with pedestrians. A combination of outdated national standards for e-bikes and inadequate road infrastructure are likely contributing to this outcome.

What is the path forward in Ethiopia? The UN Environment is implementing a program in Kenya and Ethiopia to promote electric motorcycles as an intermediate step for the countries to leapfrog to cleaner vehicle technologies including other forms of electric mobility. In Kenya for example, the import of highly polluting conventional two-stroke motorcycles surpassed all other vehicle imports in 2015. Promoting electric motorcycles will hence play a crucial role in reducing emissions from motorcycles while at the same time promoting sustainable development as local manufacturing options will be reviewed. In Ethiopia already, electric mass transit is being promoted by the government. The program will support a baseline analysis of the current situation including the energy mix and projected energy needs for the transport sector with the introduction of electric mobility, which will inform policy design. In both countries, renewable energy constitutes a large part of the energy supply thus further strengthening the expected climate gains from electric mobility.

In Sub Saharan Africa where electrification rates remain very low, the long-term viability of transportation electrification rests on its integration in plans to further develop both on and off grid access to electricity. This would allow adequately prioritizing transportation uses of electricity compared to other uses. Other barriers to address include incremental costs for the vehicles, costs for developing charging infrastructure, financing options for both vehicles and infrastructure, as well as mid to long-term scalability of deployment and infrastructure to cover a range of mobility needs. In the near term pilot projects as those envisaged by UNEP can help identify opportunities and barriers for transportation and leverage lessons learned in other developing markets such as China.

## E. Program 5: Import certification process for imported vehicles and vehicle assembly kits

147. In addition to establishing a DPOS for the main vehicle types with respect to both emissions and road safety / fuel economy, there is also a need to establish a compliance process to ensure that the profile of incremental vehicles are actually conforming to that DPOS. The immediate need for Ethiopia is to establish that process for SHVs, GFUVs, and CKDs in particular. This would meet an immediate need of reducing the risk of ineligible vehicles arriving at the import country and unnecessary financial burden of risk passed on to the end-consumer. Compliance mechanisms for MSFUVs can be developed over time if and when their market share grows.

148. In developed countries with mature motor vehicle industries, these mechanisms usually consist of measures to issue Type Approval (TA) to manufacturers and then ensure Conformity of Production (COP). TA is the procedure by which each vehicle type produced for the particular market is determined to meet all the technical and administrative requirements established in a given regulatory regime in place. UNECE R83, under WP49, governs the definition of a vehicle "type" internationally. COP is a related process which confirms that each vehicle is manufactured in accordance with approved specifications. Presence of a quality-management system such as ISO9001 often suffices to demonstrate COP.

149. For Ethiopia, however, it would be preferable to utilize existing TA-COP systems already in use in the source countries. An Ethiopia-specific COP certification process would only be needed for CKDs. In this case, the certification process would be oriented to ensuring that vehicles entering Ethiopia for use on Ethiopian roads meet certain build-to standards for crash-worthiness and emissions, that they were manufactured in accordance with TA-COP requirements of the country of manufacture, that they have not been illegally modified, and that their crash-avoidance and emissions control equipment are properly functioning at the time of import. Verification documents such as the last proof of ownership of the vehicles, last registration information and report from the last conducted vehicle inspection, is critical to the entry certification process.

150. Current practice in New Zealand is an interesting case study for Ethiopia. Like Ethiopia, nearly all of the incremental vehicles in the New Zealand fleet are imports (both SHV and GFUV) – New Zealand no longer has a domestic vehicle manufacturing industry – with the vast majority coming from Japan. However, New Zealand maintains some of the most stringent emissions and vehicle safety standards in the world, with road safety statistics as evidence of their effect. The two key features of New Zealand's vehicle import regime of note are extensive reference to other countries' vehicle standards in its own legal codes, and an importation process centered around Entry Certification, known locally as "compliance".

151. The requirements for vehicle importation in New Zealand are built around a myriad of requirements depending on the country of manufacture and the year of production of the vehicle. Entry Certifiers carry out both document inspection – to ensure compliance with these requirements – and physical inspection to determine the condition of the vehicle with respect to rust, previous structural repairs, structural damage, brakes, emissions, and seat-belts / seat-belt-

anchorages, among other things. Repairs, if necessary, are carried out and certified by third- and fourth-parties to ensure integrity of the process. After passing document and physical inspection, the Entry Certifier issues a Warrant of Fitness, which is required in order to register the vehicle.

152. The Brussels-based International Motor Vehicle Inspection Committee (CITA) likewise recommends a two-stage entry certification process, similar to that carried out in New Zealand. , consisting of a first-stage done in the country of export (pre-shipping), and the second done at import (post-shipping). The main objective of the former is to determine whether characteristics of the vehicle itself would make it ineligible for import. These might include whether, at manufacture, it met the crash-worthiness requirements of the DPOS then in-force, whether it meets the emissions control requirements of the DPOS then in-force, and whether there has been irreparable structural damage or alteration to the vehicle that render it ineligible to be roadworthy. The main objective of the inspection at import is to determine whether there has been damage or tampering to the vehicle during shipping, and what repairs might be needed prior to issuance of a roadworthy certificate.

153. In Ethiopia, currently there is no effective entry standard or entry-certification process set up for imported vehicles. Its neighboring country, Kenya, is a bit advanced in this aspect, importing vehicles subject to "pre-export inspection" in the country of origin, but it has the advantage that nearly all vehicles are imported from a single country, Japan. Vehicles are inspected on export from Japan by a company contracted to the Kenya Bureau of Standards, but there is no systematic inspection or certification of the vehicles at arrival, other than verification of paperwork.

154. For Ethiopia, motor vehicles are imported from various sources, including Asia, Europe, and the United States. That said, there are vehicle inspection companies with global presence that could be engaged to manage the inspection process on the export side for the Ethiopian government. In addition, an entry-certification agency in the country of import similar to the New Zealand model may prove to be beneficial. It is ultimately the responsibility of this national agency, not the inspection center in the export country, to authenticate and verify the compliance of the imported vehicles to the nationally applicable vehicle safety and emissions regulations and authenticity of the certification documents. The entry certification agency may subject the vehicle for additional inspection at the port of entry only if necessary or glaring discrepancies (including visible structural damage or modifications) or documents missing to verify the compliance of the vehicle in question.

155. In light of the above considerations, the team recommends the following measures with respect to establishment of a more effective import certification process:

- Consider establishment of a two-staged system, involving contracting with an international vehicle inspection company with global presence for export certifications at the country of origin, combined with a separate contract with a different vehicle inspection company (in order to ensure improved checks and balances and minimize conflicts of interest) for certification at import.

- Consider adopting a country-context-applicable-standards approach to filtering eligibility of vehicles for import to Ethiopia similar to that used in New Zealand. Doing so would entail a comprehensive review of applicable vehicle standards in the area of emissions, safety, and physical compliance as described by UNECE, EU, Japanese, and other standards of countries of provenance, against the requirements / objectives established by the DPOS processes.
- Work with impartial experts such as the International Motor Vehicles Inspection Committee (CITA) to design such a system in a cost-effective manner. The Bank team is ready and willing to facilitate this technical assistance.
- Consider knowledge exchange activities with countries that have well established and well-functioning import certification processes such as New Zealand.
- Engage with the vehicle import industry to begin to establish institutional structures, norms, testing regime, and agreed practices for Entry Certifiers. Project team should agree early with import industry on a timetable.
- Explore, through international diplomatic channels, opportunities to harmonize source-country export data with import, customs, and entry certification, to facilitate integration with the new drivers' licensing and vehicle registration database being developed under the TRANSIP process.
- Develop mechanism for licensing and supervising Entry Certifiers. For example, FTA could develop and empower a unit responsible for carrying out Entry Certification licensing.

156. For the entry certification agencies collaborating with the lead agency (e.g. FTA), it is important to continuously update the performance-based standards pegging to the UN Harmonized Standards on Vehicle Safety as well as applicable technology in the automotive market, especially in the context of importing new vehicles. Guidance from research institutes will also be valuable in terms of prioritization of safety features and their uptake in the local vehicle fleet which should then be regulated as part of the entry certification process.

## F. Program 6: Development, certification, oversight and / or operations of I/M centers

### *1. General concepts*

157. Inspection and Maintenance (IM) is a set of requirements designed to ensure that in-use vehicles are properly maintained and kept in good working order by vehicle owners or leaseholders. The goal of a good IM program for emissions is not to verify whether an in-use vehicle is meeting an emission standard, but rather to check whether it is exceeding a certain threshold (ICCT 2015). This distinction is important, because the way an IM program is established and the parameters that define it are quite distinct from those of a program designed to filter incremental vehicles. In this respect, it is particularly important to distinguish between IM programs, and surveillance and verification programs, which are designed not to ensure maintenance and upkeep, but rather to ensure that vehicles – particularly Market-Specific First-Use Vehicles – are performing to the standards to which they are built.

158. The main goal of an IM program is to identify the dirtiest and / or hazardous vehicles, and to get those vehicles repaired or out of circulation from the locations they can do the most harm. For emissions, best practice cases from around the world point to the need to separate emissions testing from vehicle repair, with the former centralized in high-throughput facilities that can be readily monitored through both visual and electronic means. This minimizes the opportunities for corruption, and facilitates investment in advanced emissions control testing equipment if required. This principle of separation of testing from repair also applies to vehicle safety, though in practice; indeed, there are a few jurisdictions, such as Burkina Faso, that require separation of testing and repair functions for safety as well as emissions aspects of in-use vehicles.

## *2. Inspection for emissions*

159. The two key characteristics that should define IM program design to address emissions are the evolving nature of the vehicle fleet – what will be the predominant level of emissions control equipment in the urban fleet in the next five years, what proportion will be compliant with ISO 15765 (OBD2), and what proportion will be petrol, diesel, or other? – and the nature of the ambient air quality pollution problem being faced, which is best identified through ambient air quality and source-apportionment studies. However, even without such studies, it is nearly universally true that Particulate Matter (PM10 and PM2.5) is a chronic and serious public health challenge in cities, particularly but not only where there is a high predominance of diesel vehicle use. Other transport-related pollutants that are often public health challenges in cities are carbon monoxide, oxides of sulfur, and ozone precursors, namely non-methane hydrocarbons and oxides of nitrogen. In Addis Ababa, where altitude and topography combine to also make tropospheric ozone a very likely local pollutant hazard, ozone precursors such a non-methane hydrocarbons and oxides of nitrogen (NOx) are also likely going to be important automotive emissions warranting testing and control. However, the relative importance of these emissions and others, including oxides of sulfur (SOx) and Carbon Monoxide (CO) should be established through empirical evidence.

160. Therefore, the IM program for Ethiopia should be focused initially in Addis Ababa and surrounding metropolitan Oromia, ideally designed on the basis of scientific evidence regarding these key public health pollutant challenges, though almost certainly efforts to control PM would be included. Development of scientific evidence rests on two key pillars, which should be implemented as soon as possible:

- In-use vehicle emissions testing: prior to the establishment of mandatory emissions requirements for in-use vehicles, at least two years of data should be collected, meaning that mandatory inspections should be required well in advance of specific emissions limitations being required. Emissions limitations should be established in order to eliminate the dirtiest 10 – 15 percent of vehicles in a given year, so having a database of empirically measured emissions is an important first step in determining what the cut-off should be.
- Ambient air quality monitoring: In order to determine which pollutants should be targeted in any in-use vehicle emissions control program, the key air quality problems in Addis Ababa should be documented. The Government of Ethiopia should develop an air quality monitoring program for Addis Ababa, taking advantage of advances in sensing technology,

reduction in costs and size of installations needed, and ability to do remote monitoring and management of equipment.

161. Most of the vehicle fleet in Ethiopia uses no emissions control measures at present. Indeed, as noted above, sulfur levels in fuels are too high to permit effective usage of even basic exhaust after-treatment technology in both light-duty and heavy-duty vehicles. For heavy duty vehicles, this means second-hand vehicles, for example, from Europe, cannot be used because they are incompatible with the low-quality fuel available in Ethiopia; as a result, most HDVs joining the fleet in Ethiopia are either imported or assembled using Euro II equivalent or lower technology. For light duty vehicles, low fuel quality means that exhaust after-treatment mechanisms are usually disabled.

162. For these reasons, a basic smoke opacity test (e.g. with a two-stage idle testing protocol for gasoline vehicles or snap-idle protocol for diesel vehicles) should be sufficient to identify the worst emitters for the foreseeable future. It is well known that as emissions control equipment becomes more sophisticated, smoke opacity becomes less effective at identifying gross emitters. Hence the effective duration of an emissions testing program based on smoke opacity will depend on the DPOS and how effectively it is enforced. Even so, it may not be necessary or cost-effective for Ethiopia to contemplate system-wide investment in machinery to carry out loaded emissions tests, if the fleet becomes compliant with OBD2 within ten years or so. In that case, it may be more cost-effective to design a two-stage program around unloaded tests for non-OBD compliant equipment, with follow-up PEMS testing for failing vehicles and randomly selected OBD2-compliant vehicles to deter OBD tampering. For OBD2 compliant vehicles, the emissions inspection would consist of verifying the effective functioning of the OBD system, and then addressing any flagged codes.

### *3. Inspection for safety*

163. The vehicle testing protocol should be designed to ensure that all vehicles adhere to a minimum standard of safety performance while under operation. The testing protocol may potentially be combined with exhaust emission and noise pollution along with compliance to safety performance standards. Entry vehicles (imported or locally assembled) need not be subjected to the testing protocol at the time of registration, if they will be subjected to regular inspection once under operation as part of the current fleet. This applies to all categories of motorized vehicles including passenger cars (sedans, SUVs), heavy vehicles (trucks, larger trailers), and passenger service vehicles (taxis, shuttles, buses). The compliance to the vehicle testing protocol may be ensured with the issuance of a "Certificate of Performance" which must be produced by the vehicle owner or vehicle dealership during import registration or annual inspection process. It will be the responsibility to of the vehicle owner, even during the pre-import stage, to ensure all vehicle comply with the Certificate of Safety Performance. For road safety objectives, the maximum inspection interval, as recommended by the UN, is one year after the first registration (or if the vehicle is not required to be registered, date of first use) and annually thereafter. Further, the inspection schedule may additionally also apply to vehicles involved in tow-away crashes and random on-roads inspections.

164. The vehicle safety testing protocol should aim to cover the following aspects of vehicle safety features:

1. Tire condition and minimum permissible thread depth
2. Brake condition and operation
3. Structural conditions (including corrosion and rusting)
4. Certificate of loading and load restraints (load anchorages, towing connections).
5. Lighting (headlamps, brake lights, turning indicators, reflectors as applicable)
6. Glazing (windscreen and wiper condition)
7. Door operations and locking mechanisms
8. Safety belts and buckle/anchorage system
9. Airbag operations if fitted
10. Speedometer and odometer check
11. Steering and suspension
12. Fuel system integrity

165. The development of vehicle testing protocol for the specific case of the African nations is aimed at harmonizing country-specific vehicle safety inspection standards with the UN regulations under WP.29 (Uniform Conditions for periodical Technical inspections of Wheeled Vehicles and the Reciprocal Recognition of such Inspections of 1997). In addition, being a contracting member also allows for the reciprocal recognition of the certificates of such inspections from other member countries. The Kenya Standard (KS1515: 2000), "Code of Practice for Inspection of Road Vehicles" (KBS, 2000) may be used as a template standard for period vehicle testing protocol.

166. Inspection centers should be designated by the relevant government authority through a well-established, transparent, and predictable process. As for emissions inspections, where the capacity of this government authority is weak, efforts should be taken to limit the number of different inspection entities that require oversight. The approval of government authorized inspection centers should also extend to equipment used for inspection to be certified by an authorized body and certified training for personnel using the equipment and involved in the issuance of the certificate. It is important that the prohibition of the vehicle is clearly marked and categorized as immediate or delayed in case the vehicle shall be deemed for repair at the cost of the owner. Without a Certificate of Performance the vehicle shall be denied renewal of registration, road license or insurance coverage and further penalized if found under operation during random on-roads inspections.

## *4. Maintenance*

167. More challenging for Ethiopia than the Inspection will be the Maintenance part of IM. Emissions control strategies adopted by car manufactures to meet increasingly stringent requirements in vehicle production countries are not only increasingly intricate and complex, but they are also more varied, requiring increasing depth and breadth of knowledge from automotive mechanics. Thus, the development of an effective IM program must go hand-in-hand with efforts to develop the automotive mechanics industry, discussed next.

## *5. Management of inspection system*

168. Many countries evolve their emissions inspection systems out of an older system of safety inspections, which tend to be more dependent on labor than machinery. As a result, many nascent emissions IM programs follow a model of decentralized inspection at small facilities that do maintenance as well as inspection. Numerous best-practice compendia[19] examining IM programs, however, have concluded that emissions inspection systems are more effective and cost-efficient when they are carried out by centralized, test-only facilities focused on high vehicle throughput, with separation of the test from the repair function. There are a number of advantages to test-only facilities – namely greater manageability for oversight agencies to supervise the activities, less susceptibility to corruption, and greater ability to invest in the latest and most technically advanced equipment. However, there are a few disadvantages as well, most notably greater inconvenience for motorists.

169. In light of the above considerations, the following parameters for an IM system are recommended for consideration in Ethiopia:

- Centralized test-only facilities should be developed for Addis Ababa and metropolitan Oromia.
- Decentralized (small test and repair) facilities would still be standard in smaller metro areas, but with the intention of reducing their role as motorization develops.
- As management capacity of the regulator (e.g. FTA or regional transport authorities) improves, consideration could also be given to allowing decentralized facilities to develop and co-exist with centralized facilities, in order to give private motorists more choices, but the fees at such de-centralized centers should be kept higher than those at centralized facilities, to encourage use of the latter. In this manner, time-sensitive users in large metro areas could choose to use the decentralized facilities, but they would pay a premium.
- Based on the presumption that tests at centralized facilities are more accurate and less susceptible to fraud, vehicles in commercial use would be required to undergo tests at centralized facilities, as would any private vehicle flagged for testing through an on-road enforcement action, or any private vehicle that fails an initial test and is required to undergo repairs.
- Fees for both would be collected centrally using internet-based services, and then distributed to the test centers by a third party.
- For both centralized (test-only) and decentralized (small test and repair facilities), authorized inspectors should be required to have access to the MVIMS system to both extract necessary information about the vehicle, and to deposit the test results. Where testing is carried out by equipment, this equipment should have direct link to the MVIMS system to deposit test results without human intervention, in order to track and minimize human error and fraud.

[19] Michael P. Walsh. 2005. "Motor Vehicle Inspection and Maintenance: The Worldwide Experience".
Clean Air Asia. 2016. "Vehicle Inspection and Maintenance in Asia: Status and Challenges".
Asian Development Bank. 2002. "Vehicle Emissions Standards and Inspection and Maintenance: Policy Guidelines for Reducing Vehicle Emissions in Asia".

- Decentralized facilities would be *licensed* through application to a relevant department, such as the regional RTA or FTA, after demonstrating adherence to certain criteria. Among these criteria should be a requirement for strong and redundant internet connectivity in order to access the MVIMS system.
- Centralized (test-only) facilities should be operated by appropriately constituted and organized entities (e.g. public or private) using Public Service Contracts (PSC) – that is, a public or private company would operate the facility on contract to the responsible department, such as the regional RTA or FTA. Using PSCs – including to several different operators at the same time – is one way to ensure quality of service to the customer and enhanced ability to address corruption if and when it occurs.
- These facilities could either be built by the public sector and then leased out to the operator under the PSC, or else developed under a public private partnership (PPP) model such as BOT.
- Regardless of centralized v. decentralized, PPP or fully public, revenues raised within the testing eco-system should be hypothecated and used for investment of test equipment, staff training, and oversight costs. These revenues would include
    - License fees paid by decentralized facilities
    - Testing fees paid by vehicle owners at centralized facilities, if in public operation
    - Contractual payment by private entities under public service contract for centralized facilities, if operated in PPP model

As noted above, the IM system should be supported through complementary measures for on-road enforcement. Vehicles which are flagged through on-road enforcement actions would be required to retest at a centralized (test-only) facility within a certain amount of time.

170. It is recommended that a system of mandatory vehicle inspections be carried out for a minimum of two years in each metropolitan area subject to the inspections, prior to association of regulatory enforcement to those inspections. This recommendation is for three reasons. First, it allows the authorities and inspection station operators the time to develop on-the-ground experience with equipment and protocols and to fine-tune them prior to taking enforcement actions. Second, it enables the general public to understand the inspection process and anticipate any problems they may have with their vehicles for some period before being forced to take corrective action. Third, and most importantly, it enables the collection of a robust set of empirical data on which to base regulatory and enforcement actions.

171. For the Federal Transport Authority (or whoever is ultimately charged with taking responsibility for establishing this program), the above considerations have a number of implications. First, as manager of the drivers' licensing and vehicle registration database system (MVIMS) under development through TRANSIP, it would need to ensure that the necessary protocols and data protection measures are developed to enable access to the VIMM by the vehicle inspection industry. Second, it would need to develop the regulatory capacity – decentralized into field offices as appropriate – to be able to administer a system of licenses and or PSCs, including capacity to carry out snap inspections and facilitate enforcement actions as appropriate. Third, FTA would become the custodian of a great deal of operational data related to vehicles, so needs

to develop the necessary capacity to exploit and utilize that data productively. This may mean development of in-house capability to analyze data, but it might also mean development of standing protocols or MOUs with academia to produce regular analyses of data for public policy development. Such useful data that could be collected would include profiles of the fleet, profiles of fleet usage (through collection of odometer readings), identification of anomalies that may indicate fraudulent behavior such as odometer rolling, profiles of empirical emissions rates to identify gross emitters, and many other possible applications.

172. Moving forward, as a practical matter, the team recommends that the government of Ethiopia seek the advice of an independent expert, such as the International Motor Vehicle Inspection Committee (CITA) to establish detailed recommendations and parameters for such a program. Again, the Bank team is ready and willing to facilitate such technical assistance.

## G. Program 7: National protocols for visual and instrumented enforcement

173. I/M programs form one leg of the tripartite system of compliance with the social contract for driving. A second leg consists of awareness raising about the existence and nature of the social contract itself, to encourage self-regulated enforcement. But a key third leg of the compliance program consists of visual and instrumented on-road enforcement.

### *1. Visual enforcement*

174. **Public spotter programs** encourage and enable public to report the license plate of vehicles with visible smoke from their tailpipes. Although the breadth of intervention is limited to smoking vehicles, these programs are relatively easy to set up and have low operation costs. Successful implementation requires active program promotion to ensure high awareness, easy reporting methods and follow up with reported vehicles. The program requires a database that links vehicle license plate to owners and contact information (phone and address). It also relies on an existing system of inspection and maintenance centers. Once a vehicle is reported, authorities should contact owner and ensure the vehicle is tested and repaired before it is once more allowed to ply the roads.

175. Hong Kong and cities in Guangdong Province, China have ongoing public spotter programs. Hong Kong was particularly successful in ensuring public participation by recruiting and training citizen volunteers. Guangdong rewards those that have reported vehicles that are confirmed to be gross emitters. For both programs there are a variety of ways to report vehicles by phone or through a website, email, mail. A text message option offered in Guangzhou would have wide applicability in regions where cell phone ownership is high. Follow through is critical and these programs consistently ensure vehicle owners are tracked down and the vehicle is tested and repaired as needed.

176. **Spot-checking programs** are carried out by government officials that are trained to identify vehicles with potentially high emissions and conduct roadside testing. These programs are meant to complement inspection and maintenance programs by providing more targeted selection

of vehicles. Spot-checking programs are often set up in locations where high-emitting vehicles are likely to be found such as parking lots, bus stations and motorway exit ramps. As with public spotter programs, successful implementation is contingent on not only identifying high emitters but also ensuring vehicles are repaired, and retested before they are allowed to operate. Data on what vehicle makes and models have higher rates of non-compliance can be used to target these roadside inspection. Spot-checking programs are also a good complement to remote sensing programs.

### *2. Instrumented enforcement*

177. Both loaded and unloaded tests can be carried out on the roadside but the costs and equipment requirements vary. For light-duty gasoline vehicles, one option is the lower cost two-speed idle test, an unloaded test that was developed for carbureted engines. However, this test is less effective with today's electronically controlled engines. The Acceleration Simulation Mode (ASM), a loaded test where the vehicle is driven on a treadmill-like apparatus that replaced unloaded tests in many inspection and maintenance programs, has also been applied to roadside test notably in California. For diesel vehicles, the free acceleration smoke (FAS) or snap-idle smoke test measures the exhaust opacity at full open throttle. The test has simple equipment and set up requirements, which makes it easy to incorporate in spot check programs. Although this test similarly to the two-speed idle test is useful in detecting serious malfunctions, the results are often variable and poorly correlated to particulate matter emissions limiting its use.

178. New testing options such as onboard diagnostics and remote sensing are providing promising alternatives to current roadside testing approaches. On board diagnostics (OBD) systems monitor the performance of engine and emissions control systems, alert the driver about system malfunctions, and store information that can be accessed by service providers to diagnose malfunctions. OBD systems are currently installed in all new cars and most new trucks in the US, EU, Japan, Korea, and China, however system requirements in these markets vary. Several jurisdictions in the United States use OBD testing as the primary inspection and maintenance test for newer cars. The use of HDV OBD in truck inspection and maintenance is currently very limited. The data stored by the OBD system can be accessed during spot checking stops using an OBD scan tool, eliminating the need for an actual emission test. This approach's success is contingent on OBD regulations requiring permanent storage of diagnostics trouble codes (DTC) until adequate repairs are made and other requirements to limit tampering. For markets where multiple standards exist, the lack of standardized protocol may limit near term feasibility.

179. Remote sensing devices (RSD) use a light beam directed at the exhaust of a vehicle that is passing by to detect the amount of pollutants emitted and the vehicle's speed and acceleration. At the same time, a camera takes a picture of the vehicle's license plate to link the vehicle to its owners. These systems have been primarily deployed to research fleet level emission characteristics, verify the real world effectiveness of emission programs and to identify high emitters. It is primarily seen as a complement to inspection and maintenance helping identify vehicles that should be further screened or those that are clean and can be exempted. Much of the remote sensing deployments to date have focused on light-duty vehicles, but feasibility for HDV

has been demonstrated. Success factors for the use of remote sensing as an approach reduce in-use vehicle emissions include optimizing the location and density of the system, establishing limits that can be enforced, and following up on detected high emissions. As with public spotting programs, an accurate and regularly updated database connecting license plate to vehicle owners is a prerequisite for remote sensing as an inspection and maintenance tool.

## H. Program 8: Mechanics' training and certification program

180. Within the next two years, sulfur levels in gasoline and diesel will likely come down to below 50 part per million across Ethiopia and this is likely to substantially change the composition of vehicles being imported into the country going forward. These vehicles will have increasingly complex engines with unfamiliar configurations, computer-controlled ignition and cycle timing, and complex exhaust after-treatment technologies. More sophisticated machinery as well as maintenance practices will be required to ensure that these technologies function as intended.

181. As the team understands current maintenance practices in Ethiopia, there are almost two entirely separate industrial "eco-systems" for vehicle maintenance practices. Motor vehicle manufacturers, such as Toyota and General Motors maintain training facilities and dealer-based maintenance shops in order to provide after-market services to customers, as well as provide purchased services to the general public. Such services are generally considered too expensive for most vehicle owners and operators, commercial and non-commercial alike. On the other end of the spectrum, artisanal mechanics provide services on an informal and unlicensed basis, often in roadside shops that are associated with other problems, including poor hazardous waste control and use of public space for private activities. These are the services used by lower income vehicle owners generally, and the mini-bus taxi industry in particular. The challenge is that there is no natural mechanism for the artisanal mechanics, which is probably the largest and fastest growing part of the automotive mechanics sector, to adapt and grow their skills to meet the changing vehicle fleet mix.

182. The long-term solution is try to foster development of the missing middle of the industry – that is, low-end licensed mechanics shops that can gradually supplant the informal services with services that may be more expensive than the cut rate prices offered by the informal sector, but still affordable for most vehicle owners and operator, and with higher quality controls.

183. The team believes that the most promising way to do this would be to utilize and expand the infrastructure of the existing industry. Original Equipment Manufacturers (OEMs) who already have institutional structures and facilities for their own, (high-end by Ethiopia standards) branded products should be brought into a dialogue to facilitate training for the industry as a whole, not just for their own branded dealers. What form this ultimately takes would be determined by the outcome of that dialog. For example, the dialog could result in public-private partnership models to develop for-profit training centers.

184. Going forward, the Bank could help facilitate such dialog. Indeed, the Korean Transport Safety Authority which is a member of this project's technical advisory committee has expressed interest in facilitating linkages with Korean industry to assist Ethiopia establish not only the curriculum structure and model to facilitate training programs, but also the regulatory, permitting, and credentialing structure necessary for a modern industry.

## I. Program 9: Quality assurance program for genuine vehicles parts used in maintenance workshops and minimize use and impact of black market

185. The automotive after-sales industry has become a critical factor not only in maintaining in-use vehicle performance, but also promoting new vehicle sales; if sound after-sales services are provided, buyers are potentially more inclined to purchase new vehicles. As the automotive market matures, the potential of vehicle-part counterfeiters to tap into various untapped business opportunities and challenges of counterfeit vehicle parts prevailing in the market have gradually emerged. From the demand side, the majority of the domestic vehicle fleet in Ethiopia is second-hand and comparatively old when they were imported, so they degrade faster and increase the demand for and frequency of repairs and maintenance. From the supply side, automotive business in the world is paying more and more attention to aftermarket services which are considered to be important for enhancing customer satisfaction and brand loyalty. In some markets such as China, spare parts business is projected to be a core par of revenue source growth for Original Equipment Manufacturers (OEMs) [20].

186. Unfortunately, the lucrativeness of the motor vehicle parts supply business is such that it has also attracted the attention of counterfeiters, who supply fraudulent parts that are often designed to look like the real thing. Because counterfeit spare parts may compromise on quality of input materials or production standards, they may play a role in in traffic crashes, though the team is unaware of any studies on the subject, and they can also lead to failure of tailpipe emissions control, not to mention vehicle degradation. For these reasons, it is important for Ethiopia to design and implement the regulatory framework to address the outstanding issues in the spare parts supply chain and create a better business environment to enable these legitimate parts suppliers and distributors to survive, compete and prosper.

187. The Counterfeit Spare Parts phenomenon has supply, demand, and market function dimensions to it. On the supply side, counterfeit networks are extensive, emanating out of parts of Asia, Russia and Latin America. On the demand side, vehicle owners in developing countries tend to be very price sensitive when choosing spare part brands. For example, it was surveyed in Myanmar, a similar emerging market that has a very large used vehicles fleet, that quality of the product and service usually come second and third after consumers' concerns of the price. The majority of Burmese car owners have little knowledge of brands and products, but rather request a product by asking for the price instead of the brand. It was also observed that consumers will

[20] Deloitte Consulting. 2013. "Driving Aftermarket Value: Upgrade Spare Parts Supply Chain. Deloitte China Auto Industry Spare Parts Management Benchmark Survey", pp. 3.

choose spare parts depending on their car type, used or new, when there is a high price difference between branded and cheap spare parts. Another factor affecting consumers' preference is the period of usage, which makes sense that the longer a spare part can be used the more likely they will invest in a branded product. As household income rises and imports of new cars increase, the demand for branded/quality spare parts are expected to pick up.

188. Finally, on mediating the two are market mechanisms of the "grey" market. Some genuine auto parts are diverted from the usual distribution channel and can be sold in circuits unauthorized by local legislation or not controlled by the brand owner.

189. One important component of the quality assurance program against counterfeiting involves the registration of intellectual property (IP) rights for protection with the OEM filling of patents and trademarks, which would form the basis of legal challenges against apprehended counterfeiters. In addition, spare parts business can take advantage of some cost-effective anti-counterfeiting technologies, such as increasing product differentiation by adding security labels and sealing. These mechanisms have been of substantially more concern to industry than academia, and have been the subject of extensive industry analysis. See Text Box 3 for one of the better examples.

*Text Box 3. Counterfeit and black market auto parts: the view from industry*

*This Text Box reproduces, with minor modification, the article: "Counterfeit auto parts: a real scourge for safety and economy" from 23 March 2016 by Arjo Solutions*
*http://www.arjo-solutions.com/en/2016/03/23/counterfeit-auto-parts/*
*Accessed 6/18/2017*

# I. Counterfeiting & parallel market: 2 illicit activities on auto parts

## A. The counterfeit auto parts

The automotive aftermarket industry is affected by various issues and first and foremost by brands counterfeiting. The original parts (car manufacturer) are usually the first copied, with some brands belonging to automotive supplier and sometimes even brands of independent distributors.

The favorite targets of counterfeiters are high added value products, easy to copy and with a high turnover rate. As per a recent study conducted by the Automotive Aftermarket Suppliers Association, counterfeiters mainly target 3 market sub-segments:

- Maintenance : Oil filter, air filter, Brakes, brake linings, seals, rotors, flex disks
- Repair : Bumpers, covers, head lamps, tail lamps, sheet metal, oil pumps, water pumps, windshields
- Suspension : Steering arms, tie rods

*Figure 25. It might be difficult to distinguish a genuine auto part from a counterfeit one*

Most of counterfeit parts are found within independents networks

### B. The sources of counterfeit auto parts

Asia is known as being the first worldwide supplier of counterfeit goods (more than 2/3 of counterfeit products would be manufactured in China). Among the top-producers of counterfeit auto parts there are in particular Russia, India, Pakistan, and Uruguay.

Fake parts might be introduced within the distribution network at many times and places. As per the German association *Verein Freier Ersatzteilemarkt*, the internet would generate 12% of auto parts sales in the world. The growth of this distribution channel should keep on increasing by 10% a year with the next 5 years.

### C. Diversion of auto parts: genuine parts on an unauthorized market

The second major issue affecting the automotive aftermarket suppliers is the gray market (or parallel trade). Some genuine auto parts are diverted from the usual distribution channel and can be sold in circuits unauthorized by local legislation or not controlled by the brand owner; the loss of income might be significant.


*Figure 26. Observed frauds within the auto parts industry*

## II. The impacts of counterfeit auto parts

### A. Counterfeit auto parts: a real danger for drivers' safety

Fake spare parts might not reach safety standards as fraudsters generally used dangerous or inferior materials for production. That's why fake auto parts are in top 10 causes of accidents reaching the 7th position. Despite the enhancement of controlling measures, this high-profitable traffic for counterfeiters turns out to be deadly for drivers who are collateral victims.

### B. Illicit trade of counterfeit auto parts: an ongoing economical phenomenon

Globally, auto parts are in the « top 3 » commercial goods most targeted by counterfeiters, straight after tobacco or luxury products. The entire industry is affected; sometimes within developed economies but in particular in emerging regions. In India, for instance, the counterfeit auto parts rate would reach 40%.

Counterfeiting is a real economic scourge and also has negative impacts regarding employment, brands reputation, governments' revenues and vehicle lifecycle. As per a study published by the Worldwide Custom Organization in 2011, counterfeiting within the automotive aftermarket would globally cost $ 45 billion a year only for manufacturers, including $ 3 billion in the United States.

# III. How to fight against counterfeiting of auto parts?

## A. The key success factors for an efficient fight against counterfeiting

The first feature to be implemented in the fight against counterfeiting concerns the intellectual property with the filling of patents and trademarks. As a complement, brands tend to adopt the following good practices:

- Products differentiation: By adding security features to products or packaging to make them excessively difficult to copy or reproduce, brands might discourage counterfeiters from copying. This printed marks or secured labels can be real barriers, enabling to reassure the distribution networks by guarantying them the authenticity of auto parts.
- Stakeholders' engagement: Ideally, every segment of the distribution channel should be able to identify the genuine products without any doubt. In general, this is the role of brands to implement various means to guarantee to their customers (subsidiaries, wholesalers, distributors) the authenticity of their products. Collaboration is required not only with these actors but also with customs.
- Consumers (end-users) involvement: Due to the complexity of the distribution networks, a lack of trust may appear to some garage owners and car drivers, who want to check by themselves the authenticity of the auto parts. These ones will generally control and verify the point of sales of their first purchases; that's why brands (manufacturers, distributors) need to deliver information about security features to enable end-users to distinguish fake from genuine.
- Promotion of changes: Differentiation features that brands want to unveil needs to be promoted within networks. Some solutions such as unitary random codes [Xtrack] or complex holograms are overt features and well-adapted to a large communication. Nevertheless, these features make the product more vulnerable to copy, especially if controls are subject to interpretation (human senses might be fooled). The protection choices might target more robust security features dedicated to experts (sales force, trustworthy distributors).

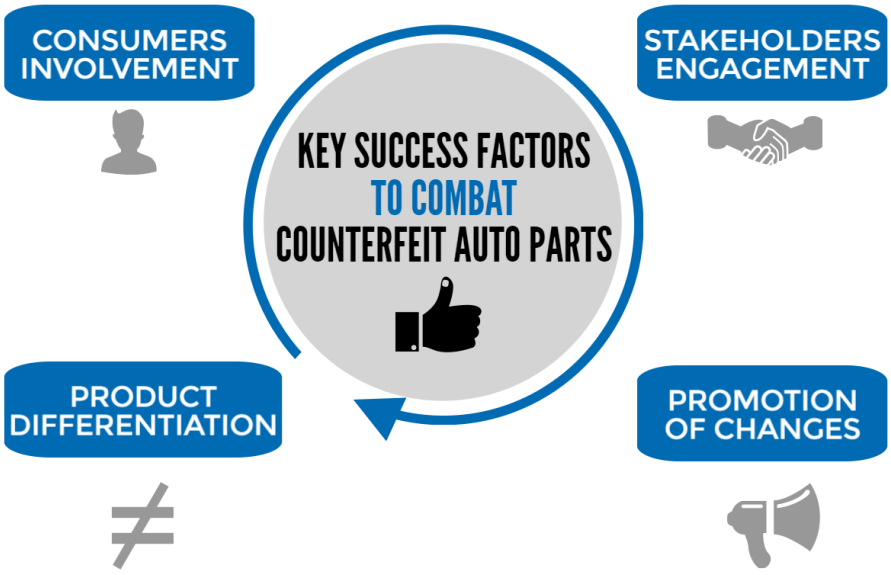

*Figure 27. Key success factors to fight counterfeit auto parts*

## B. Security solutions to combat counterfeit auto parts

Some counterfeiters have become real experts in copies, what makes the distinction between fake from genuine pretty difficult or even impossible for manufacturers themselves. [Key measures to combat counterfeit auto parts include:

- Serialization / traceability
- Anti-counterfeiting using authentication solutions; and
- Tamper evidence]

## J. Program 10: Regulatory standard development for vehicle body construction and modification

190. A key issue for vehicle safety standards is adherence to regulatory standards pertaining to vehicle body structure and modifications. This is particularly important to structural changes or modifications that compromise the technical performance of the vehicle both in terms of crashworthiness and roadworthiness performance. Compliance to vehicle body standards and modifications apply to all categories of vehicles but particularly important for high occupancy vehicles (transit vehicles such as mini buses) and heavy goods vehicles. While such transit vehicles in general have lower performance standards in terms of occupant protection (seat belts, airbags etc.) compared to private-owned vehicles, further compromise through structural changes can have disastrous effects on injury outcome even in less severe crashes (especially for mini-buses in African countries). At the same time, given the vehicle body inspection of public transit vehicles is enforced in much lesser degree, the incentive for vehicle fleet managers to modify vehicles to either increase occupancy or load carrying capacity is widely seen in many developing countries.

191. The responsibility for ensuring that the vehicles comply with the body structure and modification standards finally rests on the vehicle owner or fleet owners in the case of passenger vehicles. However, given how the industry is fragmented and deregulated in terms of vehicle body standards, it is important to have a designated agency responsible for accrediting auto body-builders in the countries. This agency will also be responsible for authorizing approvals for vehicle designs for specific vehicle type and ensuring that designs comply with national standards as well as manufacturer specific technical criteria. For above functioning it is important that the authorizing agency works closely with the lead agency on road safety to ensure that appropriate high-risk modifications are scrutinized prior to providing clearance. Typically, such standards have provisions for making exceptions if the vehicle is intended for disabled drivers and require additional modification. Similarly, special use vehicles such as school buses, ambulances may have additional criteria for consideration.

192. For the purposes of benchmarking, the currently proposed standard in Kenya (DKS 372:2010) for on-road passenger and freight vehicles body construction may serve as a good

comparator. This standard would apply to all vehicle intended for transport of passengers including articulated buses, low floor vehicles, and specifically focus on sub-components such as emergency exit doors, service door, glass, vehicle floor, driver compartment among others. The standards also regulate the tare mass of the vehicle as a result of the modification.

193. Under the proposed standard, all body-builders in Kenya would be accredited by the Kenya National Accreditation Services (KENAS). The approval of vehicle modification would be based on submission of vehicle drawings, interior arrangements, tare mass, axle mass, intended occupancy calculated in a standard way and categorization of the vehicle as per body structure.

194. The standard further stipulates requirements for the following elements or modifications:

- Drilling or welding of the chassis
- Gangway dimensions
- Window design and construction
- Hand rails and holds
- Seat belt anchorage
- Emergency exits

Other, non-crash specific, safety standards are included for ventilation, seat spacing, floor height, fire extinguisher among others.

Recommendations for Ethiopia:

195. The following measures are recommended for Ethiopia:

- *Assignment of primary responsibility for overseeing vehicle body assembly, modification, and accreditation.* It is critical for an authority to be assigned responsibility to oversee the industry, either through the establishment of standards and accreditation itself, or negotiating with industry to ensure that it is developing such standards and accreditation responsibilities.
- *In-depth crash investigation of high-occupancy vehicles*: Given that the crash dynamics and applicable vehicle safety standards are quite different for passenger vehicles; it will be important for the road safety agency to undertake in-depth crash investigation for every high-casualty crash. The focus on the investigation should at identifying vehicle related factors that not only contributed to the crash but also for the overall injury outcome (integrity of the overall body-cage, interior components responsible for blunt impact injuries or any other factor that may have increased the severity of the crash). Having an overall assessment of risk factors associated with passenger vehicles will help in guiding the standards and approval process for design modifications.
- *Engagement with the auto body-builders*: The key for compliance to body design standards would lie in having a consensus among the stakeholders that this would be uniformly enforced and economically viable. As fleet modifications come at a cost to the operators, there should be financial disincentive towards investing in the modification of existing passenger vehicles at the time of operation as well as during in-use. The role of visible

enforcement in penalizing the offending parties must be appreciated to ensure high level of compliance.

- *Public awareness on safety of passenger vehicles:* While the structural modifications are mostly driven by demand for increased capacity and travel needs, the regulatory framework in supplying the safety features must be advocated alongside demand concerns.

## K. Program 11: Fuel quality testing protocol and regime

196. There are two reasons to include fuel quality testing in an overall program of motorization management. The first and more traditional reason is to ensure that fuel is not being adulterated, for example, through the deliberate dilution with less costly fuels. The second is to test for introduction of impurities, including water, during the transport or storage of fuels. Both deliberate adulteration and infiltration of impurities can substantially degrade vehicle performance, particularly where sophisticated emissions control equipment are involved.

197. Fuel adulteration has been a substantial problem in Ethiopia. Until recently, adulterated fuels were in prevalent use through the black market, as unscrupulous traders engaged in deliberate fuel adulteration of gasoline and diesel with kerosene, which was taxed lower than other fuels (as seen in Table 2 and Table 3 in Chapter III.D). The extent of fuel adulteration or its impacts in Ethiopia are largely unknown. Very recently, however, the government policy has been adjusted to equalize tax rates among between Kerosene and other petroleum-based fuels. As a result, the team expects that prevalence of adulteration will decline.

198. Infiltration of impurities is the other reason that fuel quality testing is critically important. Where fuel storage systems are structurally weak, water and other impurities can infiltrate fuel at storage, particularly in instances of heavy rain or flooding. Consequently, infiltration of rain and groundwater into fuels can degrade motor vehicle performance, but it can also be an indicator of serious environmental consequences in the other direction as well. If water can infiltrate fuel tanks, then there is a high likelihood that fuel can leach into surrounding ground water as well.

199. A 2011 report by the International Council for Clean Transportation surveyed best practices in fuel compliance programs[21]. It found several themes in common. First, a combination of upstream testing (e.g. at import facilities) and downstream quality checks (e.g. at retail stations) was used. Second, *presumptive liability* is a concept applied to put "the onus on fuel suppliers to deter fuel contamination and the mixing of low quality fuel along the distribution chain." Third, prohibitive non-compliance penalties are applied to fuel suppliers. Fourth, financial and criminal penalties can be leveraged against suppliers. Finally, threat of reputational damage is a powerful incentive.

[21] Fung, Freda. 2011. "Best Practices for Fuel Quality Inspection Programs". San Francisco: International Council for Clean Transportation. November. http://www.theicct.org/best-practices-fuel-quality-inspection-programs, accessed February 21, 2017.

200. The report recommends 4 steps to establish an effective fuel compliance program:

- *Establish in-house capacity to enforce fuel standards*. Fuel sampling and testing can be outsourced, but the environmental agency needs in-house capacity to manage the program.
- *Secure funding to conduct fuel testing and manage the program*. Potential sources include fuel taxes, vehicle taxes, fuel registration fees, retail station registration fees, vehicle registration fees, and inspection / maintenance fees.
- *Seek authority to impose non-compliance fines*.
- *Secure industry cooperation for mandatory or voluntary self-testing and mandatory reporting.*

## L. Program 12: End-of-Life Vehicles (ELVs) management

201. In the developed world regions (EU, Japan, Australia, US, and Canada), where annual registration of vehicles is required, data show that between 3 and 9 percent of vehicles fall out of use on an annual basis. Though data is imprecise, it seems that, on average, about 60 percent of these vehicles are discarded domestically as End-of-Life Vehicles (ELVs), while the remaining 40 percent are exported as second-hand vehicles to markets primarily in developing countries. Eventually, even those exported vehicles will become ELVs in the countries they are exported to. Management of the ELV process is a growing concern around the world, but is particularly important for developing countries like Ethiopia, because unlike in the developed world, almost 100 percent of the vehicles present in the country will one day be ELVs. In Ethiopia, the World Bank projects that, by 2030, over 20,000 cars and 25,000 motorcycles will be scrapped each year, and that number will increase exponentially. Developing mechanisms for sustainable management of those scrapped vehicles, therefore, is critically important for long-term green growth.

202. Worldwide, management of ELVs has been driven by two primary concerns, both of which are relevant for developing countries: the need to manage hazardous substances, and the need to reduce landfill space, especially for countries such as Japan and Korea, with space constraints. In addition, for developing countries, ELV management can provide potential labor-creation and / or labor formalization opportunities, particularly for newly urbanized, low-income workers.

203. When mandated by legislation or regulation, the ELV management chain is conventionally structured around on two phases: Dismantling and Shredding. ELVs are essentially dismantled manually through extraction of hazardous wastes – fluids, fuels, and batteries – and then high-value items with after-market value such as engines, tires, rims. Vehicles are then shredded in industrial shredders. A series of post shredder treatments (PSTs) are then applied to Automobile Shredding Residue (ASR): heavy and light materials are sorted through an air classifier, with the light ASR portion set aside usually for landfill. The remaining ASR material is passed through a magnetic drum to separate out ferrous metals, then a non-ferrous metal separator, and the remaining, heavy ASR, is then also usually put to landfill. Over time, the objective of these mandated ELV management systems is to ultimately increase the proportion of the vehicle, by

weight, that avoids going to landfill, either by being recycled or being used in thermal conversion processes.[22]

204. Korea has had particularly progressive policies with respect to ELVs for several decades. The Korean Automobile Dismantlement and Recycling Association (KADRA) was created in 1989 through legislation, as a partnership among car-scrapping businesses and a non-profit corporation for recycling car parts, the Korean Automobile Recycling Cooperative (KARCO). This was a particularly forward-looking policy, since Korea's rate of motorization at the time was only about 81 cars per 1000 persons (World Bank calculations based on Senbil, Zhang et al. (2007)).

205. KADRA's role was to function as a think-tank and advocacy organization in the following areas:

- Suggest improvements to automobile regulations and policies
    - improving legislation including Vehicle Administration Law, Resource Recycling Law, Waste Management Law, Air Environment Preservation Law
    - Propose policies of automobile disassembling and recycling
- Carry forward the environment-friendly and automobile resource recycling projects
    - Strengthen the functions of recycling project for automobile resource cycle
    - Convert to green business environment
- Enhance the car scrap and cancellation system

[22] Development of an ELV policy is generally built around the system components of motor vehicles and their potential uses, re-uses, or transformations. These major systems include the following:

- Reusable or re-buildable automobile components – these generally include engines, starters / alternators, water pumps, and, for better or worse, transmissions.
- Motor oil (including transmission / brake fluid) – this is generally reusable when cleaned of impurities, except in the case of contamination by other hazardous waste (often measured by halogen content)
- Antifreeze – Antifreeze can be reused or recycled using distillation, filtration, or ion exchange.
- Batteries – Most cars use lead acid batteries, which can be fairly easily recycled with appropriate investment in technological and industrial processes, but which, if improperly disposed of, are highly toxic
- Scrap metals – Often salvaged from car rims (aluminum), hub caps, door handles, and antennae.
- Tires – Tires can be retread and reused, or burned as tire-derived industrial fuel. In mature markets, they can also be recycled into crumb rubber, ground rubber, molded products, or tire-derived aggregate, for use in downstream engineering uses such as paving mixtures or land-fill applications.
- CFCs / HCFCs – Primarily used in air conditioning and freezer units. They can be captured and reused. Indeed, their strict capture is mandated by the Montreal Protocol.
- Glass – Theoretically glass can be recycled, but getting glass for example from windshields can be challenging because in modern vehicles they are often layered between layers of plastic. If there is a mature windshield replacement industry, this can be managed through economies of scale. Reclaimed glass could then be used for various downstream uses.
- Plastics – The plastic content of vehicles is increasing with each model year of production, and in recent years has been spurred by increased use of electronics. Though it is technically possible to reclaim and recycle plastics, it is logistically challenging and would likely be prohibitively expensive, at least with respect to the ELV process alone. Alternatively, plastic could be harvested for thermal application in waste-to-energy plants.
- Rare Earth Metals – Vehicles with advanced technology are increasingly utilizing REMs such as dysprosium, platinum, palladium, gold and silver. How to recover these REMs from ELVs remains an important challenge for developed and developing countries alike.

    - Provide information interface with Ministry of Land, Transport and Maritime Affairs and Ministry of Environment
    - Carryout information data processing projects and system development
- Vitalize automobile used parts market
    - Operate the nationally integrated management system for automobile used parts efficiency
    - Establish Integrated Distribution Network and liaison with related organizations
- Function as an association for the car scrappage industry,
    - Foster good practices, and prevent illegal activities
    - Work to eradicate unregistered disassembling-recycling contractors

206. In 2008, Korea enacted a Resource Recycling of Electrical and Electronic Equipment, and Vehicles Act. This Act established an Eco-Assurance System, which, among other things, oversees environmentally sound management of waste, including achievement of a mandated recycling rate, compliance with methods for recycling, obligation for collection by distributor, registration of ELV recycling businesses, and professionalized management of processes. The recycling rate was mandated at 95 percent by 2015. Responsibility for compliance with both guidance and ensuring the attainment of recycling rates was place with all involved in the chain, including dismantlers, shredders, ASR recyclers and refrigerant gas processors. In keeping with prior Korean and increased international focus on Extended Producer Responsibility (EPR), to ensure adequate measures for waste *prevention* at design, automobile manufacturers and importers also have responsibility for compliance; if ELV recycling costs exceed the prices that can be recouped through market mechanisms, the manufacturer / importer bears the additional cost. Over time, these costs would be capitalized into the prices of the vehicles. In addition, manufacturers and importers then have a stake in trying to develop and support downstream markets.

207. The experience of Korea suggests that an important early step for Ethiopia would be to foster an Association of the car scrappage industry; Korea established one even when motorization rates were quite low. The following measures are therefore recommended for consideration by the motorization management committee:

<u>Recommendations for Ethiopia:</u>

208. The following measures are recommended for Ethiopia:

- Establish association of car scrappers and work to professionalize
- Develop standard policies for management of hazardous materials from ELVs[i], especially for
    - Batteries
    - CFCs / HCFC
    - Automotive fluids
- Standardize approaches to vehicle dismantlement, and look for ways to extend dismantlement beyond current practice, particularly looking for ways to develop markets that do not currently exist.

- Begin to invest in mechanized vehicle shredding and post-shredding equipment by 2020, particularly for Nairobi, though with the intention of safeguarding and enhancing labor-intensive vehicle dismantlement as the primary focus of ELV treatment.

## M. Summary of implementation programs recommended

209. The considerations presented in this chapter for the implementation programs for Ethiopia are summarized as below:

*Table 4. Summary of implementation programs recommended for Ethiopia*

| Implementation program | Implementation considerations for Ethiopia |
|---|---|
| **1.MVIMS** | MVIMS under development under TRANSIP program. Particular need, however, to develop a Vehicle Inspection Management Module (VIMM). This should probably be led by FTA (vehicle inspection division?) but merits further discussion. |
| **2. Public engagement program to sensitize citizens at all levels of the motor vehicle lifecycle** | Ensure inclusion of communications specialists in all project teams |
| | Develop meaningful and recognizable brand for motorization management program |
| **3. DPOS for entry vehicles for vehicle emissions and corresponding fuel quality** | EPA probably best placed to take lead in DPOS development |
| | Limit fuel sulfur levels to 50 PPM from 2019 or as soon as possible |
| | Limited value in pushing beyond Euro IV in 10-year projection |
| | Initiate dialogue with international OEMs to cultivate their buy-in to the DPOS, and understand what assurances they will need to warrant vehicles under DPOS |
| | Consider technology substitution pathways via electrification of fleets in major cities / electric vehicles w/ solar in rural areas |
| **4. DPOS for entry vehicles for vehicle safety and fuel economy** | FTA probably best placed to take lead in DPOS development |
| | Consider adherence to UNECE WP29 |
| **5. Import certification process for SHVs, GFUVs, and CKDs** | Consider knowledge exchanges with New Zealand or other places to understand process |

| Implementation program | Implementation considerations for Ethiopia |
|---|---|
| | Consider developing relationship with International Committee on Vehicle Inspections (CITA) to help develop import certification process further. |
| | Engage early with motor vehicle import industry on this issue, and strengthen if needed, in order to gain agreement on institutional structures, norms, testing regime, and agreed practices for Entry Certifiers |
| | Develop mechanism for licensing and supervising Entry Certifiers. Institutional home for this function (FTA?) should develop and empower unit responsible |
| | Undertake comprehensive review of applicable vehicle standards related to emissions, safety, and physical compliance of key source countries, to identify equivalencies consistent with DPOS |
| **6. Development, certification and oversight and / or operation of I/M centers** | Consider developing centralized test-only facilities for Addis Ababa and metropolitan Oromia; decentralized (small test and repair) facilities would still be standard in smaller metro areas, but with the intention of reducing the role as motorization develops. |
| **7. National protocols for visual and instrumented enforcement** | Consider spot-checking programs by specially trained squads of government officials together with public spotter programs by utilizing social media to assist authorities in identifying bad vehicles or operators |
| | Consider instrumented enforcement such as stationary tests, in-motion tests (e.g. remote sensing) or random checks of OBD |
| **8. Mechanics' training and certification program** | Consider utilizing and expanding the infrastructure of existing industry, bringing OEMs to the dialogue to facilitate training for the industry as a whole |
| | Emphasize the registration of IP rights for protection with the OEM filling of patents and trademarks |

| Implementation program | Implementation considerations for Ethiopia |
|---|---|
| **9. Quality assurance program for genuine vehicle parts used in maintenance shops** | Take advantage of cost-effective anti-counterfeiting technologies |
| **10. Regulatory standard development and implementation for vehicle body construction and modification** | In-depth crash investigation of high-occupancy vehicles |
| | Engagement with the auto body-builders |
| | Public awareness on safety of passenger vehicles |
| **11. Develop fuel quality testing regime and protocol** | Establish in-house capacity to enforce fuel standards |
| | Secure funding to conduct fuel testing and manage the program |
| | Seek authority to impose non-compliance fines |
| | Secure industry cooperation for mandatory or voluntary self-testing and mandatory reporting |
| **12. End-of-Life Vehicles (ELVs) management** | Establish association of car scrappers and work to professionalize |
| | Develop standard policies for management of hazardous materials from ELVs, especially batteries, CFCs / HCFCs, and Automotive fluids |
| | Standardize approaches to vehicle dismantlement, and look for ways to extend dismantlement beyond current practice, particularly looking for ways to develop markets that do not currently exist |
| | Consider developing and investing in motor vehicle ELV facility along new Addis Djibouti standard gauge line in Afar, with early target market being Addis metropolitan area |

# V. Principles and policies for motorization management

210. The previous chapter outlined the key programs the team believes to be necessary for effective implementation of measures to advance policy. However, In Section III.C "Scope of integrated motorization management", we identified other considerations that will affect whether implementation of measures will be effective toward attaining policy objectives. Key among these is the breadth of policies implemented – that is, is the scope of the policies identified to address challenges of motorization broad enough to be effective? The present chapter addresses this question, both generally and in the Ethiopian context.

211. On the basis of the diagnostic analysis (summarized in the Spotlight Box in Section II.D) and best practice elsewhere, the team has identified nine motorization management principles which should be taken into account in developing policy. Our key recommendation for this chapter is that one or more policies corresponding to *each principle* should be developed, in a manner that addresses Ethiopia's core needs as summarized in Spotlight Box in Section II.D). We provide some examples of what such policies might look like, both to make the principle concrete, and to provide a basis for evaluation of the evolution of the vehicle fleet under a motorization management program as against the business as usual case, but these are just examples, not necessarily recommendations. To be sure, the team believes they are plausible for Ethiopia, but other policy variants might be just as plausible. More important than the specific example policy for each principle, though, is the need to have policies across the nine principles.

## A. Principle 1: Design motorization management measures in harmony with broad transport policy approaches.

212. Because VKT, not vehicles *per se*, are the determinants of policy outcomes, the first principle is that motorization management should be seen as one component of, not a substitute for, good transport policy. Broad transport policy approaches will affect the *shadow* price of acquiring and using motor vehicles, which can also be thought of in this context as the relative cost compared to other modal and lifestyle alternatives given a set of public investments being undertaken. Development of compact cities, walking and cycling facilities, good public transport, and accessible services will affect the shadow price of automobile ownership and use much differently than urban development focused on car-oriented urban form emphasizing arterials, motorways, and parking facilities.

213. **Example of policy: Develop mass transit in Addis Ababa and surrounding Oromia zone, and facilitate public transport improvements in Addis and many secondary cities.** A key motorization management policy is to influence the alternatives to both private vehicle use and dependency on small, point-to-point, low-profit-margin collective (paratransit) transport services utilizing many small vehicles. Both of these are always at risk of explosive growth, particularly if and when the chronic scarcity of hard currency is resolved. The development of mass-transit and public transit alternatives, especially when well-coordinated with land-use, essentially raises the relative shadow price associated with using the private car or paratransit

services vis-à-vis sustainable transport modes. Further elaboration in this report is beyond the scope of the present study.

## B. Principle 2: Restrict entry vehicles on the basis of performance-based regulatory standards for tailpipe emissions and crash-worthiness characteristics

214. Governments should establish hard and legible boundaries with respect to what is permissible for tailpipe emissions and road safety aspects of vehicles. Both of these elements of motor vehicles threaten the lives and livelihoods of ordinary Ethiopians, often passively, in that those most negatively affected by bad air quality and road traffic accidents are often not involved in the decision to purchase or use the motor vehicle at all. For this reason, conventional command and control regulatory approaches are preferred.

215. **Example of policy: Codify in law fuel sulfur limits from 2019.** At present, motor vehicle fuel supplies in Ethiopia are dependent on a number of sources, including imports from various suppliers through the Sudan, and a substantial contract with Kuwait through the Port of Djibouti. EPTE anticipates that imports of low-sulfur (<50 PPM) diesel can be assured in sufficient quantities only after completion of the Kuwait National Petroleum Corporation's Clean Fuel Program, which will ensure low sulfur diesel output from two of Kuwait's refineries by late 2017. Since Kuwaiti-sourced petroleum imports represent only about half the market at the present time, it is critical that GOE guarantee the sulfur content of the fuels allowed in the country through legislation, in order to facilitate sufficient confidence among investors, OEMs and transport enterprises. If diesel with current sulfur levels continue be imported through Sudan, the team estimates that blended diesel available at pumps would average about 225 PPM of sulfur, which is still too high for Euro IV vehicles to operate reliably.

216. **Example of policy: Require Euro III equivalent from 2020, but prepare for leapfrogging to Euro IV and possibly alternative propulsion technologies in preparation of a dynamic profile of standards.** We recommend that a profile of standards for emissions from entry vehicles over a 10-year time frame be established as a key step in the motorization management process, but a good minimum starting point would be to require the equivalent of Euro III from 2020. In the team's discussions with the Ethiopian Petroleum Trading Enterprise and other stakeholders, it was determined that Ethiopia will be in a position to require maximum sulfur content in fuels of 50 PPM by the end of 2018. Assuming this occurs, particulate and hydrocarbon emissions control technology through the use of exhaust after-treatment (e.g. diesel oxidation catalysts, exhaust gas recirculation) will become viable then. However, there is a need for aggressive development of maintenance know-how and spare parts to ensure the viability of a Euro III equivalent standard – hence our recommendation for a 2020 requirement.

217. Until a few years ago, there was a robust trade in second hand heavy duty vehicles from Europe in Ethiopia. However, EU regulations have required Euro IV since late 2005. The earliest of the Euro IV vehicles hit the age when they normally would have been exported to countries like Ethiopia several years ago, but they require a maximum of 50 PPM of sulfur diesel to be kept in

good operational condition. Because Ethiopia's diesel sulfur content has exceeded this, second-hand heavy duty vehicle trade from Europe has declined markedly in recent years. Instead, most recent incremental heavy-duty vehicles tend to be Euro II equivalent CKDs. However, as the overall fuel sulfur levels come down to 50 PPM and below by end of 2018, imports of second hand European vehicles may tick up again, as sulfur levels will be able to support these vehicles' use.

218. This prospect to improve the fleet through both stricter regulatory requirements at entry and fuel-quality-induced market changes creates a number of challenges for Ethiopia. First, most European-brand Euro IV equivalent trucks use Selective Catalytic Reduction (SCR) for NOx control mandated by EU regulations. SCR requires use of diesel exhaust fluid. It is therefore critical that the supply of diesel exhaust fluid ("BlueDEF" or "AdBlue", etc) be available in sufficient quantities to meet demand when and if Euro IV vehicles begin to be imported. In the short run, it would be particularly critical to assure this supply in Addis Ababa and surrounding Oromia, and along the Addis-Djibouti corridor. Second, even with adequate supplies of low sulfur diesel and diesel exhaust fluid, exhaust after-treatment approaches used in Euro IV and higher vehicles are highly prone to tampering, particularly where operators and mechanics are unfamiliar with them and adequate sensitization and training have not occurred. Memes that repeat falsehoods about vehicle operations – for example, disabling SCR or Diesel Particulate Filter (DPF) systems can improve engine performance or fuel economy – can rapidly circulate among operators and mechanics with limited training, so there is a need for education and awareness campaigns to be developed in advance, to counter these memes.

219. As noted earlier, hard currency constraints, a perennial challenge to Ethiopia's motorization process, may ultimately limit the extent to which very advance emissions control technology can be viable in Ethiopia, because of lack of availability of spare parts. Instead, it may make sense to leapfrog toward greater use of electric vehicles. Development of a strategy for electrification should be considered part of the DPOS process.

220. **Example of policy: Require compliance with UN regulation for crashworthiness requirements[23] from 2018 for all SHVs and GFUVs, and from 2019 for all CKDs and MSFUVs.** The most important regulatory crashworthiness requirements are for front and side impact configurations. The UN Reg. 94 frontal test simulates a car to car crash at 56 km/h in which the vehicle hits a barrier that replicates the soft front end of the other vehicle. The impact is 'offset' with a 40 per cent overlap as most frontal crashes occur in this configuration. The side impact test (UN Reg. 95) uses a trolley that hits the vehicle just above the door sill area at 50 km/h. They are performance tests which stipulate loadings on an instrumented dummy that must not be exceeded. The test do not mandate the fitment of a particular technology such as an airbag. However, to remain within the specified tolerances of the test a vehicle will need both a body shell with an adequate 'crumple zone' and at least a driver's side airbag. The seat belt anchorage regulation (UN Reg.14) tries to ensure that the seat belt anchor points can withstand the loadings incurred during a crash, to minimize the risk of belt slippage and the safe evacuation of occupants. The Regulation

[23] Crashworthiness requirements complying with UN regulation include frontal impact (No. 94), side impact (No. 95) and seat-belt and anchorages (No. 14 and No. 16)

also includes the requirements for 'ISOFIX' child restraint anchorages in which the child seat is securely plugged into sockets and by tether, rather than held in place only with an adult seat belt.

221. **Example of policy: Require compliance with UN regulation for crash-avoidance requirements[24] for all entry vehicles by 2020.** Many lives have been saved as a result of improved crashworthiness but, of course, it is better by far to avoid the collision and risk of injury in the first place. To achieve this highly desirable outcome the automotive industry has invested heavily in technologies that will help to prevent the driver from having a crash at all. The earliest such system was anti-lock brakes (ABS) and this has been followed more recently by electronic stability control (ESC) which prevents loss of control (under-steer or over-steer) skidding incidents. It is widely acknowledged to be the most important safety device since the seat belt. It works by detecting if the steering inputs of the driver are inconsistent with the vehicle's direction of travel. The World Forum has adopted a global standard for ESC (13H ESC) which makes it much easier to encourage worldwide application of the system.

222. The UN is also promoting measures to reduce the risk of injury to pedestrians in a collision with a passenger car. UN Reg. 127 (GTR No.9) encourages the design of more forgiving car fronts. Softer bumpers, combined with better bonnet area clearance and removal of unnecessarily stiff structures, are required to reduce the severity of a pedestrian impact.

## C. Principle 3: Incentivize entry vehicles for better fuel economy, alternative fuels, and/or alternative propulsion, and life-saving safety technology

223. Reducing petroleum consumption[25] is an inherently national interest and important for long-term development goals. It can be accomplished by a combination of improving fuel economy of the fleet, switching to non-petroleum-based fuels, or switching to alternative propulsion technologies like electric vehicles[26]. The Text Box 1 below gives a brief introduction of the global context and ongoing program efforts in Africa to leapfrog to electric vehicles.

*Text Box 4. Leapfrog to electric-drive vehicles*

In the last decade, electric-drive vehicles have emerged as a real contender for the drive train of the future. Investing in plug-in hybrid, full-battery electric, and hydrogen fuel cell vehicles promises low to zero tailpipe emissions, climate change mitigation, petroleum use reduction and industry leadership. National, state and local governments have accordingly rolled out a wide range of supportive policies. Along with decreasing costs, these policies have resulted in strong increases in electric vehicle sales in the major motorized markets including the US, EU and China. Although global market share of electric vehicle is still under 1%, a few markets have seen uptake that is tenfold greater (i.e. Netherlands at 10% and Norway at 22% in 2015). China's market is particularly diverse with strong uptake in the car, bus, and two-wheeler segments.

[24] Crash-avoidance requirements complying with UN regulation include Electronic Stability Control (13H ESC) and pedestrian protection (GTR no. 127)

[25] More accurately, reducing *future* petroleum fuel consumption from a business-as-usual forecast

[26] Reducing petroleum consumption can also be accomplished by reducing or avoiding unneeded VKT, which links to the first principle discussed above, designing MM policies in line with larger transport policy objectives.

Electric motorcycles or e-bikes are ubiquitous in Chinese cities providing a cheap, convenient, and relatively clean way to bridge gaps in public transportation. The success of e-bikes in China has paradoxically not been fully embraced in the country's major cities, which are restricting their use citing safety concerns including collisions with pedestrians. A combination of outdated national standards for e-bikes and inadequate road infrastructure are likely contributing to this outcome.

What is the path forward in Ethiopia? The UN Environment is implementing a program in Ethiopia and Kenya to promote electric motorcycles as an intermediate step for the countries to leapfrog to cleaner vehicle technologies including other forms of electric mobility. In Kenya for example, the import of highly polluting conventional two-stroke motorcycles surpassed all other vehicle imports in 2015. Promoting electric motorcycles will hence play a crucial role in reducing emissions from motorcycles while at the same time promoting sustainable development as local manufacturing options will be reviewed. In Ethiopia already, electric mass transit is being promoted by the government. The program will support a baseline analysis of the current situation including the energy mix and projected energy needs for the transport sector with the introduction of electric mobility, which will inform policy design. In both countries, renewable energy constitutes a large part of the energy supply thus further strengthening the expected climate gains from electric mobility.

In Sub Saharan Africa where electrification rates remain very low, the long-term viability of transportation electrification rests on its integration in plans to further develop both on and off grid access to electricity. This would allow adequately prioritizing transportation uses of electricity compared to other uses. Other barriers to address include incremental costs for the vehicles, costs for developing charging infrastructure, financing options for both vehicles and infrastructure, as well as mid to long-term scalability of deployment and infrastructure to cover a range of mobility needs. In the near term, pilot projects as those envisaged by UNEP can help identify opportunities and barriers for transportation and leverage lessons learned in other developing markets such as China.

224. The team believes that influencing fuel economy, fuel type, and propulsion technology in purchasing decisions for entry vehicles is best handled through pricing and consumer information incentives, rather than regulatory controls. Such controls, such as establishment of fuel economy standards are most appropriate in countries with vehicle manufacturing and large markets that have the potential to influence the type of vehicles developed and brought to market. In small market countries, however, particularly those without vehicle manufacturers, a fuel economy standard is probably unworkable. Rather, pricing incentives can used more effectively, in the form of either direct (e.g. efficiency or $CO_2$ emissions-linked pricing) or indirect (e.g. variable rates depending on engine size, tare weight, etc.) incentives.

225. Incentives for purchasing safer vehicles can also be built into the registration process or policies which mandate vehicle insurance pricing to provide discounts for purchasing safer vehicles. Typically, advanced safety features like Electronic Stability Control or Assisted Braking

may be available in only more expensive trims, so pricing incentives can help make these trims more attractive.

226. **Example of policy: Consider $CO_2$-emission-based excise tax and / or $CO_2$-emission-based annual registration fees, "Feebate", as an alternative to excise duties or VAT.** $CO_2$ emissions are a proxy for fuel economy: the more efficient the vehicle, the lower the $CO_2$ emissions, measured as grams per kilometer. *Feebates* are essentially a fee on inefficient technology and a rebate on efficient vehicles. A "benchmark" (also known as a pivot point) defines who pays and who receives benefits by setting a level of fuel economy or emissions (e.g. in $gCO_2$/km). A "rate" determines the marginal costs and benefits (usually priced in cost per $g/CO_2$). Depending on the choice of benchmark, feebates can produce revenue, be revenue neutral or be a net subsidy to cleaner, fuel efficient car purchases.

227. Feebate programs can be extremely useful in supporting the widespread adoption of clean fuel and vehicle technologies. When developed and implemented correctly, government subsidies can speed up the emergence of new, clean technologies and help to ensure economies of scale are reached, so that the next generation of vehicles are more affordable to the general public without government intervention in the market.

228. A conceptually (though not necessarily administratively) simpler approach would be to use a direct $CO_2$ emission-based excise tax on newly registered vehicles. A threshold $gCO_2$/km is set by the government. Newly registered vehicles above this threshold pay higher taxation per $gCO_2$/km. A variant of this approach would be to peg the recurrent registration charges to threshold $CO_2$ emissions rates.

## D. Principle 4: Visualize impacts of policies, especially unintended consequences and spillover effects.

229. All too often, unintended consequences and spillover effects are not envisioned by policy makers when they define policies. But, policies to influence choices about vehicle ownership and use can often have substantial consequences on other public policy goals, and these should be thought through and considered as explicitly and early in the policy formulation process as possible. Common spillovers in transport policy (related to motorization and other aspects of transport) include driving rebound, fuel diversion, and land-price escalation.

- **Driving rebound** effect refers to the phenomenon of *increased* vehicle kilometers of travel associated with improved fuel economy with consequences to both environment and exposure to road crash risk. Economists further distinguish between price and income effects. As fuel intensity diminishes, the cost of traveling each kilometer declines, so people *substitute* more driving for other activities or inputs to production or consumption. This is the price effect. As fuel intensity diminishes, motorists have less expenditures all else equal, which is the equivalent of more income at their disposal. Since increased

mobility is one well observed phenomena linked to per capita income, additional VKT can also be associated with fuel intensity reduction. This is the income effect[27].

- **Fuel diversion** is a common spillover effect facing African countries, including Kenya and, recently, Ethiopia. Well-meaning policies to incentivize kerosene use in the household cooking sector as a means of discouraging land clearance resulting from foraging for wood, can create distortions with perverse effects.
- **Land price escalation** is another common spillover effect in transport, with key impacts on motorization, particularly in metropolitan areas. Transport investments, including anticipated transport investments that have not yet occurred, can alter accessibility patterns in a metropolitan area, and such changes (or anticipated changes) in accessibility can affect land-rents. Transport policies that seek to deliberately reduce the need for individual motorized travel – for example, by developing or enhancing a mass transport network – may inadvertently *increase* the rate of motorization. If the price escalation in land rents is not captured by public interest and rechanneled, then land rents close to the mass transport network will increase, and the poor or even middle classes may be priced out of those markets. Depending on how well the overall transport system develops and what housing opportunities exist in the metropolitan area, the result could be a net increase in either car ownership or the number of buses or mini-buses brought in to service that demand.

230. **Example of policy: With the equalization of tax rates among gasoline/diesel/kerosene to help avoid fuel adulteration of automotive fuels with kerosene, consider using instead an ICT-enabled program of targeted (demand-side) subsidies to support the social objective of enabling low-income households to purchase fuel for cooking.** Recently, the Ethiopian government has equalized tax rates among gasoline, diesel, and kerosene, which has an immediate effecting of reducing or eliminating a key incentive to adulterate gasoline and diesel with a cheaper alternative. This is a critical development, because as fuel sulfur levels decline, more sophisticated engine and exhaust after-treatment controls can be used on cars to reduce pollution emissions, but sensitivity to quality of fuels also goes up as these equipment become better and more widespread. Adulteration of automotive fuels with kerosene, therefore, would have become an increasingly critical area of concern, not just an air quality point of view, but also simply ensuring that newer vintage cars and trucks remain functional.

231. But the equalization of fuel tax rates does not eliminate (and potentially exacerbates) the key policy concern driving the tax rate differential in the first place, namely, the availability of low-cost fuel for cooking and heating for low-income households as an alternative to foraging and clearcutting. One policy that might be considered would be the use of Conditional Cash Transfers (CCT) to ensure affordability of kerosene[28]. CCT programs provide targeted subsidies to low-

[27] Lorenzo Sabatelli, PhD, *Relationship between the Uncompensated Price Elasticity and the Income Elasticity of Demand under Conditions of Additive Preferences*, GLOBMOD Health, Market Analysis Unit, Barcelona, Spain, 2016, p. 2 https://arxiv.org/ftp/arxiv/papers/1602/1602.08644.pdf

[28] Conditional Cash Transfer (CCT) are direct payments provided to people based on certain criteria. It has dual purposes of delivering income support to the intended group and creating incentives for households or individuals to

income households to purchase cleaner cooking fuels – that subsidize the demand, not the supply. There are some pilot testing in the world, for example in two states in India in 2012, using CCT as an alternative instrument for subsidy delivery. Only when the specified conditions are met can households receive the government aids. Besides, there must be stringent selection of beneficiaries and verification of compliance in order to prevent unconsumed kerosene flowing into the black market of vehicle fuels in exchange of extra income. This program, if well implemented, can substantially eradicate the abuse of fuel subsidies for illegal activities and improve the program effectiveness, and meanwhile, it would remove the incentives for fuel traders to profit from fuel adulteration and ensure fuel economy and emission performance of the vehicle fleet.

*``Text Box 2. Case study of India targeted subsidies*

In an effort to improve energy access, shield domestic consumers from international price volatility and support energy-intensive industries (such as public transport and freight), the Indian government has historically subsidized the four major petroleum products (petrol, diesel, kerosene and liquefied petroleum gas/LPG). However, subsidies have had only limited success in meeting these objectives. The unintended consequences of subsidies include, for example, low government and oil company revenue, low LPG penetration and a large portion of the benefits of the subsidy diverted to wealthy households. Similarly, while kerosene is subsidized to provide a source of lighting in areas lacking access to reliable electricity supply, several studies have shown that a large portion of public distribution system (PDS) kerosene is diverted towards adulteration of diesel according to National Council for Applied Economic Research in 2005. Thus, while subsidies on diesel have been provided to benefit the public transport and freight transport sectors, the price difference between petrol and diesel has also created perverse incentives for private motorized modes and led to higher sales of personal vehicles that are based on diesel and usage of diesel in place of fuel oil in the industry.

In 2012 the central government proposed to replace subsidies on kerosene, LPG and fertilizers with direct cash transfers. Cash transfers are identified as an alternative mechanism of subsidy delivery. The two pilot projects were initiated in the country, with one in Alwar, Rajasthan focusing on cash transfers for consumers of kerosene, and the other in Mysore, Karnataka targeting LPG users. The government aims to reduce the fiscal burden of subsidies, minimize leakages of products from the supply chain and reduce the plight of the poor. However, the success of such CCT program as an effective instrument for delivery of subsidies are contingent on the program design in the first place. Some of the key issues should be highlighted: 1) Identification of beneficiaries; 2) Mode of payment used to transfer the benefits; and 3) Indexing the amount of cash transfer to changing prices. The pilot project in Alwar was focusing on reforming kerosene subsidies with CCT programs, sharing some valuable lessons and experience that is particularly relevant to the fuel adulteration situation in Ethiopia.

In Rajasthan, the state government has initiated a pilot project following directives of the central government to bring about a transition to cash-based subsidy delivery. The pilot is being conducted in the Kotkasim block of Alwar district. A total of 25,843 ration cards exist in the

modify their behaviors to achieve broader social/national goals. The CCT programs have been widely used for various purposes, such as poverty alleviation, education and health improvement, pension support, etc.

block, including 22,114 APL cards, 2,627 BPL cards and 1,082 AAY cards. Kerosene was being sold to these consumers at INR15.25 (US$0.3) per litre. After implementation of the scheme in December 2011, the retail price was increased to INR44.25 (US$0.86) per litre. The difference between the two was credited into the bank account of the consumer. A total of 15,020 zero-balance, no-frills bank accounts were opened (as of February 2012) for consumers of PDS kerosene.

Before initiation of the scheme, awareness campaigns were conducted over a period of two months. Initially, people refused to participate in the program even when they were told that they would receive one month's subsidy in advance (Telegraph, 2012). However, when the district collector obtained permission from the state government to deposit three months' worth of the subsidy in advance, a large number of people became amenable to participating.

A sum of INR 263 (US$5.14) was deposited into bank accounts of households with no LPG connections and INR 175 (US$3.42) in the accounts of those with a SBC. Interestingly, even though kerosene is primarily used for lighting, the provision of kerosene subsidy has been linked to LPG connections. Moreover, since the transfers are being made in advance, they are not linked to the time of purchase or the amount of kerosene lifted.

Initial results from the Kotkasim block in Alwar district indicate that the purchase of kerosene has reduced drastically by from 82,000 litres (KL) in November 2011 to 18 KL in December 2011 (79 per cent), 23 KL in January 2012 and 13 KL in February 2012. (Alwar, 2012) This could be due to a combination of reduction in diversion of PDS kerosene and reduction in the purchase of kerosene by households. An annual saving of INR 466 million (US$9.10 million) is projected, assuming a net savings of 60 per cent of kerosene. Assuming the same rate of savings at the national level, the savings will amount to approximately INR 218 billion (US$4.26 billion) on lower subsidy payout on kerosene and INR 2.78 billion (US$54.30 million) on excise duty collected on additional sales of diesel. However, increased under-recoveries due to additional sales of diesel should also be accounted for.

This reduction also has implications on the savings/additional revenue generated for the exchequer from the avoided diesel adulteration. This saving of PDS kerosene and avoided chances of adulteration will also lead to an increase in excise duty received on diesel. On the flipside, unless diesel prices are revised, the OMCs will incur under-recoveries on the additional diesel purchased.

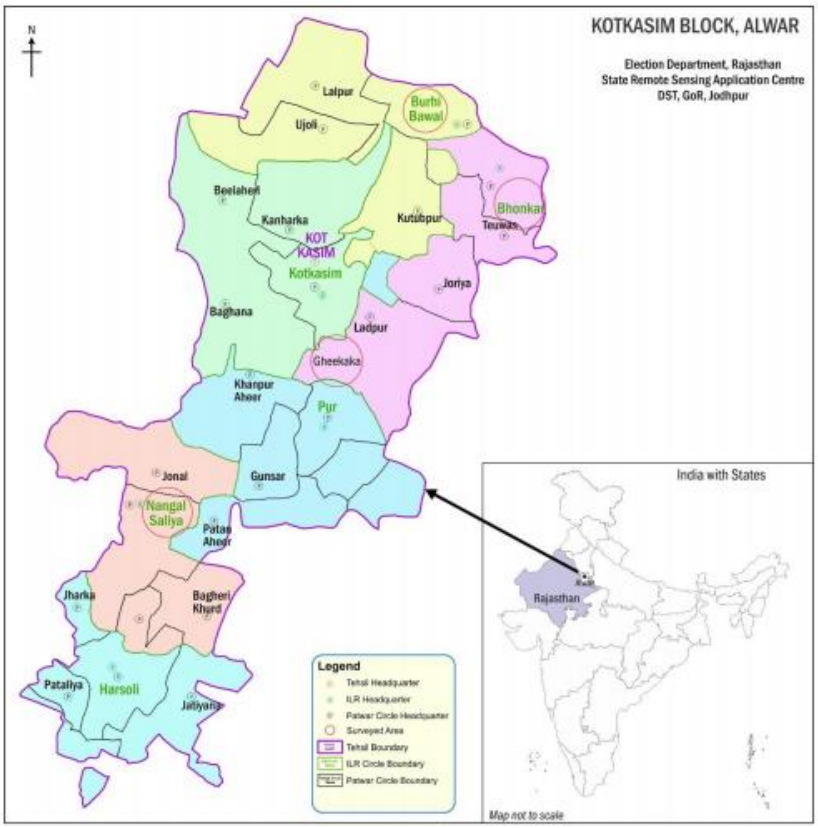


*Figure 28. Location of Kotkasim and surveyed villages in case study. Source: IISD 2014*

## E. Principle 5: Emphasize the social contract in securing compliance with owners', operators', and public officials' responsibilities, through well designed and implemented on-road enforcement and public awareness programs.

232. Vehicle ownership and operation is part of a social contract; in return for being able to operate motor vehicles in the public sphere for private gain or simply for personal use, vehicle owners and operators have an obligation to take measures to ensure that the operation of their vehicles does not inflict harm on either specific individuals or society at large. Articulation of, perceptions about, and adherence to this social contract tends to be weak in developing countries, and Ethiopia is no exception.

233. **Example of policy: Prioritize communications and public messaging as a core component of motorization management.** Include a role for a communication lead in all aspects of the motorization management portfolio, whose job is to manage public and stakeholder communications, emphasizing and reinforcing the concept of social contract.

234. **Example of policy: Use education, conventional, and social media to create awareness around the concept of a social contract associated with motor vehicle ownership, use, and**

**enforcement.** Developing the notion of a social contract is a long-term cultural shift that requires a long term strategy, with consistency in implementation of messaging over the long haul. It includes educating children as part of their basic educational curriculum to inculcate and understand the concept of social responsibility around motor vehicle ownership and use. Among the messages that can be inculcated are the need to obey speed laws, register one's vehicle properly, and ensure that it is functioning properly to protect health and safety of others. For adults, awareness of the social contract can be created through consistent messaging at different locations (including on-line interactions with drive licensing and vehicle registration authorities) about sanctions for abuse of social contract and of consequences to the community of such abuse, as well as and costs of contravention. Finally, social media can be harnessed through a system of rewards for compliance with the social contract around motorization through a loyalty program designed to provide tangible benefits to participants. Equally, it can be harnessed to bring the power of social shaming, or even more serious civil or criminal remedies by establishing programs of police and citizen reporting of vehicle or behavior which appear to defy the social contract.

235. **Example of policy: Facilitate citizen engagement in identifying vehicles or behavior which appear to defy the social contract, and harmonize protocols and training methods to capacitate police and other official enforcement agencies to successfully play their role in ensuring compliance.** The behavior of both motorists and the police is a critical source of weakness in the current vehicle / traffic / enforcement culture in Ethiopia. While it is unclear the extent to which such behavior can be altered by public policy alone, one measure which might begin to address behavioral challenges directly, greatly enhanced through the widespread availability of social media, is through social reporting and shaming. Well-designed social media spaces that invite ordinary citizens to report poorly maintained / dangerous vehicles, dangerous behavior by operators, or improper enforcement by authorities can begin to codify in the public consciousness a sense of what is and is not appropriate behavior under the social contract governing ownership and operation of motor vehicles.

236. **Example of policy: Define obligations of owners for re-registration and annual/bi-annual vehicle inspection and maintenance.** The team recommends that, once the upgrading of vehicle registration and driver licensing systems through the TRANSIP project is complete, all motor vehicles should be required to re-register on an annual or biannual basis after the initial registration. The initial registration of the vehicle for a given owner would need to be done at one of the 83 zonal offices affiliated, through the RTAs, with the Federal Transport Authority, but re-registration could be done online, provided an appropriate and secure delivery system of registration stickers could be designed. The objective would be to limit the inconvenience of the motorist in order to maximize compliance.

237. The team also recommends that commercial vehicle owners be required to submit their vehicles to annual or even semi-annual inspection, for both safety / crash-avoidance systems checks, and for emissions, regardless of vehicle age. Vehicles used for non-commercial purposes should be required to submit their vehicles to bi-annual or annual inspections, but vehicles below a certain model-year-age (e.g. less than 4 years old) might be exempted from this requirement.

238. As with the current system, the safety inspection should require performance to a standard; registered responsible parties whose vehicles do not pass will be required to fix the vehicle within a certain amount of time, or the registration will be invalidated, or re-registration will be denied.

239. The team recommends that vehicles be required to submit to emissions inspections, but that there be no performance threshold established for the first two to four years of the inspection process; that is, the obligation of the vehicle owner is simply to submit to inspection. An obligation to keep emissions within designated thresholds could be added after two or three years of vehicle inspections. This will be discussed in more detail in the next chapter.

## F. Principle 6: Limit usage of vehicles as they degrade.

240. A key challenge in developing countries is that a vehicle's residual value for the owner or operator often long outlasts the point at which the vehicle becomes a social menace to third parties in terms of safety or pollutant emissions. An effective motorization management program, therefore, should recognize this reality and seek to align the ability of owners to continue to exploit economic value from vehicles while minimizing the exposure of populations to these risks. Such a policy would make explicit and controlled what is *de facto* common but variable practice in the industry: as vehicles age, they tend to cycle from urban, to peri-urban, then to rural use, from heavy to lighter uses, and from passenger-serving to freight-serving uses.

241. **Example of policy: Consider developing performance-based and jurisdiction-based conditions of registration.** In addition to, or instead of, specific performance requirements for all vehicles with respect to emissions, the Federal government and/or the regions might consider at some time in the future adopting conditional vehicle registration, linked to emissions (or safety) testing outcomes. Examples that the team thinks might work in Ethiopia include the following:

- Vehicles exceeding certain emissions restrictions (e.g. for PM10) might be allowed to circulate generally, but not in designated high density areas (often called "low-emission zones").
- Passenger-serving commercial vehicles that fall below certain thresholds for safety might no longer be permitted to be in passenger service, but would be permitted to be registered for rural freight service.
- Commercial vehicles exceeding a certain age or falling below established performance thresholds for safety or emissions (but not below an absolute threshold for granting registration) could be required to pay kilometer-based registration fees, whereby annual registration costs is variabilized and directly linked to the vehicle usage.[29]

The rules for the above conditions or similar that might be designed would need to be clearly thought through and spelled out in advance. All of the above examples reflect a policy to limit the

[29] Ensuring compliance with such kilometer-based fees would not be feasible under the current regime for registration and tracking of vehicles, but would be practicable following the implementation of certain implementation programs discussed in the next chapter.

exposure of populations to greater risk posed by aging and deteriorating vehicles, while still enabling the vehicle owners to reap some economic value from their investments.

## G. Principle 7: Educate consumers on the lifecycle costs and impacts of vehicles at points of sale.

242. Providing vehicle information to consumers has proven to be enormously effective at influencing vehicle purchasing behavior in the developed countries[30], but it is also relatively straightforward in those countries, as many if not most of the manufacturers are headquartered or have substantial operations there, and they possess the key information needed to be disclosed to consumers. Harnessing the information in developing countries, where fleets such as Ethiopia's are highly dependent on second-hand imports, is more challenging, but ultimately manageable and critically important.

243. **Example of policy: Design and introduce vehicle labeling to reveal vehicle fuel economy information for entry vehicles (MSFUV, CKD, SHV and GFUV) based on officially established levels at entry certification.** A vehicle labelling requirement for entry vehicles is recommended to be developed. Such a requirement would establish minimum mandatory information that must be provided to consumers (on a label affixed to the vehicle) at the point of vehicle sale. Information that might be required to be included could be:

- Rated fuel economy of the vehicle
- Estimated annual expenditures on vehicle operation based on certain standardized parameters
- Known accident history
- Known structural modifications since manufacture
- Emissions information (e.g. PM10 or PM2.5, NOx, CO, SOx, NMHC emissions rates)

For MSFUVs, CKDs, and GFUVs, such information would be required to be provided by the manufacturer. For SHVs, such information would be either gathered from available general or vehicle-specific information (and certified during the during the import certification process), or determined from testing and inspection during the import certification process.

244. **Example of policy: Establish publicly searchable databases of vehicle history and estimated fuel economy based on VIN numbers, to enable second-hand vehicle purchase decisions.** The vehicle registration system is being standardized across all regions and automated through investments being made under the Bank-supported TRANSIP operation. This report recommends integrating this registration system with the emerging vehicle inspection system in real time. One key side benefit of the centralization of this data in real time is the ability to make very detailed information about vehicles available to the general public at minimal additional cost to the government. This information, in turn, can help consumers understand quickly key information about purchases of second-hand vehicles, including safety and operational cost

[30] Policy Studies Institute. 2006. Designing policy to influence consumers: Consumer behavior relating to the purchasing of environmentally preferable goods. pp. 92-93. http://ec.europa.eu/environment/enveco/pdf/RealWorldConsumerBehaviour.pdf,

aspects. This information, in turn, will help "lubricate" the motor vehicle market by improving purchase decisions, which, in turn, would help improve the quality and efficiency of the fleet overall. It is recommended that the legal and technical requirements to enable the creation of public, internet-based searchable databases of vehicles from the TRANSIP-financed vehicle registration system be integrated into the Terms of Reference for the development of the system. This recommendation would produce substantial long-term benefit for Ethiopia with minimal marginal cost.

## H. Principle 8: Suppress implicit subsidies to car use.

245. Implicit and hidden subsidies to car use can be substantial and often difficult to find, but continuous efforts should be undertaken to identify them, and reduce them or at least bring them to parity with other modes. Common hidden subsidies to car use may include the following:

- **Fuel subsidies**. Many governments actually subsidize gasoline or diesel fuels, and this constitutes the most obvious form of subsidizing motor vehicle use. This is not the current practice in Ethiopia, but fuel subsidies are practiced elsewhere in Africa.
- **Uses of fuel taxes**. Even where governments have a net tax rather than subsidy on gasoline or diesel, how the revenues from such fuels are used can create an implicit subsidy to motor-vehicle use. In particular, if fuel taxes are hypothecated into a road fund, and that road fund is used for development of new or significant expansion of existing roads, rather than for road maintenance, this constitutes an implicit subsidy for motor vehicle use.
- **Free parking**. Particularly in urban areas, where parking management policies are either nonexistent or poorly designed or implemented to allow substantially underpriced or free parking, the non-commercial use of motor vehicles is also being subsidized. Underpricing of parking typically results from lack of effective on-street parking management approaches, which undermines development of commercialized off-street parking. It can also result from employer provision of free parking as an unrecognized and untaxed benefit.
- **Disparities between public and private transport pricing**. In many cities, across Africa, there is a strong mismatch in the kinds of costs faced by private car users relative to those of public transport users. Private car users' costs are primarily *fixed costs* some of which are directly dependent on government policy, and which are comprised of both one-time costs (vehicle import duties, charges, VAT, Title fees, cost of compliance with applicable regulations, and the costs of the vehicle itself), and recurring costs (registration charges, insurance costs, vehicle storage costs, inspection fees, and personal property taxes). *Variable costs*, on the other hand, (which include fuel, tolls, parking fees, and vehicle maintenance and depreciation) tend to be a relatively small portion of the overall lifecycle costs. A motorist seeking to minimize costs will therefore do so with respect to *average* trip cost; since most of the costs are fixed costs, the more he or she uses the car, the more the sunk investment is amortized.

  For public transport users, on the other hand, nearly all the costs are variable, so the cost minimization logic is exactly opposite. The less he or she travels by public transport, the

less he or she needs to pay. The sum of these two effects is a substantial price bias toward private car use relative to public transport use and has the same impact as an explicit subsidy. In African cities, where per capita incomes are so low that car ownership is well beyond the reach of most people, this pricing differential would not ordinarily affect most people on a day-to-day basis. But it can have enormous impact on the small group of "choice" riders whose willingness to use mass transport can make or break efforts for new mass transport systems such as urban rail or BRT.

246. **Example of policy: Develop comprehensive parking pricing programs in and around all major cities, especially Addis Ababa, covering on-street and off-street parking.** One of the most effective ways of addressing implicit subsidies to car use that does not also create excessive hardship for commercial operators is to focus on parking.[31] Parking is generally a travel component and cost that affects private non-commercial transport substantially more than commercial transport. For this reason, comprehensive parking management should be seen as a key element in Ethiopia's motorization management program. We recommend that such a program should include at least the following elements:

- Economic treatment of on-street and off-street parking as scarce resources to be priced;
- Distinction between parking and vehicle storage;
- Treatment of employer-provided free parking as a benefit (in-kind income) subject to taxation;
- Use of ICT (e.g. smartphone apps) both to help allocate prices and to provide convenience to motorists; and
- Identification of high-accessibility zones (e.g. city centers, key mass transport nodes) in which *maximum* parking limitations, rather than minimum parking requirements, will be established.

## I. Principle 9: Substantiate and improve on impacts of motorization management policies through establishment of capacity for assessment, evaluation and research.

247. At present, Ethiopia relies on advice from experts based in the automobile manufacturing countries; over time, however, it will be important to develop localized expertise in motorization management control, to develop the ability to not only recommend what to do, but also how to do it.

248. **Example of policy: establish motorization observatory based in a major university in Ethiopia.** It is recommended that Ethiopia engage a university to develop an observatory of motorization, selected on a competitive basis. The purpose of the observatory would be to analyze trends in all aspects of motorization, based on data provided by Ethiopia Customs Authority (import data) and the Federal Transport Authority (registration and inspection data) and provide

[31] We distinguish here between *parking* – which refers to where the vehicle is while the vehicle users undertake trip-related activities – and *storage*, which refers to where the vehicle is kept while the owner or operator is not making a trip.

periodic reporting, analysis, trend-reporting, and policy recommendations. The deliverables could include statistical publication on an annual basis, analysis of trends in vehicle purchasing on a bi-annual basis, and periodic topical policy analysis and recommendations as agreed between FTA and the selected university. Initial support for such a program to demonstrate value could be explored in discussions on ODA.

## J. Summary of policy recommendations

249. Table 5 on the next page summarizes all of the policy examples considered in this chapter, and places them in context in terms of the principle to which they adhere, and the implementation programs that are required to effect them. The nine principles presented above are summarized in Figure 29 below, while the implementation programs can be seen at a glance in Table 5 presented at the end of Chapter IV above.

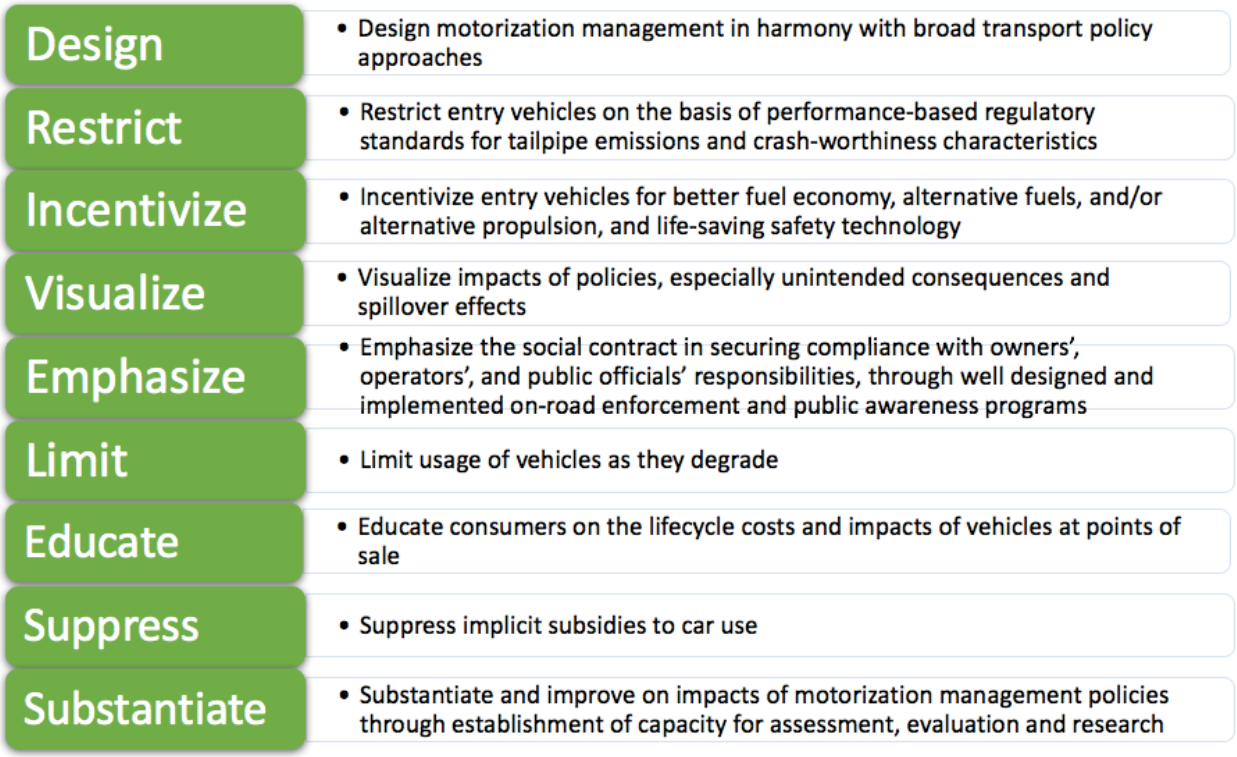


*Figure 29. Nine Principles of Motorization Management*

*Table 5. Summary of policies recommended for Ethiopia*

| Plausible policies | Principles | Outcomes | Points of Intervention | Prerequisite implementation programs (including No.) | Benefits | Costs | Political economy |
|---|---|---|---|---|---|---|---|
| Develop mass transit in Addis Ababa and surrounding Oromia zone, and facilitate public transport improvements in Addis Ababa and many secondary cities | Design | Tailpipe emission<br><br>Fuel economy<br><br>Vehicle safety<br><br>Rate of vehicle fleet growth | In-use vehicles | 2. Public engagement program to sensitize citizens of the motor vehicle lifecycle<br>7. National protocols for visual and instrumented enforcement | Increased urban mobility, accessibility, efficiency and environmental benefits | Cost of compliance | Financing is an issue |
| Codify in law fuel sulfur limits from 2019 | Restrict | Tailpipe emission | Refined fuel imports | 3. DPOS for vehicle emissions and fuel quality<br>5. Import certification process for SHVs, GFUVs and CKDs<br>11. Fuel quality testing regime and protocols at retail<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle | Enabling imports of Euro III vehicles | Cost of compliance;<br><br>Incremental fuel cost per liter | Fuel quality is under control with a pathway to reduce sulfur levels;<br><br>Forex shortage and volatility present challenge in compliance |
| Require Euro III equivalent from 2020, but prepare for leapfrogging to Euro IV and possibly alternative propulsion technologies in preparation of a DPOS | Restrict | Tailpipe emission<br><br>Fuel economy | Entry vehicles | 3. DPOS for vehicle emissions and fuel quality<br>5. Import certification process for SHVs, GFUVs and CKDs<br>6. Development, certification and oversight and / or operation of I/M centers<br>8. Mechanics' training and certification program<br>9. Quality assurance program for vehicle parts | Reduced ambient air pollution; Improved fuel efficiency | Cost of compliance | Government interested with assistance;<br><br>Critical to involve private sector of GFUVs, MSFUVs and CKDs in discussion to |

| Plausible policies | Principles | Outcomes | Points of Intervention | Prerequisite implementation programs (including No.) | Benefits | Costs | Political economy |
|---|---|---|---|---|---|---|---|
| | | | | 10. Regulatory standard for vehicle body construction and modification<br>11. Fuel quality testing regime and protocols at retail<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle<br>1. MVIMS that develops and integrates databases of registration, licensing and enforcement | | | alleviate concerns about warranty on engines due to fuel quality |
| Require compliance with UN regulation for crashworthiness requirements from 2018 for all SHVs and GFUVs, and from 2019 for all CKDs and MSFUVs | Restrict | Vehicle safety | Entry vehicles | 4. DPOS for vehicle safety and fuel economy<br>5. Import certification process for SHVs, GFUVs and CKDs<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle<br>6. Development, certification and oversight and / or operation of I/M centers<br>8. Mechanics' training and certification program<br>9. Quality assurance program for vehicle parts<br>10. Regulatory standard for vehicle body construction and modification<br>1. MVIMS that develops and integrates databases of registration, licensing and enforcement | Reduced traffic fatalities and serious injuries | Cost of compliance | Counterparts recognize public policy objective, indicate would require international technical assistance;<br><br>also express concerns about local capacity to verify compliance with proposed standards |
| Require compliance with UN regulation for crash-avoidance requirements for all entry vehicles by 2020 | Restrict | Vehicle safety | Entry vehicles | 4. DPOS for vehicle safety and fuel economy<br>5. Import certification process for SHVs, GFUVs and CKDs<br>6. Development, certification and oversight and / or operation of I/M centers<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle<br>8. Mechanics' training and certification program | Reduced traffic accidents, traffic fatalities and serious injuries | Cost of compliance | Counterparts recognize public policy objective, indicate would require international technical |

| Plausible policies | Principles | Outcomes | Points of Intervention | Prerequisite implementation programs (including No.) | Benefits | Costs | Political economy |
|---|---|---|---|---|---|---|---|
| | | | | 9. Quality assurance program for vehicle parts<br>10. Regulatory standard for vehicle body construction and modification<br>1. MVIMS that develops and integrates databases of registration, licensing and enforcement | | | assistance to effect. |
| Consider $CO_2$- based excise tax and / or $CO_2$-based annual registration fees as an alternative to excise duties or VAT | Incentivize | Fuel economy | Entry vehicles | 5. Import certification process for SHVs, GFUVs and CKDs<br>1. MVIMS that develops and integrates databases of registration, licensing and enforcement<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle | Increased fuel economy performance in the fleet | Cost of compliance | Would it be tax neutral (i.e. current VAT + Duties replaced by that?). If not, possible reluctance from Finance / Treasury |
| Equalize the tax rates among gasoline, diesel and kerosene, and use ICT-enabled targeted subsidies program to support low-income households to purchase fuel for cooking | Visualize | Tailpipe emission | Fiscal and policy environment | 11.Fuel quality testing regime and protocols at retail | Improved fuel quality that enabling the imports of Euro III vehicles;<br><br>Reduced leakage of public resource used for social subsidies | Cost of compliance | Fuel adulteration is no longer critical since tax rates among kerosene/diesel/gasoline are equalized;<br><br>Still important to develop fuel quality assurance program. |

| Plausible policies | Principles | Outcomes | Points of Intervention | Prerequisite implementation programs (including No.) | Benefits | Costs | Political economy |
|---|---|---|---|---|---|---|---|
| Prioritize communications and public messaging as a core component of motorization management | Emphasize | Tailpipe emission<br><br>Fuel economy<br><br>Vehicle safety<br><br>Rate of vehicle fleet growth | In-use vehicles | 2.Public engagement program to sensitize citizens of the motor vehicle lifecycle<br>1.MVIMS that develops and integrates databases of registration, licensing and enforcement | Improve level of acceptance and compliance by general public | Cost of compliance | Important and cross-cutting, should discuss possible channels to reach out to general public;<br><br>The tracking information of vehicles before and after import is highlighted in framing key messages |
| Use education, conventional, and social media to create awareness around the concept of a social contract associated with motor vehicle ownership, use, and enforcement | Emphasize | Tailpipe emission<br><br>Fuel economy<br><br>Vehicle safety<br><br>Rate of fleet growth | In-use vehicles | 7. National protocols for visual and instrumented enforcement<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle | Improve compliance and enforcement of motorization measures | Cost of compliance | Same as above |
| Facilitate citizen engagement in identifying vehicles or behavior which appear to defy the social contract, and harmonize protocols and training methods to capacitate police and other official | Emphasize | Tailpipe emission<br><br>Fuel economy<br><br>Vehicle safety | In-use vehicles | 7. National protocols for visual and instrumented enforcement<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle<br>1. MVIMS that develops and integrates databases of registration, licensing and enforcement | Improve effectiveness of enforcement measures | Cost of compliance | Same as above |

| Plausible policies | Principles | Outcomes | Points of Intervention | Prerequisite implementation programs (including No.) | Benefits | Costs | Political economy |
|---|---|---|---|---|---|---|---|
| enforcement agencies to successfully play their role in ensuring compliance | | | | | | | |
| Define obligations of owners for re-registration and annual/bi-annual vehicle inspection and maintenance | Emphasize | Tailpipe emission<br><br>Fuel economy<br><br>Vehicle safety<br><br>Rate of vehicle fleet growth | In-use vehicles | 2. Public engagement program to sensitize citizens of the motor vehicle lifecycle<br>1. MVIMS that develops and integrates databases of registration, licensing and enforcement<br>7. National protocols for visual and instrumented enforcement<br>6. Development, certification and oversight and / or operation of I/M centers<br>10. Regulatory standard for vehicle body construction and modification<br>8. Mechanics' training and certification program | Keep track of the fleet size and the in-use fleet characteristics;<br><br>Encourage the maintenance of in-use fleet quality in pollution emission, fuel economy and safety performance | Cost of compliance | Need to make sure the process is simple and painless for vehicle owners, otherwise, there will be fraud to just avoid the trouble |
| Consider developing performance-based and jurisdiction-based conditions of registration | Limit | Tailpipe emission<br><br>Fuel economy<br><br>Vehicle safety<br><br>Rate of vehicle fleet growth | End-of-life vehicles | 1. MVIMS that develops and integrates databases of registration, licensing and enforcement<br>12. ELVs programs to protect the environment and minimize landfill requirements<br>7. National protocols for visual and instrumented enforcement<br>6. Development, certification and oversight and / or operation of I/M centers<br>8. Mechanics' training and certification program<br>10. Regulatory standard for vehicle body construction and modification | Improved/ maintained level of in-use vehicle performance in pollution emission, fuel economy and safety | Cost of program development, compliance | Need to ensure adequate communication with commercial operators who might be affected |
| Design and introduce vehicle labeling to reveal vehicle fuel economy information for entry | Educate | Fuel economy | Entry vehicles | 4. DPOS for vehicle safety and fuel economy<br>5. Import certification process for SHVs, GFUVs, and CKDs | Improved fuel economy of the fleet; Enabling behavior change | Cost of compliance | Government interested with assistance |

| Plausible policies | Principles | Outcomes | Points of Intervention | Prerequisite implementation programs (including No.) | Benefits | Costs | Political economy |
|---|---|---|---|---|---|---|---|
| vehicles (MSFUV, CKD, SHV and GFUV) based on officially established levels at import certification | | | | 1. MVIMS that develops and integrates databases of registration, licensing and enforcement<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle | in purchasing fuel efficient vehicles | | |
| Establish publicly searchable databases of vehicle history and estimated fuel economy based on VIN numbers, to enable second-hand vehicle purchase decisions | Educate | Fuel economy | Entry vehicles | 1. MVIMS that develops and integrates databases of registration, licensing and enforcement<br>2. Public engagement program to sensitize citizens of the motor vehicle lifecycle | Increased transparency of vehicle information;<br><br>Enabling behavior change in purchasing fuel efficient vehicles | Cost of database development; cost of transition during database update | Ethiopia currently has no entry filter; it's uncertain whether source market would be happy with more transparency |
| Develop comprehensive parking pricing programs in and around all major cities, especially Addis Ababa, covering on-street and off-street parking | Suppress | Rate of fleet growth | Fiscal and policy environment | 1.MVIMS that develops and integrates databases of registration, licensing and enforcement<br>7.National protocols for visual and instrumented enforcement | Remove incentives for excessive vehicle use in urban area;<br><br>support investments in public transport infrastructure;<br><br>relieve congestion and reduce emission | Increase variable cost of vehicle use in urban area | Resistance to change from private motorists becomes more marked as motorization rate increases. Best to get parking policies in place while numbers still low. |
| Establish motorization observatory based in a major university in Ethiopia | Substantiate | Tailpipe emission<br><br>Fuel economy | In-use vehicles | 1.MVIMS that develops and integrates databases of registration, licensing and enforcement | Strengthened research, monitoring and assessment capacity; | Cost of compliance | Government and university interested with assistance |

| Plausible policies | Principles | Outcomes | Points of Intervention | Prerequisite implementation programs (including No.) | Benefits | Costs | Political economy |
|---|---|---|---|---|---|---|---|
| | | Vehicle safety<br><br>Rate of vehicle fleet growth | | | Educate younger generations for motorization management and nurture human capital | | |

# VI. Assessment of impacts of recommended measures

250. The principles and policies set out in this document provide a framework for motorization management in Ethiopia. The implementation program has been developed to address four main challenges of motorization; tailpipe pollution, fuel consumption, vehicle road safety and the pace of growth of the overall fleet.

251. The impact that the recommended policies could feasibly have on addressing these challenges is considered in this chapter, using the fleet model developed during the study as the basis for the impact assessment. The trajectory of vehicle fleet size, composition, travel activity and corresponding implications for fuel consumption, greenhouse gas emissions and generation of local air pollutants for policy interventions can be assessed against the business as usual scenario presented earlier in the document.

252. The focus of the impact modelling in this section is confined to policies which can be expected to change purchasing decisions or vehicle usage in a quantifiable way, with the scale of impact estimated with reference to wider research, case study evidence or through the application of elasticities.

253. By nature, some of the policies, whilst supporting the objectives of motorization management, are less conducive to quantitative evaluation and are not modelled. Equally, whilst certain measures may be anticipated to have a positive impact on the level of vehicle occupant and pedestrian safety, developing a quantitative estimate of road safety improvements attributable to fleet characteristics or maintenance is not straightforward and we do not seek to quantitatively evaluate it here.

## A. Motorization management in harmony with wider transport policy

254. Decisions related to the purchase and use of vehicles are made within the wider context of the needs to travel (as transport is a derived demand) and the options available to make the journey. The need to travel can be influenced by effective land use planning, reducing the distance required to access amenities, services and employment opportunities, whilst the relative attractiveness of different transport options can be influenced by investment in the transport network, the provision of quality public transport and provision for non-motorized modes.

255. Investment in improving mass transport in Addis Ababa and surrounding zone, and enhancing public transport in the secondary cities can be expected to have a two-fold impact on motorization:

- Reduction in vehicle kms resulting from shift from numerous smaller vehicle trips (both car and smaller paratransit vehicles) to fewer trips in larger vehicles, which have lower fuel consumption and emissions generated per person trip

- Reduction in future car ownership levels as improved public transport option makes private car ownership less attractive

The scale of potential impact of this policy is linked to the nature and scale of the investment. Estimations have been made based on review of international case study evidence regarding the observed experience of major developing cities in pursuing mass-transit oriented investment policies. These are presumed to be implemented from year 2020.

256. The scale of modal shift assumed to be delivered is as follows, for a package of mass-transit and public transport initiatives for Addis Ababa and the secondary cities:

- Investment in rail – 4% modal shift from car, 2% modal shift from bus
- BRT investment – 4% modal shift from car, 2% modal shift from bus
- Bus network enhancements – 10% shift from car to bus

Note that whilst the assumed shift from bus to mass-transit is smaller than assumed for car, this represents a great many more trips given the low modal share for car trips. Bus network improvements incorporate a move from smaller paratransit vehicles to larger bus vehicles.

257. The impact of these modelled outcomes are summarized in Table 6 below:

*Table 6. Modelled outcomes and impacts*

| | **Real reduction in use/emissions** | | **% reduction in use/emissions** | |
|---|---|---|---|---|
| | **2025** | **2040** | **2025** | **2040** |
| Mileage (Million v/kms) | -174 | -1,555 | -2.6% | -9.1% |
| GHG emissions ($MtCO_2e$) | -0.04 | -0.27 | -2.6% | -9.0% |
| PM emissions (kt) | -0.0023 | -0.018 | -2.6% | -9.0% |
| NOx emissions (kt) | -0.03 | -0.16 | -2.6% | -9.0% |

Source: World Bank Team

258. A reduction in the vehicle kms travelled leads to reduced fuel consumption, GHG emissions and local air pollutants generated. In 2025, the scale of reduction in vehicle kms is 2.6%, increasing to over 9% reduction compared to the business as usual scenario by 2040, reflecting the increasing numbers of trips carried by mass transit and the constraining influence on private car ownership levels.

## B. Restrict entry vehicles on the basis of performance based regulatory standards

259. The setting of minimum entry standards for vehicles is an important step in ensuring that Ethiopia will not allow its market to be a 'dumping-ground' for vehicles which are no longer have an acceptable in-service use elsewhere.

260. With the anticipated reduction in fuel sulfur levels due in 2019, the policy recommendation is that only vehicles meeting Euro III equivalent standards be imported from 2020. A dynamic profile of standards which sets out a clear path for increasing the minimum standards over time could then ensure continued benefits of minimum entry requirements.

261. The impact of restricting entry of vehicles only Euro III and above from 2020 are summarized in the figure below, compared against the business as usual scenario.

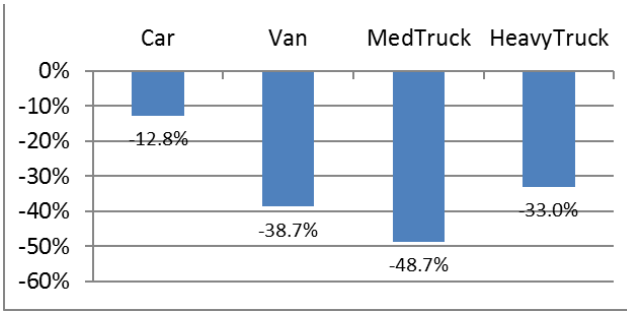


*Figure 30. % reduction in PMx emissions (new vehicles)*

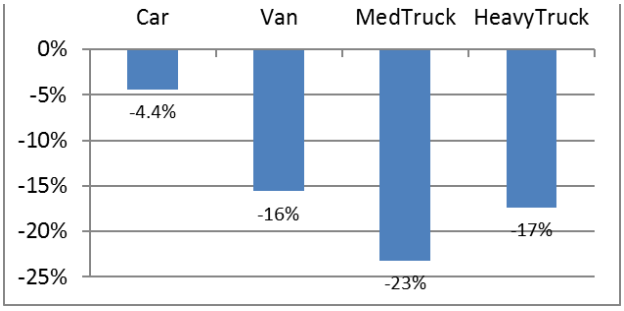


*Figure 31. % reduction in NOx emissions (new vehicles)*

*Source: World Bank Team*

262. The implementation of emissions standards on entry to the fleet result in a significant improvement in vehicle cleanliness from a local air pollution perspective. Compared to the business as usual case, cars entering the fleet will generate 12 percent less particulate matter and 4 percent less NOx, whilst the reduction for goods vehicles is even more significant. These reductions can be expected to lead to improvements in local air quality as compared to the BaU scenario.

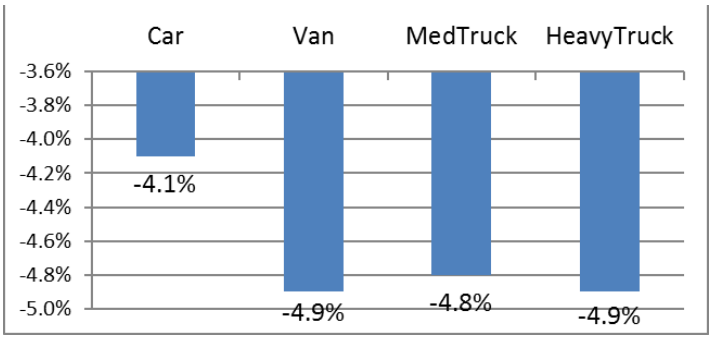


*Figure 32. % reduction in fuel consumption and GHG emissions (vehicle fleet, 2025)*

263. Higher vehicle entry standards can also be expected to lead to some beneficial fuel economy gains and corresponding greenhouse gas emission reductions. Whilst not a direct result of the emissions standards, this is a secondary the impact of the vehicle standards which in practice will limit imports to only newer vehicles which were manufactured to meet the higher standards. These newer vehicles also tend to be more fuel efficient than the older vehicles and hence lead to reduced fuel consumption and GHG emissions.

264. Additionally, whilst not quantified here, the performance standards proposed will also extend to vehicle safety equipment which may be expected to improve the quality of the vehicle fleet with regard to occupant and pedestrian safety.

## C. Incentivize entry vehicles for better fuel economy

265. Influencing purchasing decisions in favor of vehicles with desirable characteristics such as fuel efficiency, low emissions or enhanced safety features is a key component of many motorization policies around the world. Fiscal incentives related to these characteristics, such as CO2 based road tax, a first registration tax linked to engine size or even subsidy for the purchase of certain types of vehicle technology are prevalent in international comparison of vehicle taxation regimes.

266. The available evidence from these case studies demonstrates that fiscal measures can have a powerful impact on purchasing behavior. The final details of any policy adopted will determine the resulting impact, but the flexibility of fiscal policy will allow a scheme to be developed which takes account of local conditions, desired impact and budgetary considerations. A $CO_2$ based excise tax is provisionally suggested for further investigation. Given the direct link between fuel economy and carbon emissions, such a policy would discourage the purchase of large e inefficient vehicles, incentivizing instead the purchase of smaller engine more fuel efficient vehicles. The anticipated impact would be a reduction in fuel consumption, which has both environmental and economic benefits which include reducing the fuel import burden on the country.

267. The United Kingdom has pursued a $CO_2$ based taxation policy for light vehicles by varying the cost of annual road licensing according to vehicle $CO_2$ banding. Between 2001 and 2015, the observed impact of this policy was a reduction in the engine size of new vehicles by 16 percent for

gasoline vehicles and 7 percent for diesel vehicles. The policy also encouraged a 32 percent shift from petrol to diesel vehicles, driven by the higher inherent fuel economy of diesel vehicles.

268. Assuming the adoption of a $CO_2$ based light vehicle fiscal policy which results a similar observed trend, and also assuming fiscal neutrality (and hence no impact on fleet size), the potential impact of such a policy is modelled as follows:

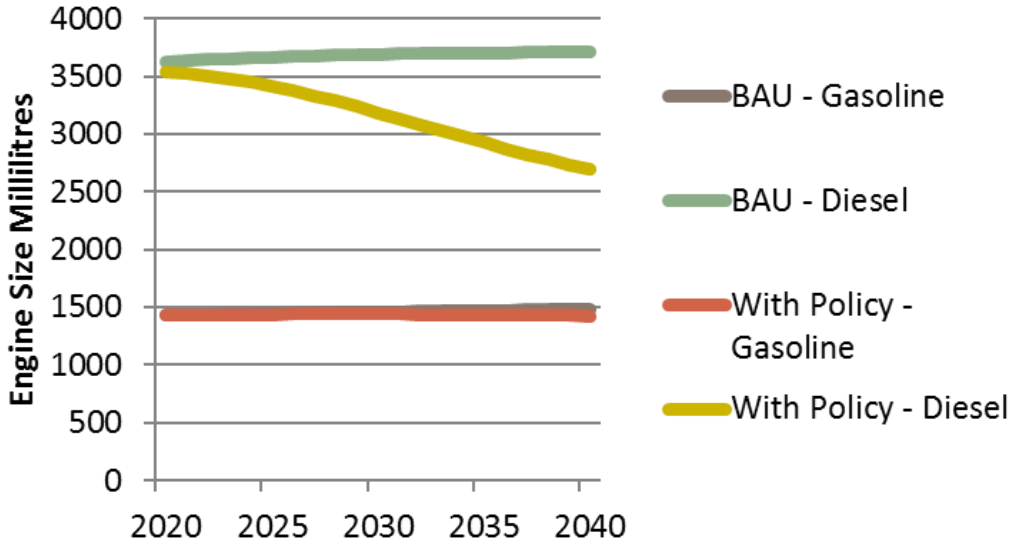


*Figure 33. Average engine size of Ethiopia light vehicle fleet*

269. The impact of the policy is observed particularly on the purchasing patterns of diesel vehicles, with greater numbers of smaller engine diesel vehicles diluting the existing larger engine diesel car fleet. The impact on petrol vehicles is less noticeable as the existing fleet and cars imported are genially already smaller-engine vehicles.

## D. Suppress implicit subsidies to car use

270. Policies to ensure that the cost of private motoring adequately reflects the wider cost to society may require politically and technically challenging measures such as congestion charging or road pricing, but as a first step, ensuring that as a minimum there are not inherent incentives to private car usage through implicit subsidy must be a priority to ensure a leveling of the playing-field between private car and more sustainable travel options.

271. Parking provision has been identified as one such area of implicit subsidy, in that the space utilization by parking in urban areas where land space is at a premium is not being reflected as a cost to those parking. Parking policy forms a key strand of transport strategies in many cities worldwide, typically comprising of a combination of parking pricing strategy, parking restrictions and disincentives for the offering of parking by businesses (for example the work-place parking levy).

272. The potential impact of parking policy has been modelled using evidence of the impact from such policies derived from a literature review for transport modelling in Eastern Europe (Romania). The expected impacts include modal shift away from private car in the order of 5 percent towards public transport and slow modes for urban car trips.

| | **Real reduction in use/emissions** | | **% reduction in use/emissions** | |
|---|---|---|---|---|
| | **2025** | **2040** | **2025** | **2040** |
| Mileage (v/kms) | -337 | -1,005 | -2.2% | -2.5% |
| GHG emissions ($MtCO_2e$) | -0.03 | -0.07 | -2.2% | -2.5% |
| PM emissions (kt) | -0.0019 | -0.005 | -2.2% | -2.5% |
| NOx emissions (kt) | -0.02 | -0.04 | -2.2% | -2.5% |

Source: World Bank Team

A reduction in car vehicle kms resulting from the modal shift leads to a reduction in fuel consumption and local air pollutants. Wider benefits may be expected to include a freeing up of landspace in urban areas, potentially improving traffic circulation and allowing other use of that space.

## E. Summary of impact and conclusions

273. Whilst not all of the recommended motorization measures are able to be quantitatively assessed in terms of likely impact, those modelled above highlight the positive impact that can be achieved in terms of constraining vehicle fleet growth, altering purchasing patterns and thus generating a more economically and environmentally appropriate vehicle stock, and in doing so reduce the national fuel consumption and emissions generated by the transport sector.

274. Below, the combined impact of the modelled policies is summarized, considering each of these metrics.

### *1. Vehicle Fleet*

275. Policies which impact on the amount of vehicle activity resulting from either modal choice or travel cost changes are also expected to have a second-order impact on demand for vehicles. This is modelled with an elasticity of 0.5 with respect to vehicle kms. Accordingly, these measures which include parking policy and improved mass-transit should result in suppression of the rate of growth in the private vehicle fleet. The combined impact is modelled to lead to a reduction of 6 percent in the car fleet, amounting to over 137,000 fewer vehicles by 2040.

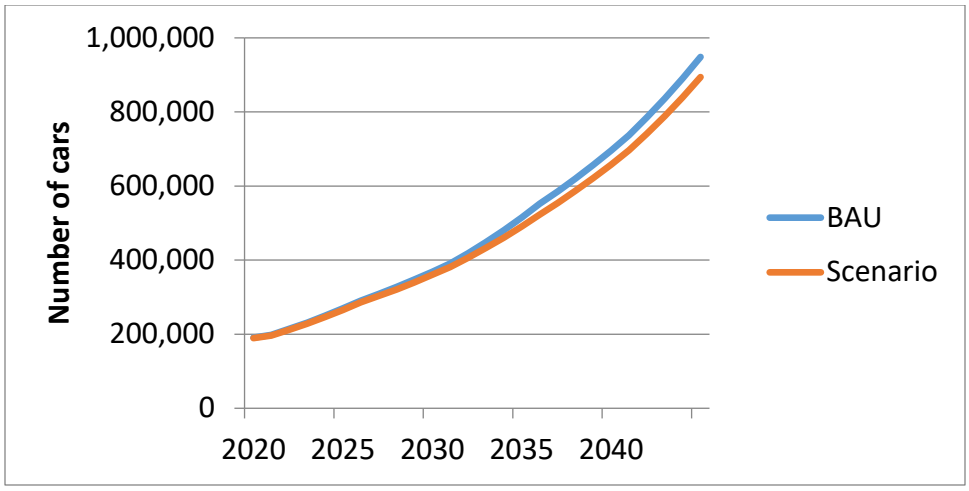


*Figure 34. Projected size of car fleet: BAU vs. Motorization Management Scenario*
*Source: World Bank Team*

## *2. Fleet characteristics*

276. The composition and characteristics of the vehicle fleet are projected to change from the business as usual scenario in response to the introduction of vehicle standards and the fiscal measures encouraging the purchase of more efficient vehicles.

277. Private car fuel consumption is estimated to fall by 6% against BAU baseline resulting in economic benefits of reduced fuel requirement and reduced emissions.

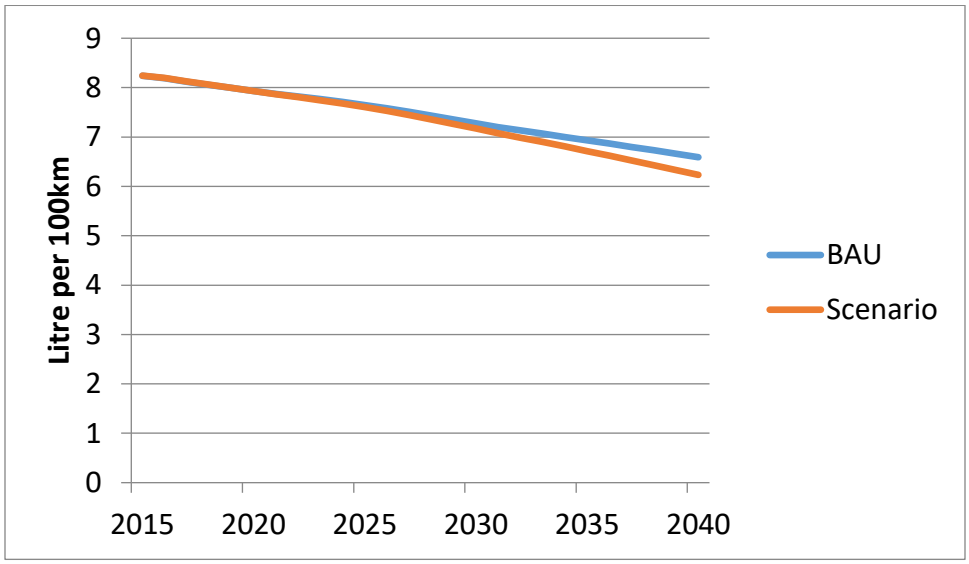


*Figure 35. Car fleet average fuel consumption*
*Source: World Bank Team*

278. The emissions standards and fiscal incentives to purchase more efficient vehicles result in the more rapid adoption of newer and more efficient vehicle technologies. This has a significant impact in particular on the levels of local air pollutants generated by the transport sector, by comparison with the business as usual scenario. Particulate matter (PMx) emissions fall by an estimated 33 percent by 2030, whilst nitrous oxide (NOx) emissions fall by 9 percent.

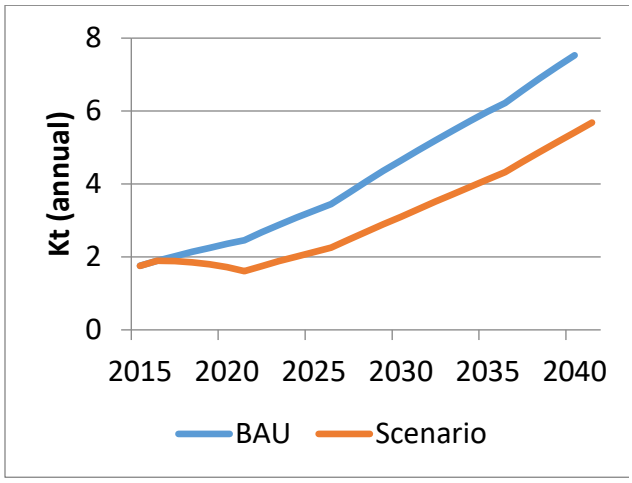


*Figure 36. PMx emissions (transport sector)*

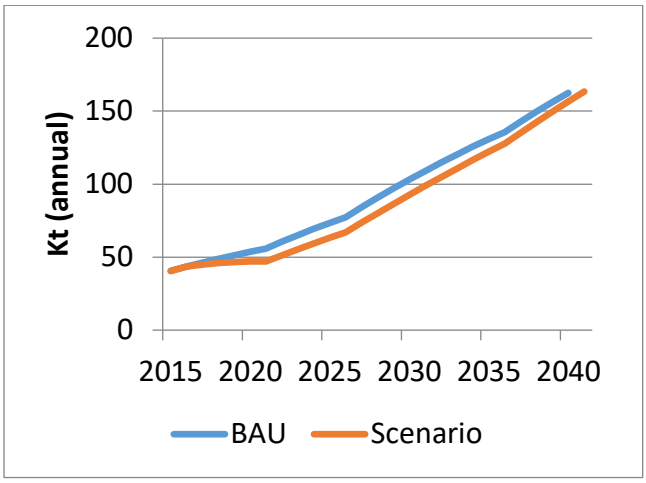


*Figure 37. NOx emissions (transport sector)*

*Source: World Bank Team*

279. Overall fuel requirement is modelled to fall by around 4 percent (reflecting the fact that goods vehicles also make up an important component of fuel consumption). This leads to a commensurate reduction in GHG emissions, which amount to a total saving of over 23 $MtCO_2e$ in the period 2020-2040.

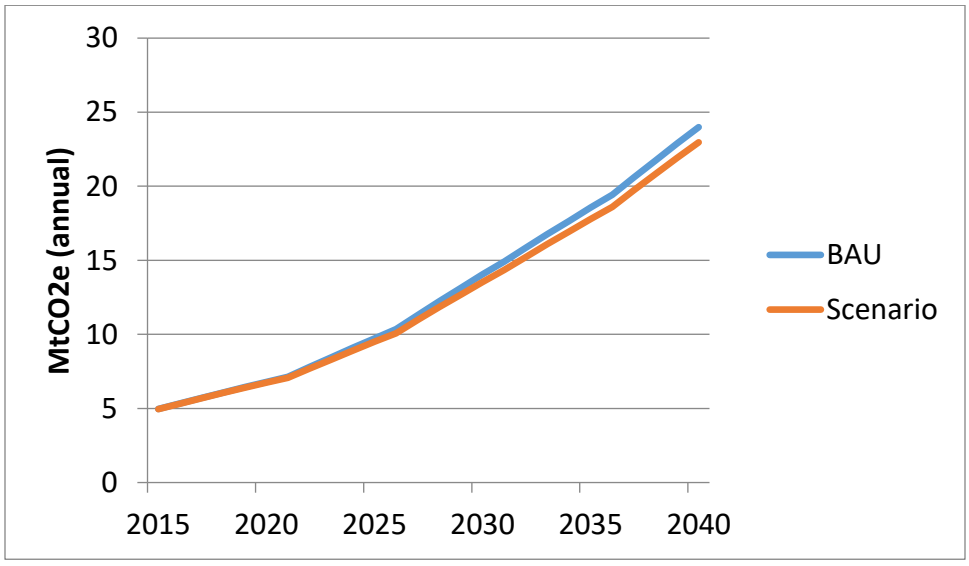

*Figure 38. Transport Sector $CO_2e$ emissions (annual)*
*Source: World Bank Team*

280. The modelling of the potential impacts of selected motorization management measures that have been recommended in this document has identified and highlighted the positive impact that policy can have on:

- Size of the vehicle fleet
- Composition and characteristics of the vehicle fleet
- Fuel requirements and greenhouse gas emissions
- Local air pollution

281. In addition to the above benefits, motorization management strategy which combines the range of policies identified can be expected to lead to wider benefits including reduced congestion, safety and increased city livability which are not modelled but which are recognized to have significant economic and social value.

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