Strengthening Statistical Capacity of Arab Countries in Producing Energy Statistics and Energy Consumption Surveys Project

Report on Transport Sector Energy Consumption Surveys Outcomes and National Energy Policies

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Abbreviation and Acronyms

ABS	Australian Bureau of Statistics
ANME	National Agency of Energy Conservation in Tunisia
CAPMAS	Central Agency for Public Mobilization and Statistics
CNC	Compressed Natural Gas
DECC	Department of Energy and Climate Change
DERV	Diesel Engine Road Vehicle
DFT	Department for Transport
DoS	Department of Statistics
DUKES	Digest of United Kingdom Energy Statistics
DVLA	Department of Vehicle License Agency
EIA	U. S. Energy Information Administration
EU	European Union
GB	Great Britain
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HGV	Heavy Goods Vehicles
IDB	Islamic Development Bank
IEA	International Energy Agency
INS	National Statistics Institute
ISIC	International Standard Industrial Classification of All Economic Activities
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas (Propane and butane)
MARSA	Morocco Ports Authority
MTOE	Million Tonnes of Oil Equivalent
NAEI	National Atmospheric Emissions Inventory
NSOs	National Statistical Offices
NTS	National Household Travel Survey
PCBS	Palestinian Central Bureau of Statistics
PSU	Primary Sampling Unit
SMMT	Society of Motor Manufacturers and Trade
SMVU	Survey of Motor Vehicles Use
TOE	Ton of Oil Equivalent
UK	United Kingdom
UN-ESCWA	United Nations Economic and Social Commission for Western Asia

Executive Summary

The availability of accurate, reliable and consistent energy data at the national level allows better analysis of energy supply and demand and enables policy makers to set out achievable targets for energy, energy efficiency and environmental policies. For the past few years, the Economic and Social Commission for Western Asia has been implementing a project on capacity building in energy statistics and balances. It has become evident that a considerable gap still exists between the demand for information and the ability of most member countries to routinely supply reliable energy statistics disaggregated by sector and by energy types, both in terms of the availability and the quality of data. The overall objective of the current project is to strengthen the capacity of the national statistical offices in the three selected member countries, namely, Egypt, Jordan and Palestine. In particular, the United Nations Economic and Social Commission for Western Asia is aiming to improve the quality of statistical data on energy use in the transport sector of the three chosen member countries by using a field survey methodology.

This report introduces the relation between energy surveys and national energy policies, and then focuses on the transport sector of the three member countries, which covers: road transport, railway/subway and public transit system, maritime, and air transport in order to calculate the energy use by fuel types. The report gives the status of the energy data in the transport sector for these countries and the readiness of their national statistical offices to conduct a field survey. Moreover, this report reviews successful transport surveys experiences from United Kingdom and Australia followed by a brief discussion of transport surveys which were conducted in Tunisia and Morocco recently. For the most part, the national statistical offices of the three selected member countries are ready to carry out the survey and eager to produce reliable and accurate statistical data. The national survey results are published on the websites of the statistical offices of Palestine, Egypt and Jordan as well as on ESCWA's website: https://www.unescwa.org/events/final-meeting-energy-consumption-transport-sector-survey-project-and-result-launching

1 Introduction

Energy statistics is a vital source of data for governments, energy agencies, energy analysts, oil companies, and investors for decision making and policy design. The availability of accurate, concise, reliable and consistent energy data regarding energy sources, energy use and energy efficiency at the national level will allow for a better analysis of energy supply and demand balance and enable policy makers to set out achievable targets for energy, environmental and energy efficiency policies. In particular, reliable data on energy use are very important for energy managers as it plays a vital role in anticipating future changes in energy efficiency and conservation potentials. Furthermore, reliable energy data would make it possible to compare energy efficiency indicators across countries.

It is imperative to establish a national energy databank for energy forecasting and policy impact analysis, to improve the process of energy policy decision-making. In order to establish this databank, it is crucial to recognize the purposes of the databank, the data elements, variables and indicators needed, and to determine the methodology for collecting and compiling accurate, reliable, consistent and comparable energy statistical data. It is also essential to prepare an institutional and organizational framework for the updating and upgrading of this national energy databank [1].

For the past few years, the UN-ESCWA has been implementing a project on capacity building in energy statistics and balances. It has become evident that a significant gap still exists between the call for information and the ability of most Arab countries to regularly supply reliable energy statistics disaggregated by sector and by fuel type, both in terms of the availability and the accuracy of data. The overall objective of the current project, which is funded by the Islamic Development Bank (IDB) on behalf of the Department for International Development Fund (DFID) and implemented by UN-ESCWA for a period of one year, is to strengthen the capacity of National Statistical Offices (NSOs) in the three selected member countries, namely, Egypt, Jordan and Palestine. In particular, UN-ESCWA is aiming at improving the quality of statistical data on energy use in the transport sector in the three chosen countries to enhance the decision-making process and to better design an effective energy policy. The project seeks to achieve the following specific objectives:

- Provide the three member countries with the necessary capacity to conduct periodic surveys on energy end use in the transport sector according to international standards on energy statistics and to adopt corrective policies and conservation programs;

- Support member countries in producing and disseminating statistics and indicators on energy consumption;

- Enhance the capacity of member countries to compile national energy balance;

- Train staff from the National Statistical Offices (NSOs) to conduct (develop) energy consumption surveys (which will also be used as benchmarks by the NSOs for future energy consumption surveys), and;

- Provide policy-makers in the pilot countries with statistical evidence to assist them in making informed decisions on setting their energy policy.

In this context, this report overviews transport sector energy consumption surveys outcomes and relates them to national energy policies for the three selected member countries. The study covers road transport, railway/subway and public transit systems, and maritime and air transport, as well as the energy use by fuel types such as gasoline, kerosene, diesel, aviation fuel, gas oil, electricity, and liquefied natural gas (LNG),

among others. It also reviews the existing data, i.e. administrative records of the private and public sectors, surveys that have been conducted previously and the surveys which are planned for the future. Furthermore, the report gives the status of the energy data in the transport sector and reports on the readiness of NSOs to conduct the survey in light of the first technical expert mission to NSOs.

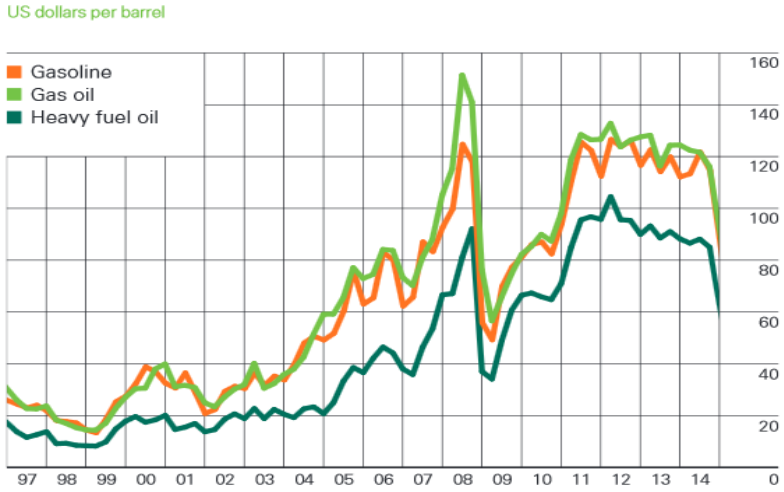
2 Background

2.1 Energy Supply and Demand Growth

Energy is essential to all economic sectors in industry, transport, agriculture, services, as well as for the development and wellbeing of society in terms of access to affordable, reliable and sustainable energy. Most fossil fuel resources are limited resources (crude oil, natural gas, coal…). Record extraction rates have been reached over the years due to the increase in the world's energy demand. Effectively, the world's total primary energy supply has increased from 6,106 MTOE in 1973 to 13,371 in 2012, accompanied by an increase of CO_2 emissions from 15,633 Mt to 31,734 Mt [2]. In particular, 42.5 % of global oil reserves and 24 % of natural gas reserves are provided by the ESCWA region, where 28.7 % of world crude oil and 13 % of natural gas were produced in of the year 2011 [3].

Furthermore, from an economic point of view, the energy prices are highly volatile with a general upward trend accompanied. This instability, described by Figure 1.1, is due to increasing oil demand and limited supply in addition to excessive market speculation. In particular, a 147 $ per barrel of oil peak has been recorded in July 2008, while in 2015 the barrel of oil price has dropped below 40 $. This unexpected fall of oil prices would increase the energy consumption especially in the transport sector.

Figure 1.1. US dollars per barrel of Gasoline, Gas oil and Heavy fuel oil [4]



In addition to the scarcity of energy resources and the related issues of energy dependency and security, governments are facing major environmental concerns with this growing energy consumption, in terms of pollution, greenhouse gas emissions and climate change.

In this context, a clear monitoring and reporting of the energy status is necessary to understand the situation of energy use in the different sectors at the national level. Therefore, timely and comparative energy statistics is the tool needed to advance this understanding. Data providers on the production and transformation side are mainly the oil companies in the national economy that do the extraction, refining, transformation and distribution.

Information on the use side by product and by sector depends on the t on the accuracy of the surveys conducted by through national statistical offices and their partners in the national statistical system in households, businesses and in specific sectors. Targeted indicators collected through official statistical techniques provide decision-makers evidence to draw the adequate national energy policies seeking realistic results and recommendations to reduce energy consumption through energy efficiency.

In the meantime, most of UN-ESCWA member countries are still on their way to build their statistical capacities in order to meet the requirements for producing data for developmental plans. The main problems encountered are the availability and reliability of information coupled with low level of awareness and non-harmonized data.

2.2 End-Use Surveys in the Transport Sector and Outcomes and National Energy Policies

A policy is a set of guidelines, laws, rules, regulations, principles, and directives structured to achieve a defined goal. The main objective of energy policies is to reduce energy consumption by improving energy efficiency.

Energy policy is a rising priority for many countries around the world; however, it varies significantly from country to another due to many factors:

- Limited natural energy resources;
- Governmental policies and priorities;
- Lack of infrastructure;
- Economic limitations.

Therefore, a successful energy policy adopted for a specific country cannot be replicated to another one. In order to formulate a national energy policy, energy analysts and policy makers need to understand the national energy situation through a variety of energy indicators [5]. Effectively, the data collected enables policy makers to identify the priority areas for improvement of energy efficiency and reduction of energy consumption and define the sector(s) that offer potential for further improvements. Consequently, data and indicators that best support policy development in these sectors will be selected and energy strategy and targets to be achieved will be developed. Also, the use of survey indicators will help tracking progress of energy policies.

In brief, statistical data is necessary to build energy indicators, and it is nearly impossible to make a strong assessment of a situation without the energy indicators. Thus, a lack of information leads to failure in optimizing measures and policies [6]. The deficiency of data and indicators is mainly due to inadequate resources, lack of expertise, know-how and practices. However, surveying, metering and modeling practices are developed all around the world.

The transport sector's activities are crucial; mobility is the core of modern economic activities. If the transport sector suffers congestion or safety issues, there will be significant negative economic impacts and a loss of valuable resources to all productive sectors in the economy. Collecting reliable and comparable statistical data on energy consumption allows the formulation of a range of policy options to slow the growth of energy demand and provides insights for reducing total energy costs while still sustaining economic growth and development. Furthermore, knowing the costs of transportation in terms of fuel use and fuel efficiency is necessary to optimize the use of the available energy resources and to increase the profitability and competitiveness of various economic sectors. Policy insights are also instrumental to the transport sector's activities because of the need to address environmental concerns regarding greenhouse gases and the global health hazards related to the use of fossil fuels such as CO_2 emissions and ecological damage.

2.2.1 Future transport pathways

Recent in-depth studies conducted in the European Union and the USA, namely, "Progress in energy efficiency policies in the EU member states—the experts' perspective" in 2012 [7] and "Perspectives on Energy Policy and Economic Research, Results of a Survey" 2010 [8], have illustrated that the most important transport sector energy policies are:

- Policies to reduce greenhouse gas emissions (GHG), in particular, in road transportation activities;
- Development of new approaches to increasing fuel efficiency standards;
- Use of alternative transport modes (non-motorised) and alternative fuels on the road by vehicles such as hybrids and electric vehicles;
- Examination of the effect that cap-and-trade policies would have on transportation and transportation fuels;
- Road Tax and Fuel Tax;

Therefore, the transport system has to be identified through the collection of reliable, comparable and disaggregated statistical data on both the road network and road vehicles activities, in order to monitor and evaluate the performance and to provide policy insights into the following:

- Levels of passenger and commercial vehicle use;
- Road safety issues;
- Fuel consumption;
- Fuel efficiency and development of effective fuel efficiency standards;
- Passenger and goods movements and congestion problems;
- Emission of GHGs: Assess economic and environmental impacts;
- Future transport infrastructure requirements;
- Sustainability of transportation activities.

In brief, surveys are essential for the collection of data to obtain the necessary indicators and follow up on their progress and therefore identify policy objectives.

3 Transport Sector Energy Consumption

3.1 Importance of the transport sector

The aim of the project is to enhance and improve the quality of data on energy use by the transport sector in order to assist governments to adopt corrective energy policies and design conservation programs. Unfortunately, the main message from the numerous energy efficiency surveys conducted worldwide is that there is a complete lack of comprehensive policies on energy efficiency in transport sector energy consumption as depicted in the Annual World Energy Outlook [9]. Even though there are some positive examples in specific transport modes in some countries, including changes in car taxation, road pricing or fuel efficiency standards, experts criticize the absence of a political will to enforce. They see a lack of a clear strategy for the transport sector across the world in all modes. Moreover, the experts see the highest gaps in energy efficiency policies in the transport sector. Thus, it is essential to capture in detail the current transport system for each country by collecting and analyzing transport activities statistical data and indicators to identify and understand the determinants of transport energy demand.

It is important to note that the demand for energy by transportation activities is a derived demand, meaning that the demand is not for energy or for the vehicle; the real demand is for travel from point "A" to point "B". Depending on the circumstances, the daily, monthly or annual demand for travel is

usually measured in kilometers or miles of travel. Many developing countries such as the United Kingdom, the USA, Canada, and Australia, among others, conduct periodical national household travel surveys in order to collect information about travel activities. These national household travel surveys provide valuable up-to-date and regular information about personal travel within the country and monitors trends in travel behavior. Certainly, these surveys represent an important source of statistical data and key indicators in order to formulate effective transportation and energy policies. However, it is essential to recognize and understand some key points:

- Each country's specificities are unique in terms of the modes of transportation. The project implementation plan should be flexible enough to accommodate these specificities.
- Obtaining reliable data is a problematic task for all types of energy use but it is particularly problematic for the energy use by transport sector for the following reasons:

- Transport sector is known to be heavily dependent on oil products. It usually consumes more than 60 % of total oil products worldwide according to the International Energy Agency as shown in Figure 2 [2].
- The IEA has shown that the transport sector accounted for around 20 % of global energy-related CO_2 emissions for 2009 (see Figure 3).
- According also to IEA, about 80 % of total transport sector consumption of oil products occurs on the road mode of transportation (see Figure 4). Undoubtedly, the road mode energy consumption is highly significant and should be the focus of study.

Figure 3.1. 1973 and 2012 shares of world oil consumption by sector (%) [2]

**Other includes agriculture, commercial and public service, residential and non-specified*

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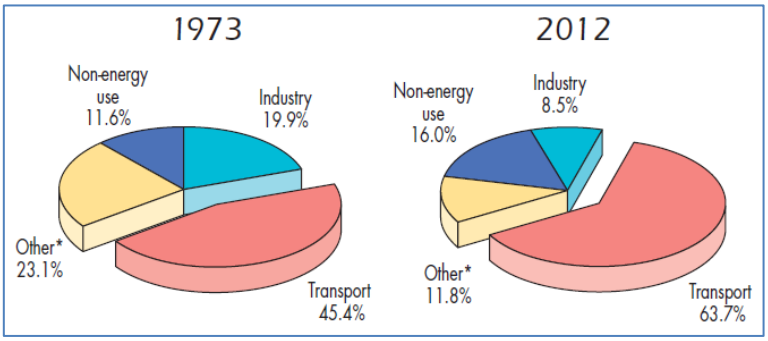


Figure 3.2. The relative share of various sectors CO_2 Emissions (%) [10]

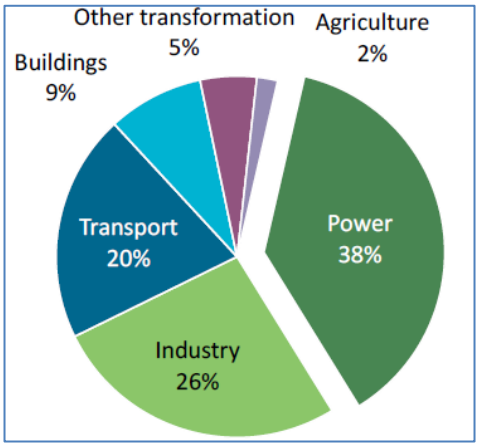
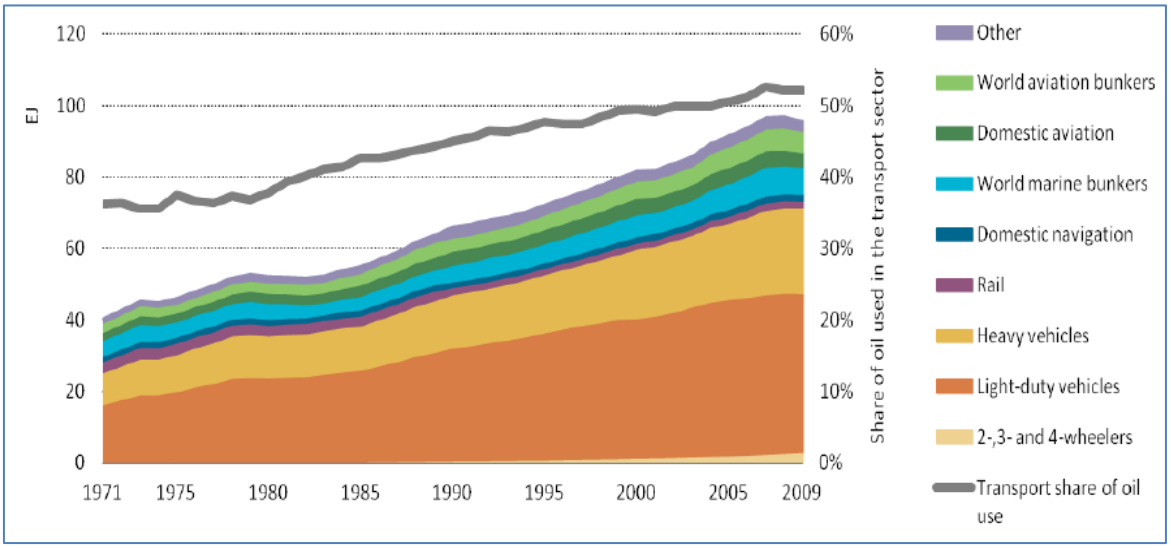


Figure 3.3. Share of Oil Consumption in Transport Sector Worldwide (%) [10]



- Furthermore, when assessing energy use, unlike road mode of transportation which is extremely complex and highly diverse, all the other modes of transportation such as air, rail, and maritime, are straight forward and rely largely on administrative records due to their governance nature and mainly public ownership.

- The road mode of transportation typically consists of all types of vehicles: automobiles, motorcycles, trucks, lorries, buses for use by private, public or residential, commercial, governmental, construction, industrial and agriculture sectors.

- The monitoring and evaluation of energy policies and the mitigation of greenhouse gas emissions require the development of a range of relevant energy and environmental indicators for the various policy decision-making levels. Therefore, it is essential to know the characteristics of the vehicles in the fleet such as:

- Type, make, age, model, and maximum number of passengers;
- Technical fuel efficiency of new vehicles measured in number of liters per 100 kilometer or miles per gallons;
- Fuel efficiency of the fleet (used + new). The average fuel efficiency of the fleet is also measured in number of liters per 100 kilometers or miles per gallons.
- Number of kilometers travelled by the vehicle each year, in particular; the intensity indicators such as: Fuel per passenger-kilometer (fuel/pkm) and Fuel per tones-kilometer (fuel/tkm)

Some of these key variables are available from traffic departments as part of the annual registration and renewal of the vehicles' license, and can be utilized and linked to the data from the survey. Thus, it is essential to collect information on these key indicators of energy use (intensity) and fuel efficiency by the road mode of transportation, namely:

1- Fuel consumption: type, quantity;
2- Vehicles: number of vehicles, model, age, make, maximum number of passenger or tonnage of capacity;
3- Technical fuel efficiency and average fuel efficiency of the fleet;
4- Use of the vehicle: kilometers driven, number of passengers or tonnage transported;
5- Characteristics of the driver: gender, age, education, etc.

These key indicators would help set the baseline and perform scenarios for optimization and therefore be the fundamentals for better effective transport and energy policies in the future.

3.1.1 Sources of data

Official statistics, developed by the national statistical systems, are obtained from a variety of sources. They can be obtained from primary sources through the census and surveys and from secondary sources such as administrative sources, or through measuring/ metering and modeling.

There is increasing demand for official statistics, with increasing pressure to improve the efficiency of the statistical production process, to reduce costs and staff resources and respondent's burden. Therefore, statisticians are being forced to consider other alternatives to costly and time consuming statistical surveys sources such as administrative records. However, in many cases there are no alternatives to surveys to benchmark, obtain disaggregated information, link to other surveys, and to other administrative sources etc…

3.1.1.1 Administrative sources

The main source of data collection in the transport sector is based on administrative sources, in particular, vehicle registration centers, motor inspection centers, vehicles manufacturers and energy companies. In addition to the statistical office, two ministries developed specialized data; the ministry of transport has records related to the transport sector, while the ministry of energy has energy related data, among which are the statistics related to energy demand and supply in the transport sector.

3.1.1.2 Surveying

This method of data collection consists on direct observation by answering questionnaires regarding travel activities, energy use, etc. Surveying can provide useful and rich databases however it is time consuming, and requires large human and financial resources. Surveys in their nature, allow collecting accurate statistics based on respondents experiences. Surveys are conducted when the topic to collect statistics for includes a large number of subjects to be visited and recorded within a specified period of time. For instance, the road transport sector contains large number of various vehicles types. If a full enumeration of the road sector is to be made, the collection of data might take more than a year, depending on the total number of vehicles. In that regard, a smaller sample is selected, this is representative of the original population, to collect statistics from. The sampled data is then weighted and transformed into national statistics through statistical methods.

3.1.1.3 Measuring/metering

This method consists on direct observation of physical phenomena related to the transport sector. It needs metering systems and/ or specific equipment that are used to obtain the statistics, for example roadside car counters, speed detection systems, atmospheric concentration metering. This measure is very reliable but often expensive to perform.

3.1.1.4 Modeling

Modeling is an advanced informatics technique used when statistics are not available in time series. Modeling and simulations would fill in the gaps and establish the missing information through statistical methods using interpolations, correlations… Another use for modeling would be when trying to estimate future values, for instance assessing the supply and demand of a country for the coming one year.

3.1.2 Efficient transport measures

Efficient and sustainable concepts of transport were discussed by Korner [10] and summarized below:

3.1.2.1 Reduce or avoid travel or the need to travel

Actually, the most energy efficient trip is the one that is not performed. This solution can be addressed by:

- Integration of transport and land use planning in urban design through legal, governance and political framework conditions affecting site/area development dependency on the quality of accessibility to it using different transport services and infrastructure [11]. Effectively, an increase of 10 % in urban density reduces 1 to 3 % travel vehicle per capita [10]. Therefore compact development policy could present a solution to reduce the need to travel through placing population near employment premises, designing pedestrian friendly policies (safe sidewalks, car-free zones,…), and facilitating access to transit;
- Strict parking policies with high parking fees put in place;
- Alternative work concepts: Tele working which requires working through the internet while being physically absent from the office.

3.1.2.2 Shift to more efficient transport modes

It is recommended to use the most efficient mode for a defined given trip, depending on trip distance and trip location. For instance, toll fees at the entrances of cities for private cars could be enforced to encourage the population to use public transportation.

3.1.2.3 Improve the energy efficiency of transport modes and vehicle technology

The technological development concentrated on the improvement of energy efficiency of all modes of transport. For example in the cars industry, more efficient engines are being designed and weights of cars are being reduced, in addition to the adoption of hybrid cars and biofuel.

3.1.3 Simple transport policy model

The main objective of transport sector policies is to seek efficiency and sustainability. This would start by understanding historic development of the transport sector energy use by analyzing the data and the collected indicators, then identifying transport system parameters that have high impact at low costs, in particular on fuel economy. After that, targeted laws can be developed and enforced to attain the desired outcome.

3.1.4 Current transport policies examples

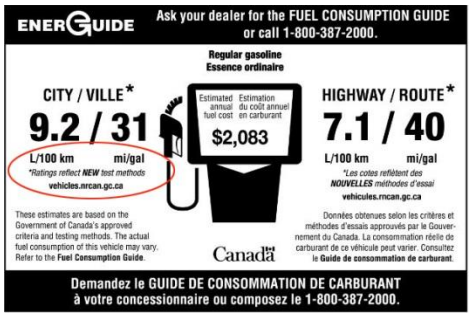
Several transport policies could be implemented and could be classified as regulations or incentives or awareness tools. The regulation strategies could concern the fuel efficiency standards per type of vehicles. Speed limits are also considered as regulation tools. Incentives are normally monetary incentives, such as fuel taxation, road pricing schemes, registration tax incentives for efficient vehicles or fuel use and emission based on annual vehicle taxation. Eco driving campaigns, car labeling, tires labeling and other measures are considered as awareness policy tools.

Effectively, some countries like Canada, Japan and United States have set fuel economy standards as limits of “liters / 100 km” across their fleets based on vehicle weight or class. The European Union has set GHG emissions standard as limit on “emissions / km”.

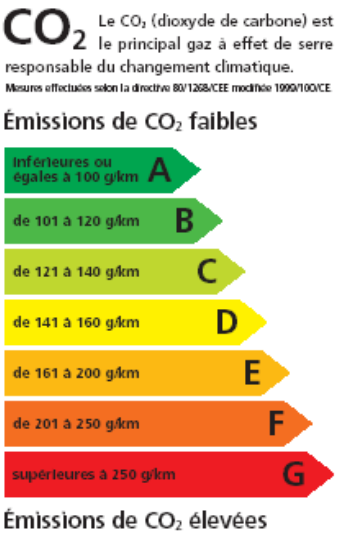
Fuel prices play a major role in transport policy. Indeed, fuel prices have direct effect on countries' driving culture. People in low fuel prices countries, due to high fuel subsidies, drive big cars at high annual mileages, while often smaller cars are used in countries with higher fuel prices. Therefore, an important policy instrument could be the fuel subsidies that should target the low-carbon emitting vehicles or fuel efficient vehicles, in addition to other fiscal incentives that could be adopted such as taxes or fees based on vehicle performance.

Also, vehicles classification based on fuel economy and GHG emissions is used to inform consumers about the fuel efficiency of the vehicles (Figure 3.4).

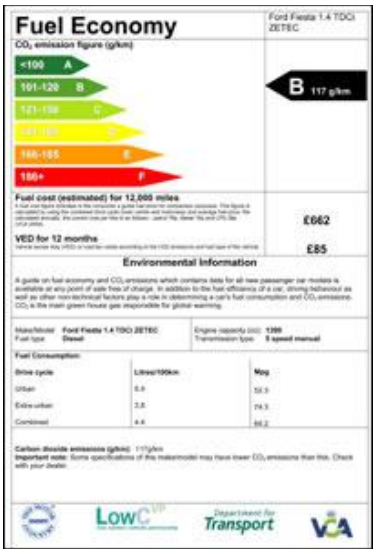
Figure 3.4. Vehicles labeling examples



Source: nrcan.gc.ca



Source: carte-grise.org



Source: Department for Transport, UK

Another transport policy instrument is the feebate system; this is the case of the French green taxation "Bonus/Malus" introduced in 2008. A "Bonus", up to 1,000 euros, would be won by customers that buy low CO_2 emissions cars and it can attain 5,000 euros for electric cars. On the other hand, a "Malus", up to 2,600 euros, would be charged to customers that buy high CO_2 emissions cars [12].[7]

[7] Low-calorific: 1 kg of L-gas consists for 61.4% of carbon, or 614 g of carbon per kg of L-gas. In order to combust this carbon to CO_2, 1638 g of oxygen is needed. The sum is then 614 + 1638 = 2252 g of CO_2/kg of L-gas. An average consumption of 5 kg / 100 km then corresponds to 5 kg x 2252 g/kg = 113 g CO_2/km.
High-calorific: 1 kg of H-gas consists for 72.7% of carbon, or 727 g of carbon per kg of H-gas. In order to combust this carbon to CO_2, 1939 g of oxygen is needed. The sum is then 727 + 1939 = 2666 g of CO_2/kg of H-gas. An average consumption of 4,2 kg / 100 km then corresponds to 4,2 kg x 2666 g/kg = 112 g of CO_2/km. http://www.ecoscore.be/en/how-calculate-co2-emission-level-fuel-consumption

Table 3.1. Amount of the feebate as a function of CO_2 emissions [12]

Class	CO_2 Emissions	Rebate
	(g/km)	(euros)
A+	<60	5,000
A	61 - 100	1,000
B	101 - 120	700
C+	121 - 130	200
C	131 - 140	0
D	141 - 160	0
E+	161 - 165	-200
E-	166 - 200	-750
F	201 - 250	-1,600
G	>250	-2,600

4 Status of Energy Consumption by Transport Sector in Developed Countries

This section presents the successful cases from industrialized developed countries such as Great Britain (GB) and Australia to demonstrate the usefulness of transport sector field surveys in providing statistical data and indicators to inform the policy-making process.

4.1 Great Britain Transport Sector

The Department for Energy and Climate Change (DECC) is the main source for statistical data from administrative records on energy consumption in the UK and produces oil products consumption figures in "The Digest of United Kingdom Energy Statistics" (DUKES) [13].

4.1.1 UK Current Status

According to the Department for Energy and Climate Change (DECC), the transport sector consumes 38 % of the UK national energy, being the largest consumer before the building sector 27 % and the industry 17 % [13]. Also, most of the oil is used for transport with around 57 % for road transport and 18 % for air transport followed by heating, chemical plants and industry.

The UK government has announced its intension to promote sustainable travel initiatives within its goals to reduce carbon footprint. Effectively around 55 % of British car journeys are less than 5 miles and many trips could be made by bike or public transport or even by walking [14]. A policy paper for local transport was

adopted by the government and consisted of a five year implementation plan, between 2010 and 2015. It consists in maintaining and improving the infrastructure of local public transport, setting a highways maintenance efficiency program, encouraging more people to use buses through enhancing their services. Also, cycling was of great concern in the policy, and other important actions like smart ticketing, and sustainable door to door journeys.

4.1.2 Road transport

Estimates of total consumption of road fuels are produced by DECC – based on inland deliveries of petrol (gasoline), road diesel (DERV) and liquefied petroleum gas (LPG). However it is not possible to trace what this fuel is used for. The DECC figures include the road fuel consumed by off-road machinery and equipment. On the other hand, the National Atmospheric Emissions Inventory (NAEI) produces estimated breakdowns by vehicle type of petrol and DERV consumption as part of its work in producing GB' GHG emissions estimates. In order to produce the breakdowns of road fuel consumption by vehicle type the NAEI produces "bottom up" estimates of petrol and DERV consumption by vehicle type derived using a number of different data sources including:

4.1.3 Road traffic volume estimates

Road traffic volume estimates are published by vehicle type and road type information on what models of vehicles are on the road (engine sizes, fuel types, vehicle age, model ... etc) and estimated grams of fuel used per km for different types of vehicles under different conditions, i.e. fuel efficiency. The bottom up estimates are then adjusted to add up to the top down totals for petrol and DERV produced by the DECC (after removal of estimated fuel consumed by off-road machinery and equipment).

4.1.4 Average new car fuel consumption

These figures are based on all newly registered petrol and diesel passenger cars for each calendar year. They are calculated from average CO_2 emissions figures for newly registered petrol and diesel cars, weighted by the numbers of new car for each model. These average CO_2 figures are converted into fuel consumption figures, e.g. miles per gallon, using information on the typical carbon content of petrol and diesel published in the DECC emission reporting guidelines. This approach accounts for the relative sales of different models of car. From 2001 onwards, CO_2 figures of new cars have been recorded on the Department of Vehicle License Agency's (DVLA) registration database and earlier figures are based on the Society of Motor Manufacturers and Traders (SMMT) car registration database.

4.1.5 Average Heavy Goods Vehicle (HGV) fuel consumption

The figures are produced from data collected by the Department For Transport (DFT) Continuing Survey of Road Goods Transport [15] and is based on returns on the amount of fuel purchased by road haulers or taken from their own supplies for a surveyed vehicle, and the mileage covered by that vehicle, during a given survey week.

4.1.6 Gasoline and diesel prices and duties

The price estimates are based on information provided by oil marketing companies and super/hypermarket chains and are representative of prices paid (inclusive of taxes) on or about the middle of the month, usually the 15th of the month.

4.1.7 Department for Transport (DFT)

The DFT is another main official agency that is in charge of all activities relating to the transport sector including publication of statistical data and conducting field surveys in Great Britain [16]. For the most part, the DFT conduct surveys on transportation vehicles of all types from the light duty trucks to heavy duty Lorries. These annual field surveys cover the utilization of the vehicles and the fuel consumed as well as the efficiency indicators and characteristics of drivers. The questionnaires and the results of these surveys can be accessed online along with other important statistical data on their website [16].

4.1.7.1 National Travel Survey (NTS)

One of the major field surveys on transport energy use for Great Britain (GB) is the National Travel Survey [17] conducted by the DTF. Great Britain includes England, Scotland and Whales. GB was the first country worldwide to undertake such a survey, having initiated this in 1965/ 1966, followed the next year by France, and three years later by the USA. Since that time, many other countries have initiated national household travel surveys, which have then been undertaken on a recurring basis since inception [18]. The DFT recognizes that the demand is not for energy or vehicles but for travel and mobility. Thus the purposes of the NTS were primarily to provide a description of travel throughout the nation, and secondarily to provide information on long-term trends in travel patterns. The survey was based on a face to face interview with household members along with a self-completion travel diary given to each household member. Two interviewer visits were normally made to each household, the first to recruit the household and deliver the self-completion diaries, and the second to collect the diary and any remaining auxiliary data. GB has since implemented such a survey annually starting 1988, while the latest one was for the year 2013. The sampling survey increased from 5,040 households in 1988 to 5,796 in 2001, to reach 12,864 households in 2013 [19].

In this context, the NTS constitutes a main source of data on household travel patterns in GB for consultants, and researchers. The objectives of this survey is to collect valuable data for analysis in order to understand the transport conditions from social, economic and sustainable development point of views. Actually, the survey's results help identify travel requirements by different age groups of the population and gender, and individuals preferences between private automobiles and public transport. From sustainable development point of view, the results contribute to assess CO_2 emissions, evaluate the sustainable transport mode (walking, cycling…), and compare between travel patterns per living environment (urban, rural area…). Also, the individual patterns of travel to their work, schools, shopping are identified.

In general, two data collection methods were used for the NTS:

- Face to face interviewing;
- Self-completion of dairy travel record for seven days.

A sample of 12,864 private households was drawn randomly from the postcode address file in England for the NTS in the year 2013. Initially, the interviewers were trained to do the fieldwork. Then they started the procedure by sending letters in advance to the selected sample of addresses, describing the aim of the NTS and probable contact by interviewers. Also, the letter stated that a £5 gift voucher would be received by each respondent if all household members completed the entire survey.

After the advance letter, interviewers follow up with the household through personal contact and arrange a placement interview. Generally, the placement interview is held before the travel week. During the interview with all household members, data is gathered about household characteristics in terms of members, vehicles,

long distance trips recently made. Seven-day travel diaries are provided to all household members after explanation of the interviewer. Finally a pickup interview is conducted in order to gather the diaries within 6 days of the end of the travel week.

The topics covered by each section of the placement interview are shown in Table 3.2 below.

Table 3.2: Placement interview question [19]

HOUSEHOLD	INDIVIDUAL	VEHICLE
Household grid	Mobility difficulties	Registration no.
Accommodation	Walk of 20 minutes or more	Vehicle details
Tenure	Transport methods used	Parking
Length of residence	Use of bicycles	Company cars
Shopping and home deliveries	Car Club membership	Mileage
Local transport services	Driving licenses	SatNav
Children's travel to school	Reasons for not driving	
Household vehicles	Economic activity	
Satisfaction with local transport services	Transport barriers to employment	
	Income	
	Place of work	
	Home working	
	Difficulties travelling to work	
	Difficulties with other journeys	
	Road accidents involving adults	
	Road accidents involving children	
	Season tickets	
	Long distance journeys	

The length of the NTS questionnaire was reduced slightly in 2013 following the removal of questions on local services and local amenities. Other minor changes to the questionnaire included updates to harmonized questions on marital status, relationships, accommodation and internet access; questions covering home deliveries and food shopping were moved to the household questionnaire; and the addition of some new questions on automobile clubs.

4.1.7.2 The Importance of Vehicle Registration Number Checking for Accuracy

All household vehicles registration numbers were asked to the respondents to the NTS since 2002, in order to get more technical information through the DVLA database about the vehicle, e.g., type of fuel utilized, engine size and technical fuel efficiency. In this way, more accuracy would be obtained and the interview could be shorter, since questions about engine size and other vehicles' characteristics wouldn't be asked directly in the interview. Although that most of the respondents were willing to give their vehicles' registration numbers, in particular about 80 % in 2013, some of the numbers were invalid according to the DFT. In order to identify the reason behind this mismatch, respondents were contacted again and asked to check the registration numbers. It turned out that, for the year 2013, 18 % of unrecognized registration numbers cases, the respondents confirmed the number. Therefore, most of the cases were for new vehicles not included yet in the DVLA database. Monthly

follow up attempts by members of the statistical team to contact again those respondents concluded in getting 62 % of cases a new registration number.

4.1.7.3 Long Distance Journeys

Long distance journeys were defined as journeys of 50 miles or more within GB. Within the NTS, data were collected on long distance journeys made in the one week period prior to the travel diary week and the result (4,056) was lower than the number reported in the travel diary (6,004). The data gathered in the travel diary is considered more accurate, and therefore the daily journeys weighting was based on this week.

Great Britain is a profoundly industrialized country in which transportation activities are the backbone of the economy and was the pioneer in adopting and implementing a national household travel survey utilizing the weekly diaries of participants. Over the years a rich database has been accumulated and expertise has grown. The case of GB has illustrated that statistical data and indicators obtained from the NTS are used extensively by the DFT to monitor changes in travel patterns and to inform policy decision-making. The NTS findings and statistical data are also used by various organizations including: other governmental departments (such as Public Revenue and Customs, the Treasury, the Department for Energy and Environment, Food and Rural Affairs); university academics and students; transport consultants; local authorities and voluntary sector organizations representing a wide range of interests including motorists, cyclists, the elderly, rural communities and children. It is note-worthy that the methodology of implementing the survey has been frequently adjusted to reflect new developments and lessons learned from the previous years' surveys. Such a methodology for conducting road transport surveys has proven to have positive impacts on national energy policies and provide the necessary information needed to formulate appropriate energy policies.

4.2 Australia Transport Sector

4.2.1 Australia Current Status

According to the IEA, the transport sector consumes around 39 % of the Australian national energy, being the largest consumer ahead of the industry sector at 30 % and the building sector at 22 %. Also, most of the oil products are consumed in the transport sector at around 72 % followed by heating, industry and agriculture.

The Australian Government has recently released an Energy White Paper [20] as an energy policy framework for all sectors, in particular for transport sector. It aims to achieve transport efficiency through mainly improved vehicle technologies and proper maintenance. Also, the Australian Government is supporting regional development and local transport energy policies. The Department of Transport in Western Australia has published a Green Paper "On-demand Transport A discussion paper for future innovation" [21] that seeks to enable on-demand services answering the needs of the travelling public. As well, the Department of Transport, Planning and Local Infrastructure in Victoria State, has identified objectives for sustainable use of energy in the transport sector [22].

4.2.2 Australia Transport Sector

Unlike the case of Great Britain, surveys are undertaken at the metropolitan level instead of national level. Thus, the national statistical figures for Australia are aggregated from these local surveys. It may, of course, be argued that Australia's population is so heavily concentrated in the eight state capital cities, namely, Sydney,

Melbourne, Perth, Adelaide, Canberra, Brisbane, Darwin and Hobart that the data collected from the field surveys that covered those cities would amount to about 95 % the population of Australia.

Table 4.1 summarizes the national transport surveys NTS that have been conducted in Australia in the last two decades.

Table 4.1. Summary of Recent Household Travel Surveys in Australia [19]

Metropolitan Region	Year Last Conducted	Data Collection Method	Period Covered	Sample Size	Area Covered
Sydney	Continuous since 1997	Face-to-face Interview	365 days	3,500 per year	Greater Sydney + Wollongong and Newcastle
Melbourne	2009-10	Interviewer drop-off and pick-up of a self-administered diary	365 days	10,000 in Melbourne, 1,000 elsewhere	Melbourne, Geelong, Ballarat, Bendigo, Shepparton, and LaTrobe
Brisbane	2009	Interviewer drop-off and pick-up of a self-administered diary	10 weeks in school terms, weekdays only	10,000 households	Brisbane, Sunshine Coast, and Gold Coast
Adelaide	1999	Face to face, using Memory Joggers	9 months	5,886 households	Adelaide Statistical Division
Perth	2002-2006	Interviewer drop-off and pick-up of a self-administered diary	Every Day from 20/10/02 to 30/09/06	10,947 households	Perth Metropolitan Region and the Shires of Mandurah and Murray
Hobart	2008-9	Self-administered diary	365 days	2,400 households	Derwent Valley, Brighton, Glenorchy, Clarence, Hobart, Kingborough and Sorell
Canberra	1997	Self-administered dairy	8/02/1997-23/04/1997 excluding weekends, school holidays, and public holidays	3,054 households	Canberra and Quenbeyan
Darwin	2003	Telephone	Sample spread equally over 7 days	1,000	Darwin, Litchfield, and Palmerston LGAs

As can be seen from the table, there is a serious lack of consistency among the different surveys, with different methods implemented to undertake the surveys [19]. The surveys covered different periods of time and tremendous differences exist when it comes to sampling method and sample sizes. The geographical areas covered by those surveys are also a relatively small part of the populated areas within Australia. As pointed out by the authors, it must therefore be difficult to make any effort to pool the data from these individual metropolitan areas to form some sort of national household travel data source for Australia. Furthermore, a quick review of the list of surveys conducted reveal that evidently the various regions of Australia are not properly represented by the travel data that have been collected and thus it would be misinformed energy policy if it utilized data from those surveys.

4.2.3 Department of Transport (Government of Australia)

The Australian government's Department of Transport is in charge of all activities related to transportation including publication of road statistical data. All the statistical data and latest developments are published on their website [23].

4.2.4 Department of Environment (Government of Australia)

The Department of the Environment mainly monitors and collects administrative records on energy use by fuel type and fuel efficiency. It also gives guides to fuel use and efficiency statistical data and the latest developments [24].

4.2.5 Australian Bureau of Statistics (ABS)

The ABS publishes statistical data on the consumption of the various fuels, in general, and the use of fuel in the transport sector in particular. It publishes administrative records on energy use and quality of environment indicators and conducts various field surveys [25].

4.2.5.1 The Australian Survey of Motor Vehicle Use (SMVU)

This survey is frequently conducted by the ABS [26]. It contains statistics on passenger vehicles, motorcycles, trucks and public buses use for characteristics such as distance travelled, consumed fuel, fuel efficiency and range of operations. The data are collected in four quarterly sample surveys. The SMVU was first conducted in 1963, and was carried out about once every three years up until 1998. Participants were asked to provide information on the use of their motor vehicles based on their memory of the previous 12 months usage. Following an in-depth review, the SMVU was redesigned to a quarterly survey using more advanced methodology such as the use of a daily diary, starting the year 1998 and extending from the beginning of July to the end of June of the following year [27].

The latest survey conducted in 2012 provided a measure of total distance travelled and tonne-kilometres for each state/territory of registration by type of vehicle. The scope of the SMVU is all vehicles that were registered with a motor vehicle authority for road use during the 12 months ending 30 June of each survey year. Note that Caravans, trailers, tractors, plant and equipment, vehicles belonging to the defense services and vehicles with diplomatic or consular plates were all excluded. A sample size of about 16,000 vehicles was selected to account for the vehicle use over a three-month period within the reference year. The sample was divided proportionately by various vehicle type categories, i.e., 24% were passenger vehicles and motorcycles, 61% were freight vehicles, 11% were buses and 4% were other non-freight-carrying vehicles. This sample size was chosen in order to increase the accuracy for estimates of total distance travelled and tonne-kilometres for each state/territory of registration by vehicle type category [26].

The survey methodology was such that operators of vehicles selected in the survey received early guidance about their inclusion to encourage a high level of participation and respondents. These operators were asked to complete two questionnaires (sent by mail) that were tailored to their vehicle type. The first, completed at the beginning of each quarterly survey period, asked for vehicle characteristics and the vehicle's odometer reading. Operators of vehicles were also informed that they would receive a follow up questionnaire at the end of the quarter seeking details about the use of their vehicle over the quarter and a second odometer reading. When questionnaires were returned to the ABS, they were checked for completeness and accuracy and a follow-up contact was made with operators to resolve any missing information. Estimates from the statistical data collected from the field survey in each quarterly collection period were processed and classified into annual estimates relating to the use of vehicles during the period 1 July 2011 to 30 June 2012.

Australia is a vast country with large geographical territories. Unlike in the UK, there is no NTS that covers the entire country of Australia but there are surveys undertaken in each of the major urban areas. Since 1963, the ABS has also routinely conducted a very important and equally informative survey for motor vehicle use, which contains statistical data on passenger vehicle, motorcycle, truck and bus use for characteristics such as distance travelled, fuel consumption, efficiency and area of operations. This emphasis on motor vehicle use shows how crucial statistical data on transportation activities and fuel consumption are for the policy decision-making in Australia. The experience of the ABS in conducting this survey again illustrates the 'learning by doing' process for transportation activities field surveys.

5 Status of Energy Consumption by Transport Sector in Arab Developing Countries

A 2013 UN-ESCWA report entitled: "Training Manual on Methodology for Data on Energy Use by the Transport Sector and Case Studies from the Arab region" [3] has discussed in details the surveys conducted in Tunisia and Morocco for energy consumption in the transport sector. The report provided a good reference on those two countries' statistical data availability and quality especially with regards to transport surveys implemented by both countries. In 2014, both countries carried out new transport surveys. However, discussions related to the methodologies used and results are limited due to the fact that the full documentations of the survey and the results have not been published yet. Although it is challenging to discuss the case of un-completed surveys in Tunisia and Morocco, it is crucial to study these two countries, since they were the only two in the Arab region that have implemented such surveys.

5.1 Republic of Tunisia Transport Sector

5.1.1 Tunisia Current Status

The transport sector consumed around 52 % of total oil products in Tunisia, while it consumed 30 % out of all energy sources consumed in the country in 2012 according to the IEA. On the other hand, the International Monetary Fund IMF reported that the Tunisian government has launched some reform for the national energy subsidies, where the oil products prices have increased by 7 % in September 2012 and increased by an additional 7-8 % in March 2013 [28].

In 2004, the government of Tunisia has adopted the Act for Energy Conservation (Act no. 2004-72) pertaining to the various energy consuming sectors of the economy. In particular to the transport sector, the act has promoted the development of environment and energy conserving transport plans for urban and large cities and has diagnosing the transport fleet in terms of energy consumption and emissions as per the road code in Tunisia [49]

In 2009, the government of Tunisia has edited Act no. 2004-72 to become more specific. Act no. 2009-7 that edited and completed the previous act, included specified measures to be taken to conserve energy. In the transport sector, the act has explicitly specified that urban planning should address the general laws of the organization of the transport sector with the purpose of facilitating transport and rationalizing the consumption of energy and protecting the environment [50].

5.1.2 Tunisia Transport Sector

The National Institute of Statistics (NIS) has conducted a survey in 2014 with the following objectives [29]:

1. Estimating the final energy consumption by transport category and fuel type;
2. Calculating the energy efficiency indicators;

3. Estimating the GHG emissions from fuel consumption;
4. Contributing to the establishment of the statistical system for energy efficiency;
5. Improving the quality of statistical data collection on final consumption of transport fuels, especially diesel;
6. Estimating the cross-border energy flows.

5.1.3 Sample Size

The sample size selected was about 53,200 vehicles (about 5% of existing Tunisian vehicle fleet) proportionally distributed according to the urban centers and vehicle categories. The response rate was estimated at 83% (about 43,229 vehicles), which is a very good level considering the geographic and temporal distribution of the sample used in the survey.

5.1.4 Methodology

The NIS had to carefully select a consistent and homogeneous database by internationally recognized classifications and concepts, which has led to using the national vehicles registry as the main database to construct the sample frame for the survey.

Based on the national vehicles registry, four types of vehicles registries were adopted in Tunisia [29]:

1- Records extracted from taxes and public management of public accounting. This includes all the vehicles that paid taxes such as taxis and all rented vehicles.
2- Records obtained from national insurance companies, which cover all the vehicles that paid for automobile insurances.
3- Vehicles registered in the "Technical Road Transport Agency" database.
4- Vehicles registered in the motor vehicle inspection centers database during annual motor check-ups.

5.1.4.1 Questionnaire

The information collected in the questionnaire covers vehicles registration number, personal contact information and geographical location of vehicle owner, and fuel consumption data by type of fuel, vehicle type, quantity and cost of weekly consumed fuel and distance traveled.

5.1.4.2 Classification of vehicles type

Vehicles have been classified into eight categories: private vehicles, dual use vehicles, light trucks, heavy trucks, towed and a half towed trucks, road tractors, buses and rapid intervention vehicles.
The utilization of these vehicles has been classified according to the approved vehicles proxy set by the Technical Road Transport division which is divided through two categories: 1) private transfer, administrative transport, tourist or commercial transport, agricultural purposes transport or freight transport and 2) individual and/or collective taxis, large taxi, learning vehicle or rental vehicle.

Furthermore, data on the use of vehicles was used to determine whether each vehicle was utilized for the private use or for the use of others, or to both. If the vehicle is utilized for private use, the average distance traveled per day and the number of passengers and the rate of use outside work time were reported. If the vehicles were mainly used for others or dual-use, a table was prepared to count the vehicles activities that included number of weekly trips and traveled kilometer and the number of passengers by vehicles to transport passengers. If activity is the transport of goods, the information required is the same as vehicles use by others.

5.1.5 Pilot Sample

A pilot survey was conducted in the national motor vehicle inspection centers where 13 % of the owners of all inspected vehicles were interviewed. The interview lasted about 10 minutes and the response rate was 90 %.

By examining the questionnaire, one can sense that it is a considerable improvement compared to previously conducted surveys in Tunisia in many ways, including the following:

1- Focused on the details of the fleet of vehicles, e.g. make, age, model, type, kilometer traveled and fuel efficiency characteristics.
2- Sample size is large and covers satisfactory all Tunisian regions.
3- The classification of vehicles by type and utilization is also considered as very significant improvement.
4- The technique used to collect information, through completing a daily diary, is innovative in the region and Tunisia was the first country to use this technique. NIS confirms that the individuals were carefully selected to reflect the various lifestyles, cover large geographical locations and different vehicles categories.
5- The revealed information also indicated that, the database for selecting the sample included various sources among which the database from the Technical Road Transport Agency of Tunisia and the Technical Examination centers. This is also considered a major improvement. It will be very interesting to examine the results and the fuel intensity and efficiency indicators obtained from the statistical data collected by this survey.
6- The importance of developing energy efficiency and environmental indicators that serve to monitor and evaluate the current policies, and assist in developing more focused national energy policies.

5.2 Kingdom of Morocco Transport Sector

5.2.1 Morocco Current Status

Morocco is among the countries in the region that is experiencing growth in final energy consumption in the transport sector. Furthermore, the transport activities across all modes consume about 35 % of the total energy consumed in Morocco. The road transportation is the most dominant sub-sector; it provides 75 % of the flow of goods and 90 % of the mobility of people. In the past five years, consumption of diesel, gasoline and jet fuel increased dramatically by 25.5 %, 34.8 % and 32.5 % respectively. A significant effort has been made by the Government of Morocco to implement Act no. 47-09 relative to Energy Efficiency, which was adopted in 2011 by the government. The act included the sustainable use of energy in the different sectors of the Moroccan economy, among which was the transport sector [51]. The main directives related to the transport sectors were:

- The re-orientation of demand towards less expensive energy resources;
- The introduction of certain tax incentives for the adoption of emission reduction devices such as improving the fuel efficiency of vehicles and equipment and catalytic conversions;
- Strengthening the service and maintenance of vehicles.
- Enhancing and improving the quality of the statistical data in the transport sector to better understand the various factors at work and develop statistics-based policy decisions.

5.2.2 Morocco Transport Sector

In 2014, the Kingdom of Morocco conducted newly designed surveys for energy consumption for all economic sectors including the transport sector and in particular, road transportation. Although Morocco did not officially publish yet the methodology and results of the conducted surveys, it is important to assess the methodology selected and used and the different targeted sectors.

5.2.3 Survey on Energy Consumption in the Transport Sector

The main goal of the survey was to collect detailed and comprehensive statistical data to provide reliable estimates on fuel consumption for the transportation activities. These statistical data will be aggregated by vehicle categories and by type of fuel used. The reported objectives of the survey in the transport sector are:

- To determine the final consumption of energy by the transportation activities for the different modes;
- To calculate the energy efficiency indicators for the transport sector;
- To help assess the emissions of GHG from the transportation activities;
- To improve the policy decision making by providing energy demand projections for the transport sector built on reliable, accurate and complete statistical data and indicators;
- To determine the share of fuel consumption by the different transport modes and by type of consumed fuel, type of vehicle and use, by vehicle age and by fuel efficiency;
- To explore the possibilities for inter-fuel substitution in the transport sector.

Based on the questionnaires, the results of the survey are expected to generate important indicators about the fuel utilized by the different modes of transportation which will then serve as inputs for the national "Energy Efficiency Program" of the Ministry of Energy and Mines, Water and Environment.

5.2.3.1 Methodology

The methodology is divided into a first stage of investigation, and a second stage of diagnosis.

5.2.3.2 Investigation

The first stage of investigation was conducted using administrative records; it was designed to collect statistical data on energy consumption in the transport sector and to consult with key institutional players in the field of study. To achieve this, two techniques were selected, the literature survey and the direct interview technique. The literature survey determined the categories of all data to be collected. Based on this, the data collection forms were developed and finally, data was collected on the various aspects of energy consumption in the transport sector. The following stage included conducting face to face interviews according to a previously designed questionnaire focusing on issues relating to the energy use by the transport sector. Furthermore, to meet the objectives of sectoral breakdown of energy consumption compatible both with the breakdown of economic activities and to meet the needs for the energy balance of the IEA, it was decided to investigate at the level of each of the economic sectors such as: industry; transport; residential; energy and mines; tertiary; and agriculture. The tertiary sector included retail trade, hotels and restaurants, communications, government agencies, education, health and social work, office activities, other community, and social and personal.

5.2.3.3 Categories of Data collection

Several detailed questionnaires were designed and developed to meet the objectives of the study taking into account the target populations in the various economic sectors. Developed questionnaires amounted to 13 different questionnaires and were divided through several categories. The first set of questionnaires included the different transport sub-sectors (rail transport of goods and passengers, air transport, shipping, toad transport for freight, road transport for urban public transport travelers, road transport for vehicles operated by professionals, road transport for intercity travellers and road transport for mixed transportation). The second set of questionnaires included the different economic sub-sectors (industrial sector, residential, energy and mines, tertiary and agriculture). The second set tackled the energy consumption in the transport sector in each of the economy sectors.

The development of each questionnaire was conducted through the following approach (a) identification of the stratum appearance of the observation unit; (b) geographical location of the respondent; and (c) description of target economic units (company, firm, farm, household).

5.2.4 Sampling Design and Planned Surveys

The objective of the survey was to collect data on fuel consumption by drivers or vehicles' owners operating in all modes of the transportation activities, as per the division of the questionnaires.

Rail, air and shipping transport data is strictly based on administrative records from national identified stakeholders, such the Moroccan Public Railway, the Moroccan Public Aviations Authority for domestic and international airlines, and the National Agency of Ports and Morocco Port Authority (MARSA) for national and international shipping. As for the remaining questionnaires, the sampling approach was utilized. For road transport, sampling included cargo and freight, passenger transport, urban transport buses, taxi transport and mixed transport were covered.

5.2.4.1 Sampling Frame

The availability of a sampling frame is an important part in the realization of such sampling undertakings. Indeed, the sampling approach was utilized. For road transport, sampling included cargo and freight, passenger transport, urban transport buses, taxi transport and mixed transport were covered.

The design of this plan takes into account a number of influencing factors. These are:

- Consider each stratum of transport as an independent field of study;
- Fix the margin of error at each layer to around 5 % and a confidence level of 95 %;
- Set the sample size to be allocated to each stratum at no less than 40 units.

5.2.4.2 Sampling Method

The selected sample design is one of stratified quota samples. This method is to divide the population into homogeneous groups called strata. The main benefit of this method is related to the degree of correlation between the control criteria and the survey variables of interest. For the survey, the control variables used to stratify the population are the different transport modes (cargo and freight, passenger, etc.) and the size of the city in terms of population size.

Thus, the investigated vehicles sample consisted of: (a) dividing the sample per transport categories while keeping a small margin of error in each stratum; and (b) ensuring fair representation nationally and given the strong correlation between the size of population and the number of vehicles on the roads, the sample used in each stratum was allocated proportionately to the population of the representative cities.

Given the constraints imposed by the sampling plan, the optimal sample size was estimated at about 970 vehicles in all categories. This size is extremely small and will not allow reasonable estimates of the transport sector as well as the stratum level components. On the other hand, questionnaires were completed through face to face interviews.

Although the survey official results were not released yet, the methodology used to conduct the survey allows some preliminary conclusions relating to the methodological assumptions and limitations. Some are enlisted below:

- A lack of clear cut sampling frames in all sectors. In other words, the lack of a comprehensive list of fine elements (vehicles, households, commercial firms or companies) which could be applied before any field visits. In fact, one outdated sampling frame was available for the industrial sector in 2005.

- The resultant overall methodological approach was to use a combination of probabilistic methods and the quota method in selecting representative samples provided in the different questionnaires. This method is generally weak and does not guarantee reliable results.

- The discussion of the sampling frame and data collection methods adopted by the survey are sound, however the sample size of only 970 vehicles is extremely small for a vast country like Morocco. It is unlikely that such a small sample size will allow reasonable estimates of the transport sector fuel consumption for all urban centers included in the survey using 6 different questionnaires for all vehicle categories.

- Apart from the industrial sector, sampling frames, and hence probabilities, are missing for all sectors and thus the extrapolation of results were done through auto-regression deductions sampling fractions in the various strata of all the sectors concerned.

- In the tertiary sector, the survey's administration did not systematically apply a straight statistical sampling methodology to all strata under investigation. Instead, they opted to utilize a dual approach: a statistical and an ad-hoc "case by case" approach.

- A probable case of double counting might occur due to using different questionnaires for road transport and economic sectors. For example, the residential sector survey is supposed to collect information on fuel use by the households including fuel for their family vehicle. Meanwhile, in the road transport survey the Professional Private Vehicles' questionnaire will likely gather the same information. This is a clear case of double counting.

- The survey clearly focuses on the road transportation activities while other modes, namely air, maritime, and rail, are all strictly based on administrative records as stated in the methodology.

6 Status of Energy Consumption by Transport Sector in Selected UN ESCWA Member Countries

This section summarizes the efforts made by the three selected member countries Egypt, Jordan and Palestine, in terms of statistical indicators' availability to assess energy consumption in the transport sector, and provides a summary of the activities undertaken by those three countries on energy consumption surveys in the transport sector. It also provides a link between the information collected as part of the surveys and a number of selected statistical indicators in the aim to build evidence-based national energy policies.

Each country has its own characteristics, when it comes to existing transport modes institutional and organizational structure of each statistical office and ways of collecting various energy-related statistical data. In addition to this, ministries related to transport and energy are considered as official institutions collecting, preparing, processing and disseminating data related to energy, transport or in some cases both.

6.1 Arab Republic of Egypt Transport Sector

6.1.1 Egypt Current Status

The total end use of energy in Egypt amounted to 55,879 ktoe in 2012 as reported by the IEA in the energy balance for Egypt. The energy use in the transport sector represented about 30 % of the total energy use. Also, most of oil products are consumed in the transport sector at around 54 % followed by heating, industry and agriculture. Natural gas is used in the electricity generation sector and the transport sector in the form of compressed natural gas (CNG) in vehicles (especially for taxis and public transit buses) [30].

The rapid growth of crude oil and natural gas consumption over the last decade has mainly been driven by the upsurge in demand by the road mode of transportation supported by relatively easy automobile loans by the banking sector and a generous fuel subsidies policy.

6.1.1.1 Central Agency for Public Mobilization and Statistics (CAPMAS)

CAPMAS is the official source of statistical data for the country [31]. It is in charge of collection, preparation, processing, and dissemination of all official statistical data and analysis for all aspects of activities in Egypt. CAPMAS is also responsible for the implementation of many censuses, collecting administrative records and conducting economic surveys in addition to specialized surveys. CAPMAS relies on administrative records and field surveys to publish their official data.

CAPMAS publishes an annual statistical bulletin on Energy and Electricity, based on administrative records, which summarizes energy supply data by energy source as well as energy consumption and energy balance in Egypt. In this bulletin, energy consumption figures are aggregated by fuel type but not by sector (residential, industrial, tertiary, transport and agriculture). The main source for oil products consumption is statistical data collected by the Ministry of Petroleum and Mineral Resources. Information related to electricity and natural gas consumption is collected from public or private companies that supply the energy. The latest bulletin was for year 2014 [32].

The Annual Statistical Bulletin on Transport and Logistics Activities: provides statistical data and key indicators for air transport, public transit, railways, maritime and shipping, postal services, telecommunication and storage capacity. This annual bulletin is based on administrative records. However, there is absence of statistical data related to the number of vehicles, their type, model, make, age or use, freight transport by railways and freight transport through maritime. The latest bulletin was published in 2014.

CAPMAS carries out several important periodic field surveys. However, none of those surveys is solely specialized to collect data on energy consumption by any economic sector. There are some surveys for various economic activities known as the Economic Surveys where the energy use was collected as one of the inputs for the production process. This survey is conducted on an annual and bi-annual basis and covers several economic sectors (industrial, agriculture, domestic trade, finance and banking, services, and construction). The main objective of such a survey is to collect information on employment and compensations, value added by various economic sectors, and estimation of the net invested capital and capital formation by various sectors. The latest reports are for 2013 or 2014.

CAPMAS also conducts an annual survey of family expenditures, aiming at collecting vital statistical data and household expenditure indicators. Costs of energy included electricity for lighting, natural gas, kerosene or wood and biomass for cooking but there is no data on travel or transportation. Unfortunately, the methodology of this survey is not discussed anywhere in the survey report. The latest survey was published in 2014.

6.1.1.2 Ministry of Petroleum and Mineral Resources

The Ministry of Petroleum and Mineral Resources publishes key indicators on energy consumption by fuel type through the collection of administrative records [33]. However, no sectoral disaggregated data is published.

Furthermore, financial data on the cost of energy subsidies are provided in the publication entitled "Facts about Petroleum and Mineral resources 2013" [34].

CAPMAS, along with the Ministry of Petroleum and Mineral Resources in Egypt, have been providing reliable statistical data for all aspects of economic, social, financial, and demographic variables. However, when it comes to energy consumption disaggregated by end-use economic sector, data is weak. Furthermore, the consumption of oil products by fuel type and for various sectors is not readily available, especially in the case of transport sector activities. In fact, CAPMAS has never conducted any field surveys that targeted energy consumption by any economic sector and, in particular, the transport sector. There was no data reported for characteristics of vehicles on the roads or their utilization, fuel consumption or efficiency.

This information gap, which CAPMAS is aware of, is substantial given the size of the Egyptian population and the large diversity of the transport sector and its central role in the Egyptian economy. The current survey in association with UN-ESCWA on fuel consumption by the transport sector is crucial to CAPMAS, as it will allow them to adequately address this statistical data gap and enhance their capabilities in conducting future energy consumption field surveys.

According to the Middle East Economic Survey (2014) [35], Egypt spent about $26 billion on energy subsidies in 2012, making Egypt the eighth-highest energy-subsidizing country in the world. The government has attempted to reform its subsidy policy. In early 2013, the government removed partial fuel subsidies, which led to increased fuel prices for heavy industries and energy inputs prices for electricity producers. At the same time, the government increased the price of electricity for household use and began using block pricing. Egypt is also in the process of implementing a smart card system to target the subsidies toward the more needy population. The smart cards would be used by drivers as they are fueling at gas stations. The government also has plans to reduce its oil product subsidies by 22 % during the 2014-2015 fiscal years. However, the Egyptian government has missed similar targets in the past. Even if the target is met, the fiscal gain would be offset by a staggering 86 % increase in electricity subsidy costs, which is also included in Egypt's 2014-2015 public budget. According to the Middle East Economic Survey (2015), subsidy spending in the current budget is planned at around $27 billion, or about 25 % of total public expenditures. These figures point to the urgent need to improve the quality of statistical data on the transport sector's energy use in order to better inform the policy decision makers.

6.1.2 Methodology of the Energy Consumption Survey

The Central Agency for Public Mobilization and Statistics (CAPMAS) is the official governmental institution in Egypt conducting the national survey on energy consumption for the entire transport sector, namely, road, maritime, air and railways transport. All questionnaires abide by the confidentiality of sharing information under the national statistics law and respondents were informed about this before starting to answer any question, along with the purpose of the questionnaire and its results usages.

6.1.2.1 Road Transport Sector

The road transportation sector includes all engine-based vehicles and trailers designed for transportation of goods and passengers. It is necessary to distinguish between two types of ownership of vehicles, namely: vehicles owned by individuals and those owned by companies (including vehicles owned by enterprises, schools, government, tourists/ rentals, etc.).

6.1.2.1.1 Vehicles owned by individuals

Target population: all registered vehicles owned by individuals.

Sampling frame: the list of all registered vehicles owned by individuals, which contains the auxiliary variables: province, governorate, vehicle type, etc. The sampling frame does not contain personal information that enables direct contact with the owner or driver of the vehicles.

Sampling design: stratified two-stage sampling based on probabilistic and quota sampling methods. The **first stage sampling** is probabilistic and purposively sampling methods**.**

The subsequent allocations are performed independently for each control variable: province, governorate, and vehicle type. The stratification of the population by provinces is given in Table 6.1.

Table 6.1. Distribution of Car Fleet by Provinces in Egypt, 2014

Province	**Governorate**								**Total**
Greater Cairo	Cairo	Giza	Qalubia						
	2,073,596	847,860	308,373						3,229,829
North Ward	Domiat	Daqahlia	Sharqia	Karf Elshaiehk	Garbia	Minofia	Alexandria	Bahira	
	119,409	372,015	288,384	117,705	312,760	309,256	637,614	176,064	2,333,207
South Ward	Bany Souf	Fayoum	Minia	Assut	Suhaga	Qana	Aswan	Luxor	
	159,423	162,654	165,301	141,150	135,597	107,862	62,640	75,906	1,010,533
Qana	Port Saeed	Sweis	Elesmaelia						
	99,885	95,262	102,909						298,056
Borders	Red Sea	Awadi Gadid	Matrouh	North Saina	South Saina				
	51,817	30,027	38,802	19,770	25,913				166,329
Total									**7,037,954**

Sample size: based on budget considerations, the department of sampling and methodology and survey managers of the project decided that the total number of vehicles to be considered for the sample is 9,000 vehicles, which represent 0.001278781 of the total number of vehicles in the sampling frame. The 9,000 vehicles distributed over the provinces based on the proportional allocation method with the following calculations:

Province size sample = total sample size * (total province car fleet / total car fleet of the country)

Using the given formula, the below results are obtained for determining the sample size for each province in Egypt.

Table 6.2. Sample Sizes of Provinces

Province	Greater Cairo	North Ward	South Ward	Qana	Borders	Total
Sample Size n_h	4,131	3,000	1,280	379	210	9,000

For example**,** the sample size of Greater Cairo is calculated as:

9,000 * (3,229,829 / 7,037,954) = 4,131.

The sample size of governorates in some provinces (selection of number of governorates in each province) might be larger than others due to the high correlation between the selection criteria set by the survey (control variables) and the availability of these criteria in these provinces (for instance North and South Wards). The selection of the governorates from each province is performed by using the probability proportional to size method (PPS) to select the number of vehicles of the Governorate using systematic PPS method (Cochran, 1977). For other provinces, governorates are selected on purpose. The selection decision is based on opinions of which governorates are typical or representative in some sense or context. Table 6.3 summarizes the results obtained from stage one sampling.

Table 6.3. Sample of Governorates by Provinces

Province	**Governorate**			**Total**
Greater Cairo	Cairo	Giza	Qalubia	3
North Ward	Sharqia	Garbia		2
South Ward	Minia	Suhaga		2
Qana	Elesmaelia			1
Borders	Matrouh			1
Total	5	3	1	9

By using the proportional allocation method, the sample size of each province is allocated over the selected governorates, using the following calculations:

Sample size of governorate = sample size of province *(total governorate car fleet / total province car fleet)

For example, the sample size for Cairo is 4,131 * (2,073,596 / 3,229,829) = 2,641. For all the Egyptian provinces, the results are given in Table 6.4.

Table 6.4. Sample Allocation by Provinces for Selected Governorates

Province	**Governorate**			**Total**
Greater Cairo	Cairo	Giza	Qalubia	3
	2,641	1,090	400	4,131
North Ward	Sharqia	Garbia		2
	1,428	1,572		
South Ward	Minia	Suhaga		2
	700	580		1,280
Qana	Elesmaelia			1
	379			379
Borders	Matrouh			1
	210			210
Total				9,000

The **second stage sampling** is non-probability sample-quota sample. This stage includes considering a sample that is dependent on the vehicle type. A quota sample is representative with respect to vehicle type if the population distribution (population car fleet structure) is close to the sample distribution (sample structure). So, the investigator need to draw a quota sample such that the proportion of sample units from subpopulation is

close to that in the population, that is, the size of each quota sample is proportional to the size of the subpopulation. The population frequencies of vehicle type and governorate are presented in Table 6.5.

This methodology (quota sampling) is often justified as a way to avoid the costly and time-consuming expense of listing all the vehicles in the sample governorates- as a prior stage before selecting the vehicles to be interviewed. It also avoids non-response since the interviewer continues questioning the vehicles' owners until she/he reaches the total number of the sample size.

Based on Tables 6.4 and 6.5, the sample size is allocated for each governorate for each vehicle type using proportional allocation approach. The resulting numbers are summarized in Table 6.6.

Table 6.5. Population Distribution of Number of Vehicles by Vehicle Type and Provinces in Egypt, 2014

	Vehicles			Buses					Truck and trail			Other Vehides			Total
Governorates	Private	Taxi	Total	Private	Tourism	Long Distance	Schools	Total	Freight	Trail	Total	Motor cycle	Rickshaw	Total	
Cairo	1,479,082	76,513	1,555,595	10,472	10,344	4,565	5,898	31,279	152,583	9,438	162,021	267,703	0	267,703	2,016,598
Port Saeed	56,360	13005	69,36	299	109	440	20	868	8,682	1,538	10,220	17,275	0	17,275	97,728
Swis	44,935	4,414	49,349	336	17	669	24	1,046	7,578	640	8,218	29,023	0	29,023	87,636
Alexandria	444,242	23,203	467,445	3,194	411	9,841	1,037	14,483	85,443	10,045	95,488	49,986	0	49,986	627,402
Domiat	46,715	5,154	51,869	195	2	174	67	438	19,507	2,654	22,161	41,956	21	41,977	116,445
Daqahlia	126,813	15,223	142,036	1027	149	2505	303	3,984	72,874	10,894	83,768	123,013	10,438	133,451	363,239
Sharqia	86,247	13,970	100,217	3,722	441	2,355	494	7,012	70,499	3,838	74,337	86,603	7,241	93,844	275,410
Garbia	119,620	12,552	132,172	427	37	2,241	25	2,730	57,872	3,256	61,128	107,085	4,501	111,586	307,616
Qalubia	99,662	13,461	113,123	1,983	15	4,106	765	6,869	31,694	2,177	33,871	148,602	805	149,407	303,270
Karf Elshaiehk	34,764	6,512	41,276	66	55	121	6	248	33,239	1,863	35,102	30,641	3,538	34,179	110,805
Minofia	52,945	13,379	66,324	405	6	2,123	74	2,608	36,396	3,126	39,522	191,562	2,978	194,540	302,994
Bahira	49,665	12,806	62,471	460	2	390	44	896	63,550	3,102	66,652	30,794	5,614	36,408	166,427
Elesmaelia	51,190	5,039	56,229	391	0	170	148	709	14,696	759	15,455	27,182	162	27,344	99,737
Giza	480,736	23,162	503,898	11,266	1,120	7,988	1731	22,105	100,467	5,297	105,764	196,666	7,514	204,180	835,947
Bany Souf	35,417	8,606	44,023	249	4	182	28	463	26,198	702	26,900	85,100	25	85,125	156,511
Fayoum	28,736	11,894	40,630	190	2	311	46	549	18,938	1,709	20,647	94,749	153	94,902	156,728
Minia	38,690	8,850	47,540	352	7	340	127	826	39,563	1,226	40,789	66,106	3,690	69,796	158,951
Assut	50,745	8,546	59,291	216	4	124	59	403	26,519	1,791	28,310	45,684	1,654	47,338	135,342
Suhaga	36,131	11,576	47,707	102	3	86	125	316	36,343	1,501	37,844	45,002	993	45,995	131,862
Qana	26,707	7,955	34,662	233	15	78	15	341	19,659	806	20,465	48,778	325	49,103	104,571
Aswan	18,960	5,357	24,317	417	350	94	41	902	15,086	327	15,413	18,331	408	18,739	59,371
Luxor	11,347	3,880	15,227	94	1,517	239	0	1,850	7,987	68	8,055	48,292	475	48,767	73,899
Red Sea	22,705	3,905	26,610	401	2,537	145	33	3,116	9,241	717	9,958	9,163	0	9,163	48,847
Awadi Gadid	5,826	1,299	7,125	44	36	95	0	175	3,788	186	3,974	16,982	0	16,982	28,256
Matrouh	9,372	4,264	13,636	75	14	11	23	123	13,471	659	14,130	3,428	0	3,428	31,317
North Saina	4,920	2,435	7355	48	3	18	3	72	7,414	168	7,582	3,481	0	3,481	18,490
South Saina	7,894	1,767	9,661	315	1,440	48	5	1,808	6,051	170	6,221	4,418	0	4,418	22,108
Total	**3,470,426**	**318,727**	**3,789,153**	**36,979**	**18,640**	**39,459**	**11,141**	**106,219**	**985,518**	**68,657**	**1,054,175**	**1,837,605**	**50,535**	**1,888,140**	**6,837,687**
Percentage	**51%**	**5%**	**55%**	**1%**	**0%**	**1%**	**0%**	**2%**	**14%**	**1%**	**15%**	**27%**	**1%**	**28%**	**100%**

Table 6.6. Sample Size of Vehicle Type by Governorate, Quota Sample

Governorates	Vehicles			Buses					Truck and Trail			Other Vehicles			*Total*
	Private	Taxi	Total	Private	Tourism	Long Distance	Schools	Total	Freight	Trail	Total	Motor cycle	Rickshaw	Total	
Cairo	2,097	109	2,206	17	17	7	10	51	198	12	210	147	0	147	2,641
Giza	749	36	785	16	1	10	2	29	131	7	138	128	10	138	1,090
Qalubia	217	30	247	3	0	5	1	9	42	3	45	98	1	99	400
Sharqia	635	104	739	26	3	16	3	48	358	19	377	226	38	264	1,428
Garbia	856	91	947	3	0	14	0	17	293	17	310	275	23	298	1,572
Minia	288	66	354	3	0	2	0	5	173	5	178	147	16	163	700
Suhaga	234	75	309	1	0	1	0	2	158	7	165	100	4	104	580
Elesmaelia	241	24	265	2	0	1	0	3	55	3	58	52	1	53	379
Matrouh	82	38	120	1	0	0	0	1	75	4	79	10	0	10	210
Total	**5,399**	**573**	**5,972**	**72**	**21**	**56**	**16**	**165**	**1,483**	**77**	**1,560**	**1210**	**93**	**1,303**	**9,000**

The classification or stratification for the governorates excluded public services automobiles of 119,783, diplomatic licenses automobiles of 6,443, customs licenses automobiles of 38,672 and public transit buses of 16,434 buses. It also excluded other vehicles for non-transport related activities such as agriculture trucks of 16,893 and heavy equipment of 2,042 which will bring the total of excluded vehicles to about 200,567.

After constructing the quotas and determining the sample size, investigators would look at different options to reach the quota needed for the sample size. There are no specific rules as to how the quotas should be filled in quota sampling.

6.1.2.1.2 Vehicles owned by Enterprises

This section covers all vehicles owned and operated by enterprises, government, schools, etc.

Target population: all registered enterprises.

Sampling frame: auxiliary variables: total number of vehicles for each enterprise, etc.

Sampling design: probability sample: stratified probability proportional to size sampling, where the size variable is the total number of vehicles for each enterprise.

Table 6.7. Population distribution of Business units, 2014

Stratum	Stratum Size
Points belonging to the administrative system of the state	614
Private companies for public transport of passengers	46

From each stratum, survey managers select a 5 % of the stratum size, see table 6.8.

Table 6.8. Sample Size of Business units

Stratum	Stratum Size
Points belonging to the administrative system of the state	30
Private companies for public transport of passengers	05

The questionnaire prepared for the vehicles owned by enterprises is very similar to the questionnaire of the privately owned vehicles (section 6.1.2.1) in matter of divisional structure and information required. The major difference between the questionnaires pertains to the general information collected from the type of the institution owing the vehicle (governmental, private or public).

6.1.2.2 Maritime Transport Sector

Target population: all business units operation in the Nile River.

Sampling frame: no sampling frame is available, but the frequency distribution of business units with type of operator is selected**.**

Sampling design: non-probability quota sample, where the control variable is the type of business unit.

The maritime transport sector is divided into two sub-sectors: sea transport and river based transport. The sea transport questionnaire focuses on the type of ships, traveled distance and type, amount and cost of fuel consumed.

The data collected from river based transport is slightly different, where individual transports and enterprises transport data is collected separately through two questionnaires. The two questionnaires target the collection of data for both passenger and freight transport in Egyptian rivers. Both questionnaires are divided through three sections: general information (contact information, educational level and geographical location), ship information (manufacturing year, size, engine size and maintenance) and energy consumption and efficiency (type of consumed energy, quantity and cost, number of monthly working days, distance traveled and efficiency through liters per kilometer).

6.1.2.3 Railway transport sector

The railway sector in Egypt is divided between trains and subways. Since the operating companies of these two sub-sectors are limited, CAPMAS has decided to perform a full enumeration of this sector based on administrative records.

The railway transport questionnaire, in addition to the descriptive data that intend to collect personal information of respondents, targets energy consumption data for long distance trains, short distance and freight trains. The main indicators include the number of trains, usages by residents, their economic added value, type of energy used and quantities.

The subway questionnaire collects statistical information on the three functional lanes of the Egyptian subway. The type of data collected pertains to the daily number of trains and trips, distance traveled and maintenance, and energy consumed per hour and cost of the energy consumed in local currency.

6.1.2.4 Air transport sector

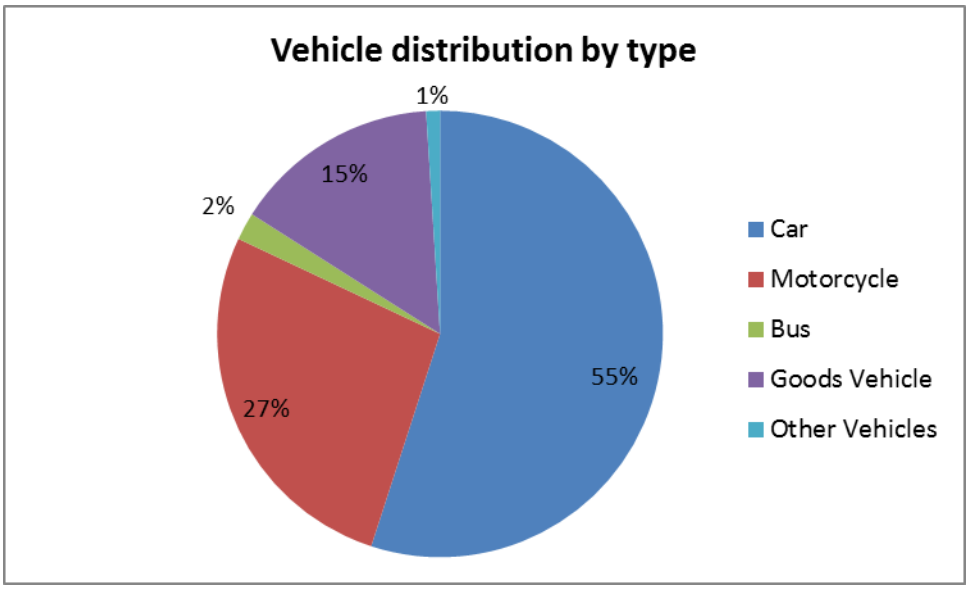
Similar to the maritime and railways sectors, the air transport sector has been fully enumerated based on administrative records due to the relatively small number of the operating enterprises.

The air transport sector questionnaire is divided into two sections. The general information section includes information about the company operating the airplanes; while the second section targets information related to the type and number of the aircrafts, quantity and cost of fuel consumed and maintenance cost in local currency. The questionnaire indicates whether the aircrafts are used for passengers or freight transport purposes.

6.1.3 Results of the Energy Consumption Survey

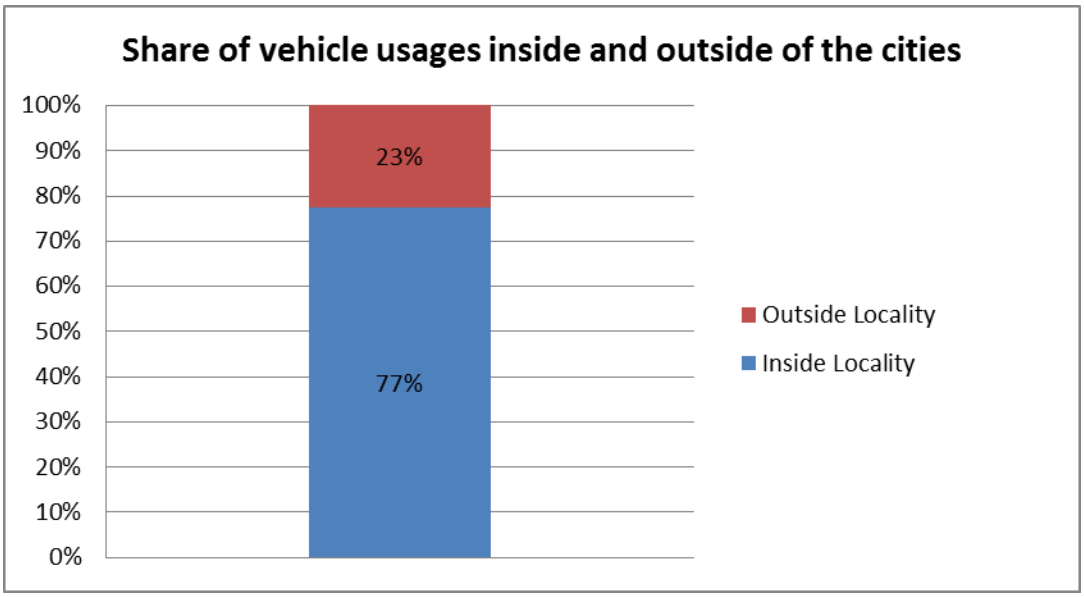
The Egyptian Energy Consumption Survey was undertaken for the road transport mode. 55 % of motor vehicles in Egypt are cars, followed by motorcycles with a proportion of 27 % and goods vehicles with a proportion of 15 % whilst buses constitute 2 % of the Egyptian vehicles as shown in figure 6.1.

Figure 6.1. Egypt's vehicle distribution by type



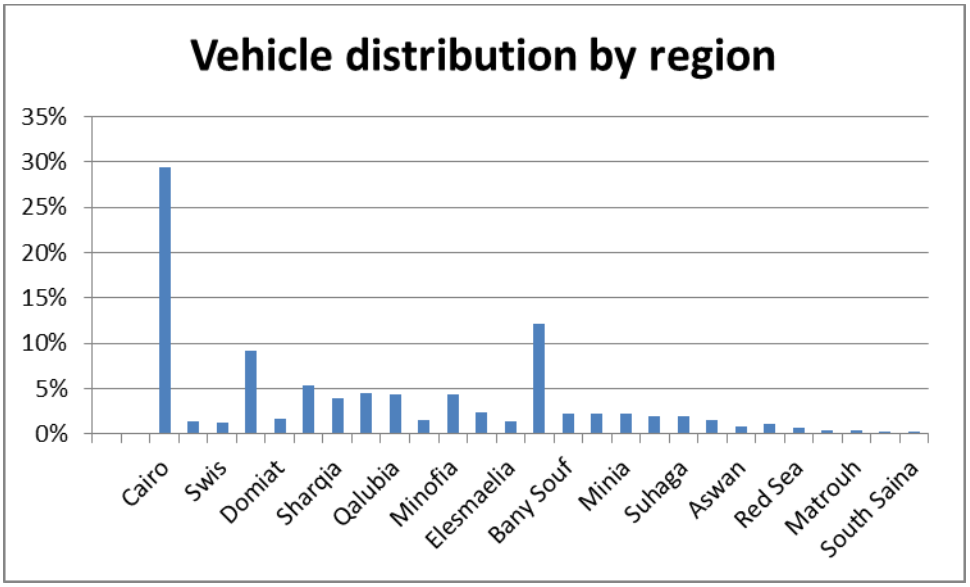
The results of the survey indicated that 77 % of the passengers vehicles and goods vehicles were used inside the locality and 23 % outside of the locality, therefore most of the trips are inside the cities. This is due to the concentration of Egyptian population in the urban areas and consequently the vehicles distribution is in the cities, in particular Cairo has around 30 % of the vehicle fleet, as described in figure 6.3 below.

Figure 6.2. Egypt's share of vehicle usages inside and outside of the cities



In this context, transport policies should focus on metropolitan transport policies supporting modal shift from individual to more collective transport modes. This can be done by encouraging the use of public transport modes through the continuous improvements of this sector (buses, microbuses and subway) in terms of services, infrastructure and organization.

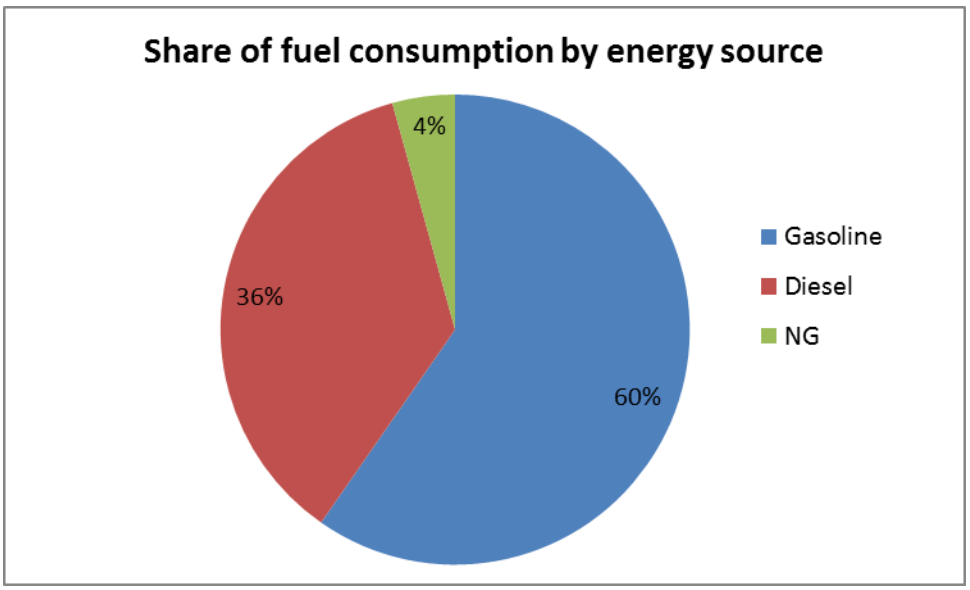
Figure 6.3. Egypt's vehicle distribution by region



6.1.3.1 Energy Consumption Indicators

The Egyptian yearly gasoline consumption is 5.9 million tons, followed by diesel with 3.7 million tons and natural gas with 498 million cubic meters. Therefore, gasoline is the main source of energy for fuel consumption in the Egyptian transport road transport sector at 60 % of the total fuel consumption, followed by diesel at 36 % and natural gas (NG) at 4 %.

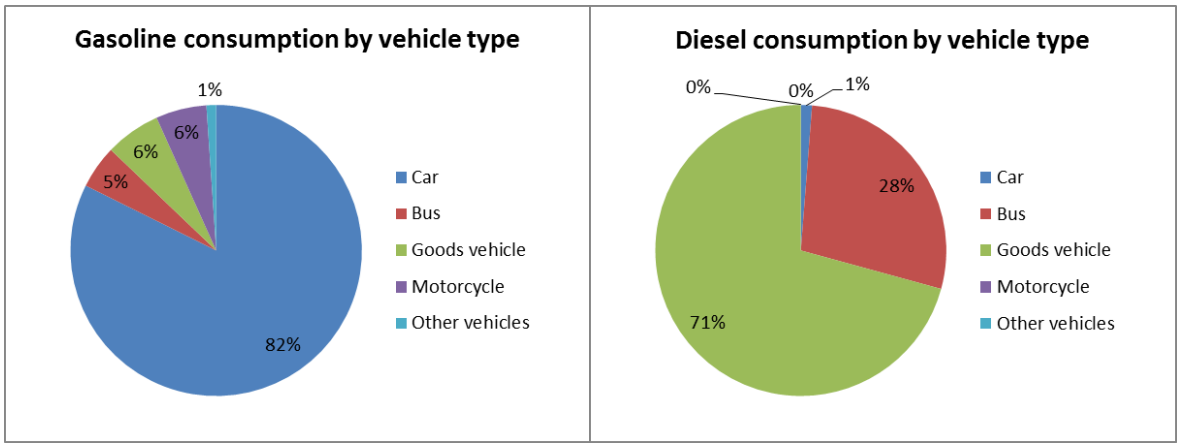
Figure 6.4. Egypt's share of fuel consumption by energy source



Gasoline consumption by type of vehicle and diesel consumption by type of vehicle are represented by Figure 6.5. Passenger cars (private and taxi) consume around 82 % of the gasoline followed by a

relatively small proportion of gasoline consumption for buses, goods vehicle and motorcycles. On the other hand, 99% of the diesel consumption is distributed between goods vehicles 71 % and buses 28 %.

Figure 6.5. Egypt gasoline and diesel share of consumption by vehicle type



Also, the Egyptian road transport mode consumes natural gas mainly for cars. Natural gas consumption is distributed between 75 % for taxis and 25 % for private cars.

6.1.3.2 Energy Efficiency Indicators

The results of this survey indicated that the average number of kilometers per liter of gasoline travelled in Egypt by the passenger vehicles reached 9 km/liter, 6.6 km/liter for microbuses, 10.8 km/liter for motorcycles, and 6.9 km/liter for goods vehicles. And the average number of kilometers per liter of diesel travelled in Egypt by the passengers vehicles reached 7.7 km/liter, 6.5 km/liter for microbuses, 4.9 km/liter for buses and 5.8 km/liter for goods vehicles.

Furthermore, the survey specified the average fuel consumption by the size of the vehicle and the type of fuel. Thus, for the case of passenger vehicles, the average consumption:

- For a 4 passengers vehicle is 10 liter of gasoline/100 km,
- For a 7 passengers vehicle is 11.4 liter of gasoline/100 km,
- For a 28 passengers vehicle (small bus) is 18.4 liter of diesel/100 km,
- For a 50 passengers vehicle (big bus) is 29.8 liter of diesel/100 km.

And for the case of goods vehicles, the average consumption:

- For 1.5 tons vehicle is 14.7 liter of diesel/100 km,
- For 4 tons vehicle is 18 liter of diesel/100 km,
- For 8 tons vehicle is 24.9 liter of diesel/100 km,
- For 15 tons vehicle is 34.8 liter of diesel/100 km,
- For 20 - 25 tons vehicle is 44.7 liter of diesel/100 km,

6.1.3.3 Transport and Economy Indicators

In this paragraph, transport economic indicators are presented. The motorization rate in Egypt was found to be equal to 0.08 vehicles per inhabitant. The survey presented the maintenance costs by type of vehicle and by type of fuel.

Figure 6.6. Egypt's maintenance cost by vehicle type and by fuel type

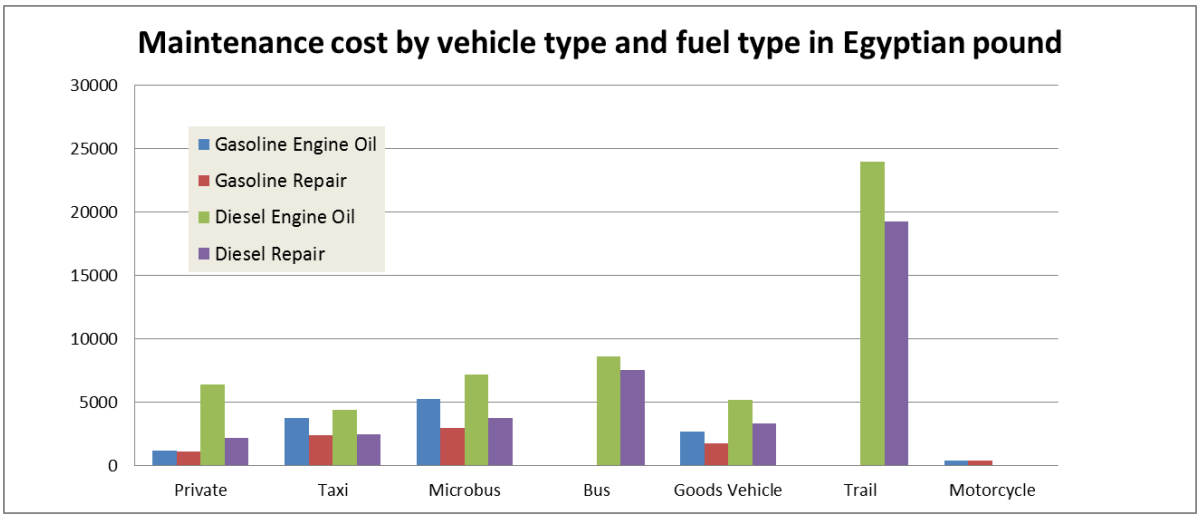


Figure 6.6 shows that the cost of maintenance is related to the size of the vehicle. Also, the diesel vehicles maintenance costs, in particular oil change cost, are higher than the maintenance costs of gasoline vehicles.

6.1.3.4 Transport and Environment Indicators

The total CO_2 emissions from the road transport sector in Egypt are estimated to 30,680 kt CO_2 leading to a ratio of 357.8 kgCO_2 per capita (based on the Egyptian population of 85,746,621 in December 1, 2014). The distribution of these CO_2 emissions is 59.97 % from gasoline vehicles, 36.83 % from diesel vehicles and 3.19 % from natural gas vehicle.

6.1.3.5 Additional Recommendations

In addition to the recommendations stated in the previous sections of this report, it is suggested to accelerate the implementation at national level of the smart cards system mentioned earlier in this report. This measure should be targeting registered vehicles first.

The implementation of the smart cards system at national level is expected to provide the data required to assess the real fuel consumption of the country's road transport sector. This will help in estimating the fuel subsidy paid by the government for the road transport sector.

With regards to passenger private cars, whose gasoline consumption represents around 70 % of the total annual gasoline consumption which is equivalent to 4.3 tons, it is proposed to define a fuel subsidy equivalent. This could be done for example for the equivalent gasoline consumption corresponding to the average distance travelled daily by a passenger car in low income households, then the excess demand would be paid at full rate. For example if this corresponds to 50 km travelled daily, this would make 5.5 liters per day and then the excess demand would be paid at full rate. This would ensure that savings are made by the government and that help goes to the more needy households.

Some of the savings on fuel subsidies could be used to support investments for improving the transport sector infrastructure (roads, bridges, public transport…) or to fund measures which have been identified

to encourage modal shift from individual to more collective transport modes especially in metropolitan areas.

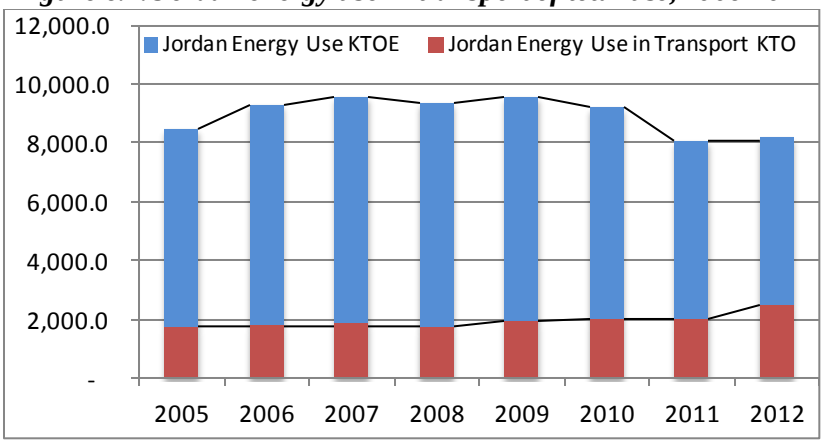
With regards to buses and goods vehicles, it is suggested for the current fuel subsidy to remain. This is to avoid the increase in public transport prices and keep the transportation of goods unaffected in order to preserve the stability of various economic sectors.

6.2 Hashemite Kingdom of Jordan Transport Sector

6.2.1 Jordan Current Status

The total end use of energy amounted to 5,095 ktoe as reported by the Department of Statistics (DOS) in the balance for Jordan in 2014 [36]. The energy use in the transport sector represented about 46 per cent of total energy end use. In 2012, the energy consumed in transport augmented by 25 per cent compared to 4 per cent annual growth rate from 2006 to 2011 (Fig. 6.7). Energy products consumed by the transport sector in Jordan comprise Gasoline, Fuel oil, Diesel, Jet fuel.

Figure 6.7. Jordan energy use in transport of total use, 2006-2012



Jordan heavily relies on imports of crude oil, oil products, and natural gas to meet its domestic demand. The energy imports bill accounts for more than 40 per cent of Jordan's public expenditures. Furthermore, the EIA indicated that in 2012, transportation activities alone are responsible for about 40 per cent of the total final energy consumption, with private passenger vehicles taking a share of about 60 per cent of the transport sector consumption in 2012.

Despite the unavailability of detailed data, the Ministry of Energy and Mineral Resources has launched a strategy in 2007 that recommended the creation of a binding mechanism to apply programs and projects to rationalize energy consumption in the diverse sectors of the economy, among which is the transport sector. It was also linked to the national strategy of the transport sector in terms of rationalizing the energy consumption. It also encourages adopting mechanisms to encourage the general public to use public rather than private cars [52]. In addition to this, the National Climate Change Policy of the Hashemite Kingdom of Jordan 2013-2020 [37] has set strategies and objectives for the development and adoption of energy efficient and low carbon transportation modes.

6.2.1.1 Department of Statistics (DOS)

DOS is commissioned in Jordan, by law, to collect, classify, compile, analyze, and disseminate official statistical data. In addition to this, it is in charge of coordinating and organizing statistical activities with various governmental organizations.

It was established in 1949. In recent years, DOS has focused its efforts on enhancing its statistical capacity, in both physical infrastructures and human capital. DOS has accumulated a wealth of statistical data, including long and diversified time series data.

DOS collects a vast amount of data from the administrative records of the various governmental and other institutions. Such statistical data are disseminated officially by DOS through the "Statistical Yearbook" which is annually issued. The latest issue was in 2014.

DOS regularly conducts many decennial censuses including Housing and Population Census, Agriculture Census, Industrial Establishments Census. The purpose of these censuses is to: (a) provide detailed data on all members of the census population, whether such member is a household, economic establishment, agricultural holding, building, or dwelling; (b) produce comprehensive data sets at the smallest possible geographic level; and (c) build a comprehensive framework to be used for sample design and drawing of samples for the various field surveys on various economic topics and activities.

In addition to using administrative records, DOS conducts a number of field surveys. However, none of those surveys is totally dedicated to gathering data on energy use and in particular, energy use by the transport sector. Energy used as inputs into the production process is collected by sector through the "Economic Survey". The Economic Surveys are conducted quarterly and annually and cover the economic sectors such as industry and mining, internal trade, finance and banking, transportation and telecommunications, services, and construction. The primary objectives of the surveys are to collect reliable and timely statistical sets on contribution to GDP, workers compensation and amount of invested capital and capital formation. A secondary objective includes measuring intermediate consumption of energy resources.

The Household Expenditure Surveys is conducted on an annual basis and aims at measuring household expenditures including expenditures on energy consumption in each household. Energy consumed as for the private transportation is not measured. The latest survey was conducted in 2014 [38].

Environmental Statistics Survey data is collected from administrative records and by a survey conducted by DOS. The objectives of the survey are to: (a) provide data on the environment pollutants by type and source; (b) collect data on the available natural resources including energy resources and utilization/ consumption rates; and (c) provide data on the impacts of national policies implemented to protect the environment [36].

6.2.1.2 Ministry of Transportation (MOT)

Another important source of administrative records relating to activities in the transportation sector in Jordan is provided by the Ministry of Transportation [39]. MOT statistical data covers several topics of interest including Jordanian airports traffic, number of vehicles operating in Jordan, number of vehicles registered, numbers of licensed private use transport, number of trucks entering and departing according to customs centers, passengers and freight transport movement by railway and roads network per governorate. The coverage period extends from 2010 to 2013.

6.2.1.3 Ministry of Energy and Mineral Resources (MEMR)

An important source for statistical data and the main governmental body responsible for policy decision making and the implementation of the energy directions is the Ministry of Energy and Minerals Resources. In recent years, MEMR carried out three important surveys. These surveys covered: (1) residential sector fuel consumption; (2) transport sector fuel consumption; and (3) industrial sector energy use.

The Transport Sector Fuel Consumption Survey was conducted in 2012 and covers all modes of transportation activities including air, rail, maritime and road transportation in detail [41]. The objectives of the study were to: (1) obtain realistic and up-to-date statistical data on the fuel consumption in the transport sector; (2) gain a better understanding of the economic and technical factors that influence decisions regarding consumption of energy in the road mode; (3) establish a database for the transport sector to use as a base for forecasting future fuel demand by the various modes of the sector; and (4) provide policy makers with vital statistical data needed to ration fuel consumption and improve fuel efficiency in the transport sector.

Its main focus was on the details of the fleet of vehicles operating on Jordanian roads, their age, model, make, use and of course, their fuel consumption and efficiency. It also provided detailed characteristics of the drivers and all other costs associated with owning and operating a vehicle such as maintenance, modifications, registration and insurance. Furthermore, it also covers the entire geographical area of Jordan with major cities and urban centers proportionately represented in the sampling frame. The study was divided into two phases. First phase relied heavily on administrative records and it covered the air, rail, and maritime modes of transportation. Meanwhile the second phase utilized field surveys to investigate fuel consumption for the road mode of transportation. The questionnaire was designed in partnership with experts from regional organizations.

The sampling method used was based on stratified random sampling- one stage where the target population was all vehicles utilizing Jordanian roads. The strata were based on proportional allocation with respect to the size of each urban center or municipality. The sample size amounted to 10,305 vehicles broken down into 6,569 private vehicles of all types, 1,113 buses of all types and 2,633 vehicles for the public sector and ministries use.

Although DOS is the sole institution mandated to conduct surveys, no survey has been implemented with the main intention to collect statistics on energy consumption. But since MEMR has conducted the first energy consumption survey in Jordan in the transport sector, this is considered as a huge step in the right direction to build statistics-based national energy policies. The valuable results and expertise gained through the first survey serve as a benchmark for a more detailed information focused survey.

6.2.2 Methodology of the Energy Consumption Survey

DOS is the official government institution in Jordan to conduct the national survey on energy consumption for the entire transport sector, namely, road transport, maritime, air and railways transport. All questionnaires abide by the confidentiality of sharing information under the national statistics law and respondents were informed about this before starting to answer any question.

6.2.2.1 Road transport sector

Road transportation sector includes all engine-based vehicles and trailers designed for transportation of freight and passengers.

Target population: all registered vehicles in Jordan owned by individuals and enterprises.

Sampling frame: the list of all registered vehicles owned by individuals, which contains the auxiliary variables: governorate, and vehicle type. The sampling frame does not contain personal information that enables direct contact with the owner or driver of the vehicles. The population frequencies of vehicle type and governorate are presented in Table 6.9.

Sampling design: stratified quota sampling method.

Sample size: the total sample size amounted to 10,400 vehicles, with about 7,400 vehicles selected from private and public vehicles and around 3,000 vehicles selected from government, judicial council and Aqaba Authority vehicles.

The sample size is allocated for each governorate for each vehicle type using proportional allocation approach (table 6.10).

The following vehicles are excluded from the sample:

1. Governmental vehicles which amount to 16,847.
2. Judicial council vehicles which amount to 8.
3. Aqaba Authority vehicles which amount to 372.

The above exceptions were made based on the following criteria:

1. Government vehicles sampling will amount to 20 per cent of all government vehicles, which is somehow higher than the sampling for the entire road sector.
2. Judicial council vehicles were excluded due to full enumeration.
3. Aqaba Authority vehicles were excluded due to full enumeration.

The data was collected from licensing centers in all governorates of the Kingdom; and in the absence of vehicles to cover all categories, data was collected from the vehicles parking stations.

Table 6.9 Population Distribution of Number of Vehicles by Type and Governorate in Jordan, 2014

Vehicle Type*	Governorate												Total
	Capital	Blqa	Zarqa	Madaba	Irbid	Mafraq	Jeresh	Ajlon	Qaraq	Tafila	Maan	Aqaba	
Small Private-Passengers	790,256	16,099	15,196	5,615	75,020	6,121	5,876	2,064	5,350	1,329	1,921	3,869	928,716
Small Public - Passengers	17,437	907	1,472	363	2,436	321	132	76	117	107	228	614	24,210
Intermediate Private - Passengers	8,807	1,230	568	205	848	115	267	72	201	67	57	195	12,632
Intermediate Public - Passengers	1,612	440	553	149	1,046	280	129	57	380	109	104	73	4,932
Private Bus	680	31	38	6	70	6	22	0	28	6	2	42	931
Public Bus	2,211	39	161	3	128	75	46	15	34	27	21	12	2,772
Freight	91,504	6,179	5,264	6,461	11,538	7,634	3,175	469	2,422	888	4,756	1,172	141,462
Big shipping	35,671	97	242	353	6,571	926	40	4	522	136	656	680	45,898
Joint transfer	91,443	2,887	2,668	1,610	10,081	4,652	1,734	891	1,390	449	1,279	882	119,966
Motorcycles	6,585	14	25	10	84	26	32	2	11		6	103	6,898
Construction vehicles	9,443	370	388	76	767	140	129	73	296	114	265	348	12,409
Agricultural vehicles	3,814	857	133	588	2,925	618	348	116	638	88	207	102	10,434
Total	1,059,463	29,150	26,708	15,439	111,514	20,914	11,930	3,839	11,389	3,320	9,502	8,092	1,303,168

* The vehicles type in Jordan is divided as follows:

a- Passenger cars include small and intermediate cars that can be used as private vehicles or for public transport (taxis). These include the above nomenclature: small private- passengers, small public- passengers, intermediate private- passengers and intermediate public- passengers.

b- Buses include two categories: public and private buses.

c- Freight transport includes freight and big shipping.

d- Joint transfer refers to the vehicles with double usages purposes, i.e. passengers and freight simultaneously.

e- Construction vehicles are those whose sole purpose is to be used in construction area for transport of personnel or for transport of construction goods.

f- Agricultural vehicles are those whose sole purpose is used in transporting goods or serving as equipment for agricultural purposes.

Table 6.10. Sample Distribution of Number of Vehicles by Vehicle Type and Governorate in Jordan, 2014

Vehicle Type	Governorate												Total
	Capital	Blqa	Zarqa	Madaba	Irbid	Mafraq	Jeresh	Ajlon	Qaraq	Tafila	Maan	Aqaba	
Small Private-Passengers	900	400	400	300	500	300	300	180	300	150	150	150	4,030
Small Public - Passengers	200	50	60	30	80	30	20	15	20	20	30	60	615
Intermediate Private - Passengers	110	50	30	15	60	7	20	10	20	10	6	15	353
Intermediate Public - Passengers	20	40	50	15	20	20	10	10	40	20	20	7	272
Private Bus	70	3	3	3	3	3	3	0	3	3	2	4	100
Public Bus	50	3	10	3	3	4	4	5	3	5	3	3	96
Freight	100	50	50	50	50	50	30	20	30	20	50	25	525
Big shipping	50	10	15	20	100	50	3	4	25	10	25	25	337
Joint transfer	100	50	50	25	50	50	25	25	25	20	25	30	475
Motorcycle	65	3	3	3	3	3	3	2	3	0	3	10	101
Construction vehicle	95	15	20	5	10	10	10	10	10	10	20	35	250
Agricultural vehicle	40	20	6	20	40	20	20	15	20	10	20	10	241
Total	1,800	694	697	489	919	547	448	296	499	278	354	374	7,395

The Jordanian road transport questionnaire is divided into three main categories: the general information section that includes contact information of respondents, geographical details and gender while the second category included technical information about the vehicle, i.e. registration plate number, type of vehicle (passenger and/ or freight), engine size, fuel consumption types, and type of maintenance. The third category tackled the energy efficiency of the vehicle, based on the monthly consumption of fuel, distance travelled, and percentage of vehicle usage within and outside of the city, and impact of maintenance on the fuel efficiency of the vehicle.

6.2.2.2 Maritime transport sector

Companies in the maritime transport sector, which account to 10, are fully enumerated based on administrative registers. The full enumeration of this transport sub-sector is related to the limited number of companies, which facilitates the analysis and publishing of more precise results on the total consumption of fuel in this sub-sector, and annuls the error due to sampling. DOS has collected information from the registries of these companies, pertaining to the type and amounts of energy consumed by the companies.

6.2.2.3 Railway transport sector

The railway transport sector in Jordan includes two enterprises, which are fully enumerated based in administrative registers. The full enumeration of this transport sub-sector is related to the limited number of enterprises, which facilitates the analysis and publishing of more precise results on the total consumption of fuel in this sub-sector, and annuls the error due to sampling. DOS has collected information from the registries of these companies, pertaining to the type and amounts of energy consumed by the enterprises.

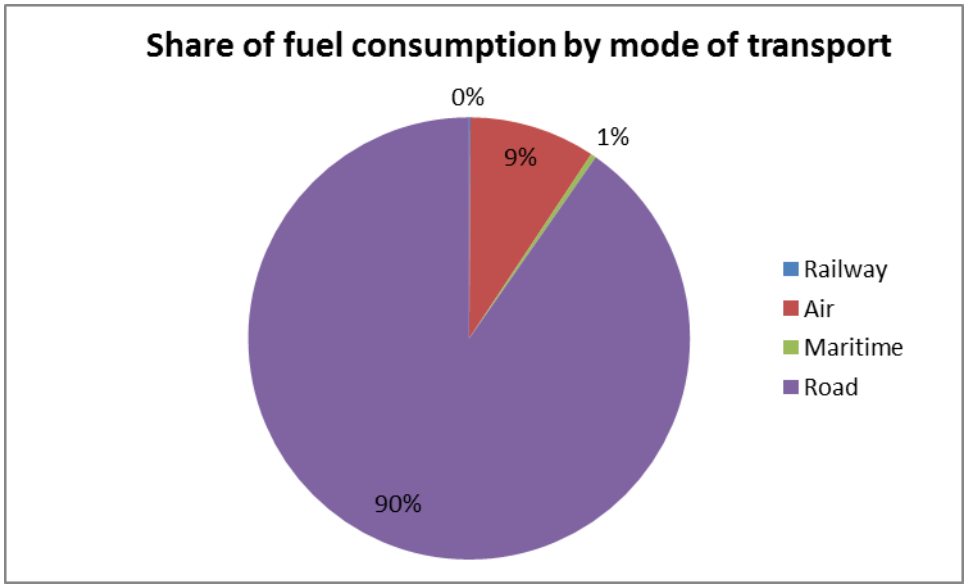
6.2.2.4 Air transport sector

The entire air transport sector amounts to 10 companies in Jordan. All the companies are enumerated in this survey based on administrative registers. The full enumeration of this transport sub-sector is related to the limited number of companies, which facilitates the analysis and publishing of more precise results on the total consumption of fuel in this sub-sector, and annuls the error due to sampling. DOS has collected information from the registries of these companies, pertaining to the type and amounts of energy consumed by the companies.

6.2.3 Results of the Energy Consumption Survey

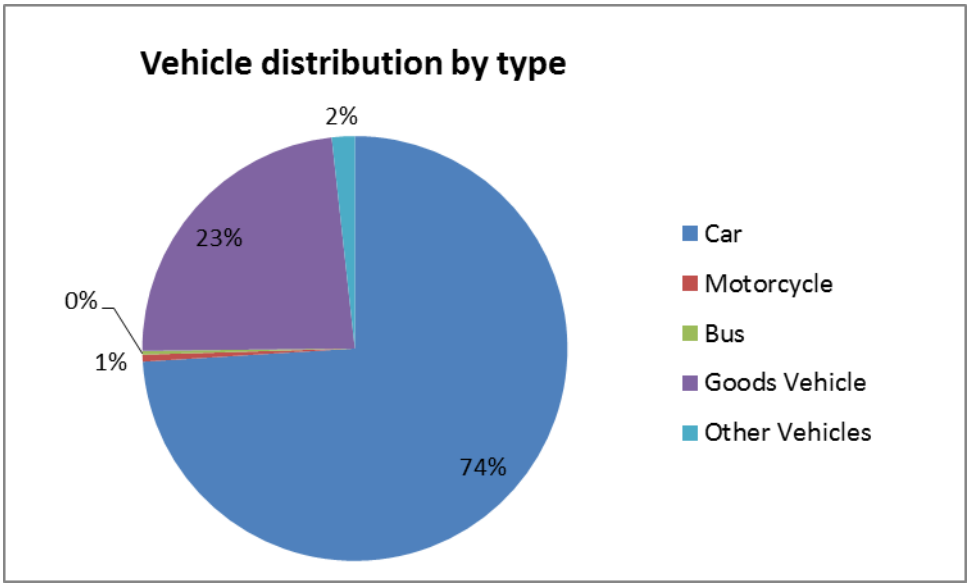
Most of the fuel consumption in the Jordanian transport sector is for the road transport mode with a share of 90 % as shown in the figure 6.8.

Figure 6.8. Jordan's share of fuel consumption by mode of transport



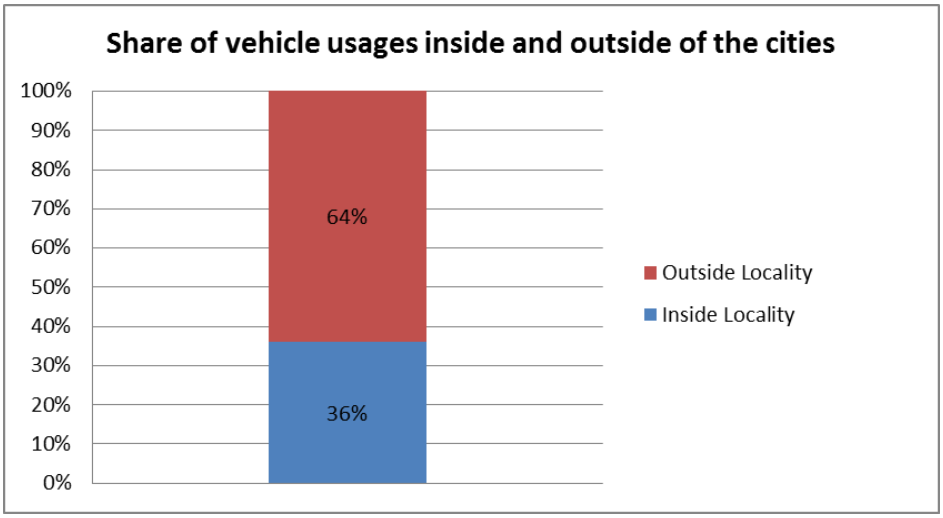
74 % of motor vehicles in Jordan are cars, while less than 1 % are buses as shown in figure 6.9. Policies to encourage modal shift from individual transport modes to more collective transport modes should therefore be considered by the Jordanian Government. This will indirectly improve energy consumption for passengers transport in the road transport mode.

Figure 6.9. Jordan's vehicle distribution by type



The results of the survey indicated that 36 % of the passenger vehicles and goods vehicles were used inside the locality and 64 % outside of the locality. This is a result of intercity trips, and according to Figure 6.12 below, most of these trips are carried out by passenger vehicles. Consequently, transport policies encouraging modal shift for the transport of passengers from the road transport mode to the railway transport mode should be considered by the Jordanian government. Also 23 % of motor vehicles in Palestine transport goods. The Palestinian Government should consider establishing voluntary agreements with freight transport companies to renew their fleets. This is expected to improve the goods vehicles energy efficiency.

Figure 6.10. Jordan's share of vehicle usages inside and outside of the cities



Also, it is important to mention that more than 80 % of the Jordanian fleet is concentrated in the capital Amman as described in Figure 6.11 below. This is mainly due to the population concentration in the Jordanian capital. In this context, long term policies could be proposed such as decentralization for all economic sectors leading to a more geographically distributed population.

Figure 6.11. Jordan's vehicle distribution by region

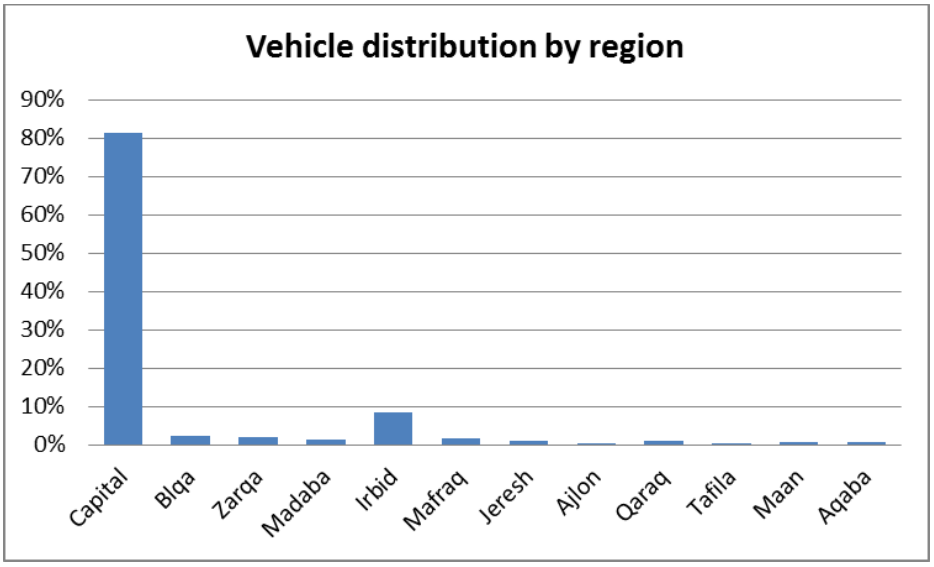
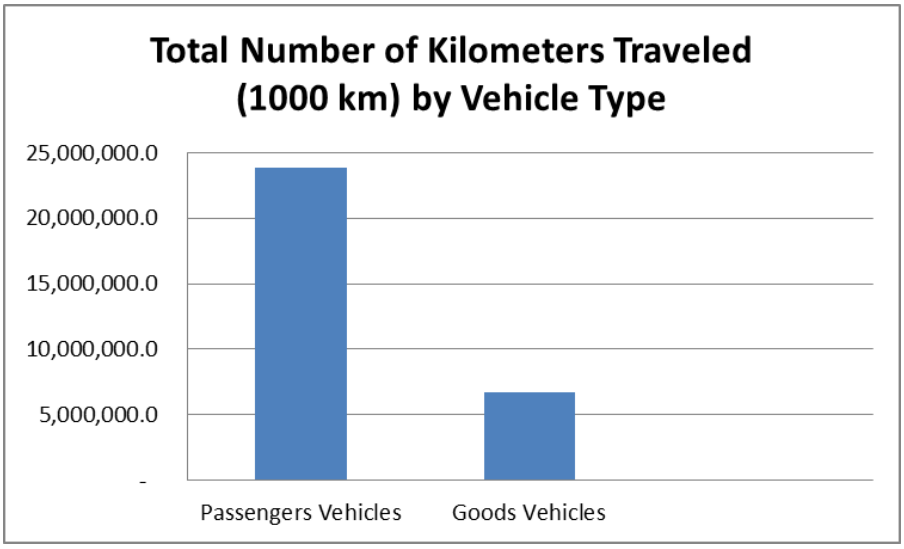


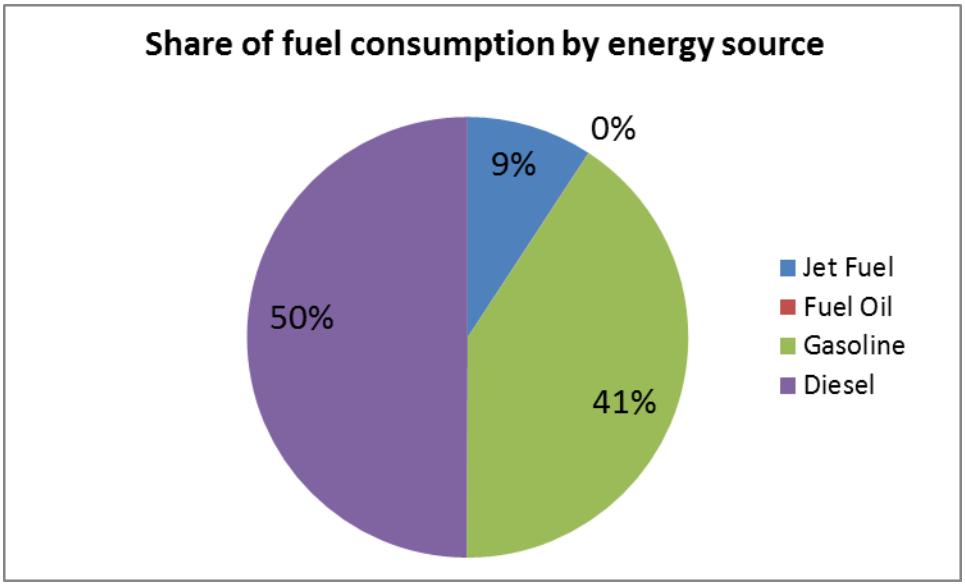
Figure 6.12. Jordan's total number of kilometers traveled (1000 km) by vehicle type



6.2.3.1 Energy Consumption Indicators

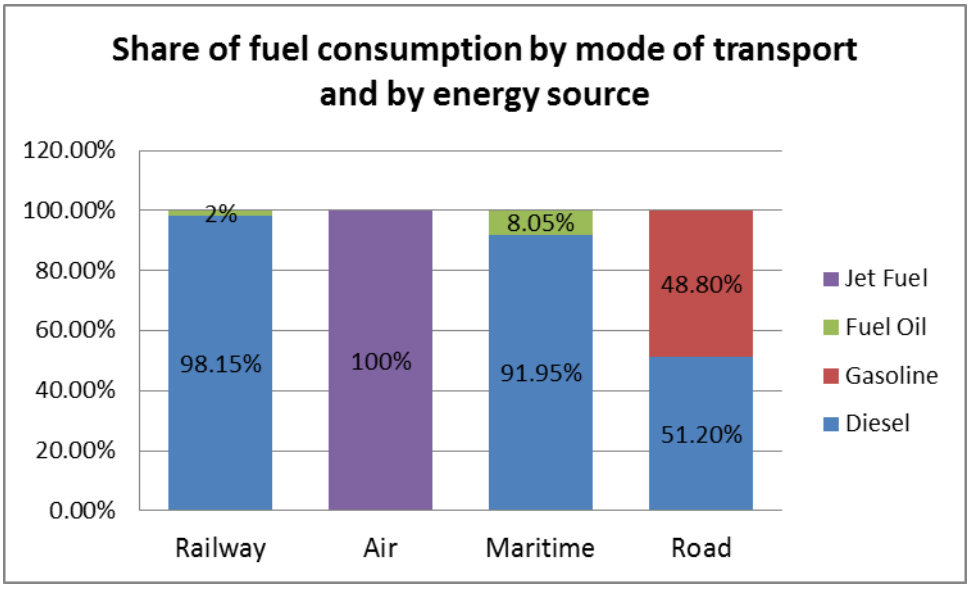
Diesel is the main source of energy for fuel consumption in the Jordanian transport sector where it has a proportion of 50 %, followed by gasoline with a proportion of 41 % and jet fuel with 9 %.

Figure 6.13. Jordan's share of fuel consumption by energy source



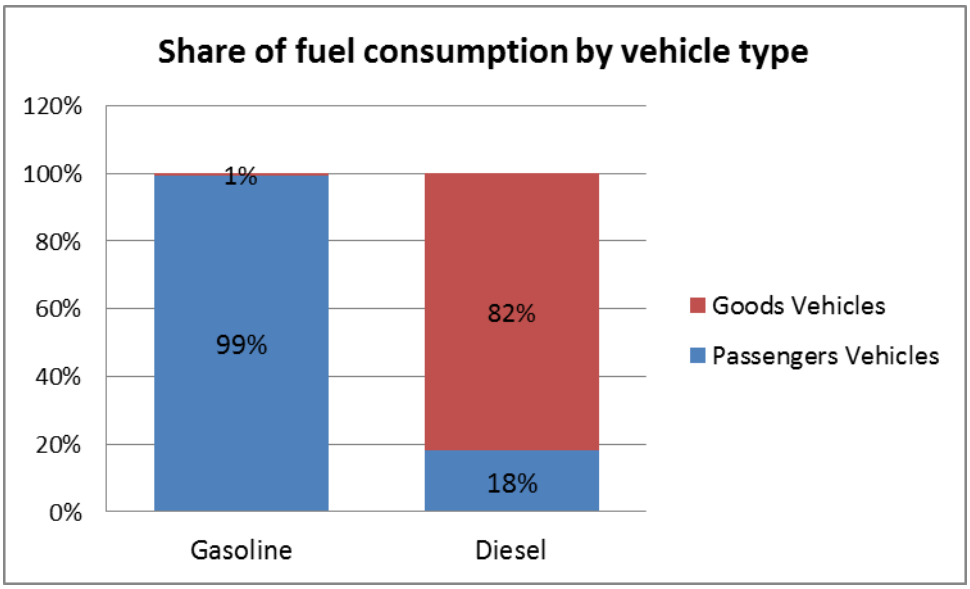
Figures 6.13 and 6.14 represent Jordan's share of fuel consumption by mode of transport and by energy source. Fuel oil is used in railway and maritime transport modes in a limited proportion compared to diesel, while all the jet fuel is consumed in the air transport mode.

Figure 6.14. Jordan's share of fuel consumption by mode of transport and by energy source



Also, in Jordan 99 % of gasoline is consumed as fuel in passenger vehicles. Diesel fuel usage is distributed between goods vehicles 82 % and 18 % for passenger vehicles.

Figure 6.15. Jordan's share of fuel consumption by vehicle type



6.2.3.2 Energy Efficiency Indicators

The results of this survey indicated that the average number of kilometers travelled in Jordan by passenger vehicles reached 10.3 km per liter of gasoline, and between 2.6 and 6.8 km per liter of diesel for the goods vehicles, and 25.2 km per liter of gasoline for the motorcycles. The average fuel consumption for one kilometer in Jordan is 0.13 liter/km. Also the fuel consumption in passenger vehicles is 0.46 liter/(passenger.km), and the fuel consumption in freight vehicles is 0.66 liter/(ton.km).

6.2.3.3 Transport and Economy Indicators

In this paragraph, transport economic indicators are presented. The motorization rate in Jordan was found to be equal to 0.2 vehicles per inhabitant. The total energy consumed per GDP/capita for passengers vehicles is 654 liter per Jordanian Dinar (JOD) per capita (ca), equivalent to 922 l/USD/ca. Another indicator was calculated related also to the GDP, which is the energy consumed by energy source per GDP:

- For gasoline: 89 l/1000 JOD equivalent to 63 l/1000 USD
- For diesel: 94 l/1000 JOD equivalent to 66 l/1000 USD
- For fuel oil: 0.06 l/1000 JOD equivalent to 0.04 l/1000 USD
- For jet fuel: 18.13 l/1000 JOD equivalent to 12.86 l/1000 USD

As for the value added of the transport sector, it is 1,034,953 (1000 JOD) equivalent to 1,458,249 (1000 USD); it was calculated for the following Jordanian mode of transport:

- Railway transport mode: 4442 (1000 JOD) equivalent to 6259 (1000 USD)
- Road transport mode:
  - Passengers transport: 401978 (1000 JOD) equivalent to 566387 (1000 USD)
  - Freight transport: 466432 (1000 JOD) equivalent to 657203 (1000 USD)
- Maritime transport mode: 31509 (1000 JOD) equivalent to 44396 (1000 USD)
- Air transport mode: 130592 (1000 JOD) equivalent to 184004 (1000 USD)

6.2.3.4 Transport and Environment Indicators

The total CO_2 emissions from the transport sector in Jordan are estimated 7905 kt CO_2, leading to a ratio of 1189 kgCO_2 per capita and a ratio of 1.08 g CO_2/km per kilometer.

6.3 Palestine Transport Sector

6.3.1 Palestine Current Status

Palestine does not have any proven crude oil or natural gas reserves. According to the EIA [42], the main source of energy in Palestine is imported from Israel, where 60 per cent of total energy consumed in 2012 was by the road transport sector.

On the other hand, a transport sector strategy has been developed, covering the period between 2011 and 2013, with the main purpose of enhancing the transport sector in Palestine. The strategy recommends, among other issues, conducting integrated studies to propose alternative transportation means to develop modern and environment friendly transportation means that use clean energy [54]. There has been no update for the transport strategy beyond 2013.

6.3.1.1 Palestinian Central Bureau of Statistics (PCBS)

The Palestinian Central Bureau of Statistics (PCBS) is the official governmental body in charge of collecting, compiling, analyzing and disseminating all kinds of statistical data on economic, demographic, social, financial and other variables for the Palestinian territories. The PCBS is also responsible for collecting energy consumption data by all sectors of the Palestinian economy.

PCBS publishes annual energy data in several reports: the Energy Consumption report and the Energy Balance report [44] that cover data about consumption of all types of energy (electricity, petroleum products and other types of energy) by all economic sectors. The data for this report is based on administrative records and the statistical data extracted from surveys conducted by PCBS. Such report provides essential statistical data for preparation of energy balance, necessary data for research and policy makers. In addition to the energy balance indicators that are published, data is available on the average energy prices by energy type. The reports are disaggregated by type of fuel imported, consumed (including renewable energy) and by economic sector. Many sources are used by PCBS to generate the report, of which administrative records obtained from relative institutions (e.g. General Petroleum Corporation), and other surveys implemented by PCBS (e.g. economic surveys, foreign trade statistics, price statistics). These reports are published annually and the latest report was in 2013.

In addition to the use of administrative records, several surveys are carried out by PCBS that target the energy use by the various economic sectors including the transport sector. The Household Energy Use Survey gives statistical data on electricity and other fuels consumed by households, covering all types of fuels for different activities such as cooking, baking, heating, lighting and transport / travel [45]. The survey was implemented as part of the Labor Force Survey and is implemented twice a year. The survey gives statistical data on electricity and other fuels consumed by households, covering all types of fuels for different activities such as cooking, baking, heating, lighting and transport / travel. These data are actually the household expenditure on the consumption of different fuels and the reported amounts of gasoline used mainly for transportation.

6.3.1.2 Transport Survey: Outside Establishments Sector 2013

Transport surveys have been conducted by the PCBS to gather information on the outside establishments transport sector [46]. The last issue was published in 2014; its aim is to provide reliable data on certain variables such as number of vehicles and their distributions in Palestinian territory, number of employees by economic activity, fuel consumption, and other important financial performance information.

The questionnaire adopted for the survey took into account the main economic and financial variables and the requirement to compile of National Accounts for Palestine. The survey sample was designed

as one stage stratified quota sampling with a sample of 2,285 vehicles out of 11,502 vehicles that comprise the survey frame, covering activities of the outside establishment sector for both non-scheduled passenger land transport and freight transport by road. The survey had a 95.5 % response rate.

6.3.1.3 Industrial Sector Survey

The economic surveys series were initiated by the PCBS in 1994. These surveys include industrial survey, surveys on services, internal trade, construction-contractors, and transport and storage sectors. The objective of the industrial survey is to obtain reliable data on:

1. Number of enterprises and personal engaged in industrial activities by location.
2. Value of output, intermediate consumption including energy and other inputs.
3. Value added components.
4. Payments and transfers.
5. Capital formation.
6. Contribution of the surveyed industrial activities to the GDP.

The latest survey was conducted in 2002 while data pertained to the year 2000. All data and tables for the last released survey can be accessed online [47].

The survey covers small, intermediate and larger enterprises with various activities: mining and quarrying, manufacturing and electricity, gas and water supplies. The survey sample was designed as single-stage stratified random sampling with a sample of 2,339 enterprises out of the 14,509 enterprises that comprise the survey frame. The survey had a 78.6 % response rate for West Bank and Gaza Strip.

6.3.1.4 Ministry of Transportation and Communication's Annual Statistics Report

The Ministry of Transportation and Communication's Annual Statistics Report [48] is an important administrative record source for the transport sector activities; however, it lacks information on energy consumption by the transport sector.
The report concentrates on statistical data for the main components of the transportation system, in particular the road transport that covers all types of roads and their length, including bypass roads that were built by the Israelis to serve their settlements. Also, the number of registered vehicles for various categories, age, model and make is presented. The report includes as well information for air transportation, which covers the departure and arrival of flights. The report, which was first published in the late 1960s, aims at constituting a database covering the key statistical data on the transportation activities and communications in the Palestinian Territories. The report last issue was released in 2010.

Serious challenges in the statistical data for the transport sector are faced by PCBS and the Ministry of Transportation. The biggest difficulty faced is the Israeli occupation of their lands which limits their mobility and data collecting abilities and the embargo on the Gaza strip which hinders any collection of data.

Furthermore, gasoline and diesel are subsidized and thus are sold relatively cheaper in West Bank gas stations than in Israel. This encourages vehicles from the Israeli side, especially the 1948 Palestinian Arabs, to fuel up in the West Bank. The obvious consequence of which is to raise the fuel consumption figures above what it should be. Moreover, there are an estimated 260,000 vehicles operating in the Palestinian territories, however, due to the relatively costly annual insurance fee (which exceeds 2,000 Shekels or around 500 USD), an estimated 78,000 vehicles are registered but the owners opted not to renew their license in the last decade (about 30 %).

Moreover, there are vehicles that are registered and licensed by Israeli authorities, known as the yellow license plate vehicles, but owned and operated by Palestinians. These are mainly operating in the city of East Jerusalem. The PCBS staff estimates the number of these vehicles to be about 80,000. PCBS claims that it has no information on these vehicles; only the Israeli traffic department has the information.

Although PCBS thrives to provide reliable statistical data on all aspects of the economy, the published statistical data on transport activities' energy consumption is still lacking a great deal of information. In particular, it lacks information about the makeup of the fleet of vehicles operating in the Palestinian lands, their fuel efficiency, their use and the characteristics of the drivers.

6.3.2 Methodology of the Energy Consumption Survey

The Palestinian Central Bureau of Statistics (PCBS) is the official institution to conduct the national survey on energy consumption for the road transport sector in Palestine. Road transportation sector includes all engine-based vehicles and trailers designed for transportation of goods and passengers. All questionnaires abide by the confidentiality of sharing information under the national statistics law and respondents were informed about this before starting to answer any question.

Target population: all registered vehicles in Palestine in the year 2014.

Sampling frame: frequency distribution of all registered vehicles in Palestine in the year 2014, distributed according to governorate and types of vehicles, obtained from the Ministry of Transportation.

Sample size: the sample size is 6,974 vehicles.

Sampling design: stratified quota sampling divided through two stages. The first stage enumerates all motor vehicle inspection centers in Palestine, while the second stage consists of sample selection of vehicles distributed across governorates, vehicles' types, models, type of engine, and engine capacity. Several strata were conceived during the design phase of the survey to respond to specific criteria for vehicles and to be able to sample all types of operating vehicles in Palestine. The selected strata were Governorates, types of vehicles, types of fuel consumed, vehicles manufacturing year, and engine size.

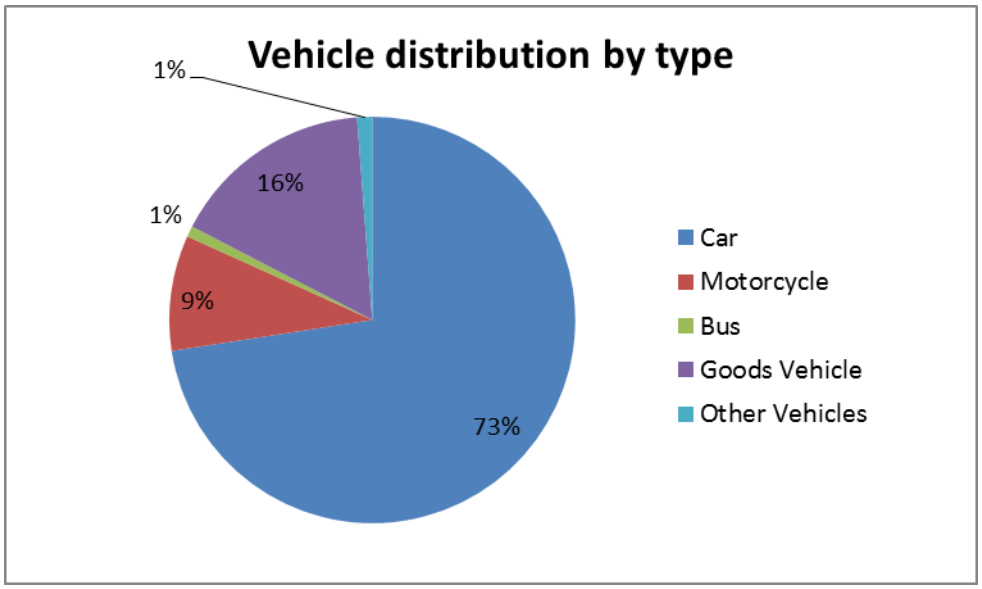
The survey was implemented in motor vehicles inspection centers across Palestine. However, in the absence of vehicles to cover all categories, data was collected from the parking vehicles and gas stations. The survey included the West Bank and Gaza strip.

The questionnaire design was divided through three main categories. The first category collects contact information of the driver, including the registration plate number of the vehicle. The second category tackled information related to the type of the vehicle, manufacturing year, maximum load capacity, engine size and maintenance activities. The third category included questions related to the type of fuel consumed by the vehicle, energy efficiency indicators, monthly cost of fuel and cost of the annual maintenance activities and insurance policies.

6.3.3 Results of the Energy Consumption Survey

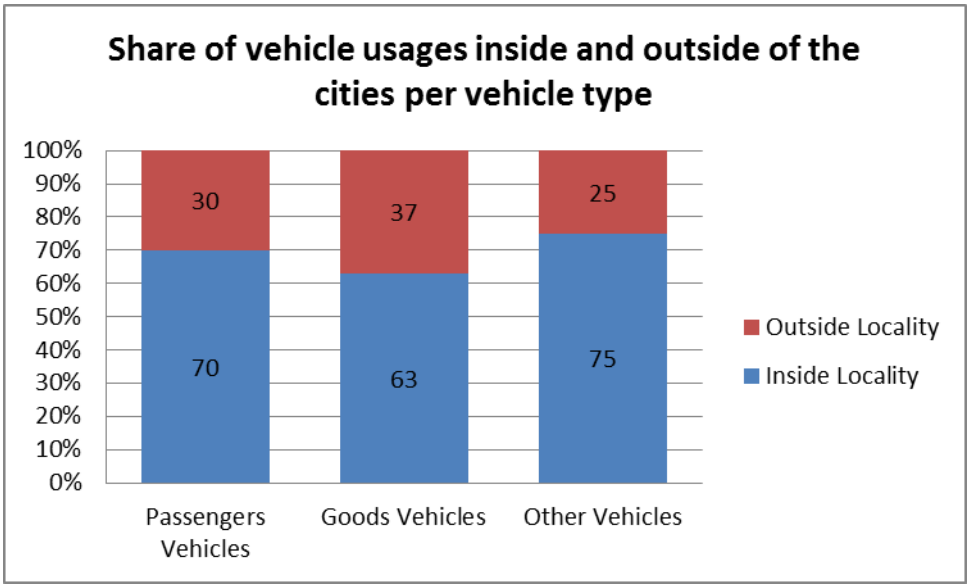
73 % of motor vehicles in Palestine are cars, 9 % are motorcycles and 1 % are buses as shown in figure 6.16. Policies to encourage modal shift from individual transport modes to more collective transport modes should therefore be considered by the Palestinian Government. This will indirectly improve energy consumption for passengers transport in the road transport mode.

Figure 6.16. Palestine's vehicle distribution by type



16 % of motor vehicles in Palestine transport goods. The Palestinian Government should consider establishing voluntary agreements freight transport companies to renew their fleets. This is expected to improve the goods vehicles energy efficiency.

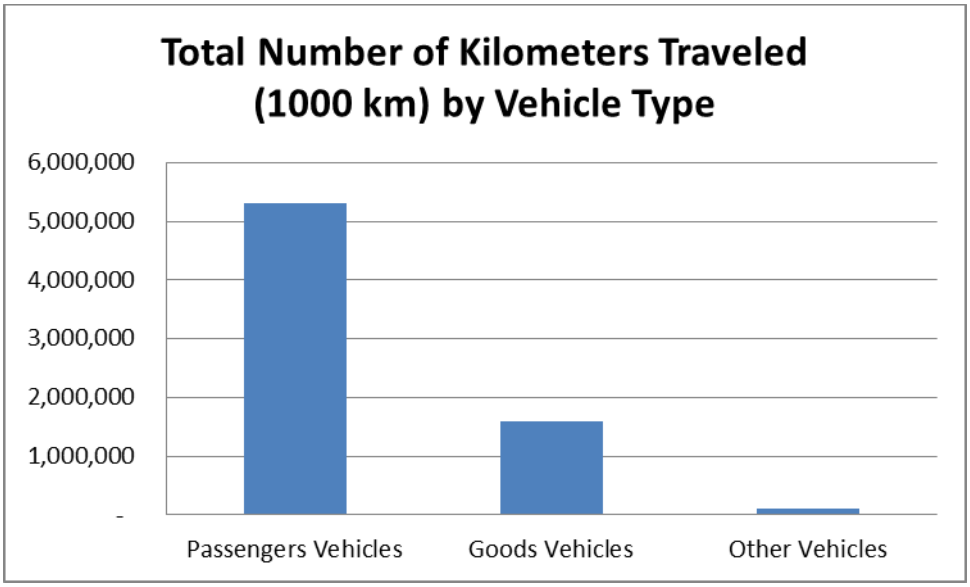
Figure 6.17. Palestine's share of vehicle usages inside and outside of the cities per vehicle type



The results of the survey indicated that 70 % of the passenger vehicles were used inside the locality and 30% outside of the locality. The results also showed that 63 % of the goods vehicles were used inside the locality and that 37 % were used outside of the locality. They also indicated that 75 % of

the other vehicles were used inside the locality and that 25 % were used outside of the locality. Most of the trips are short and carried out by passenger vehicles as shown in figure 6.18 below. Therefore most passenger vehicle trips could most probably be done through the use of either public transport or other transport modes such as walking or cycling. It is therefore suggested that policies encouraging modal shift to more energy efficient modes are considered by the Palestinian government.

Figure 6.18. Palestine's total number of kilometers traveled (1000 km) by vehicle type



6.3.3.1 Energy Consumption Indicators

70 % of motor vehicles in Palestine use diesel whereas 30 % use gasoline.

Figure 6.19. Palestine's share of fuel consumption by energy source

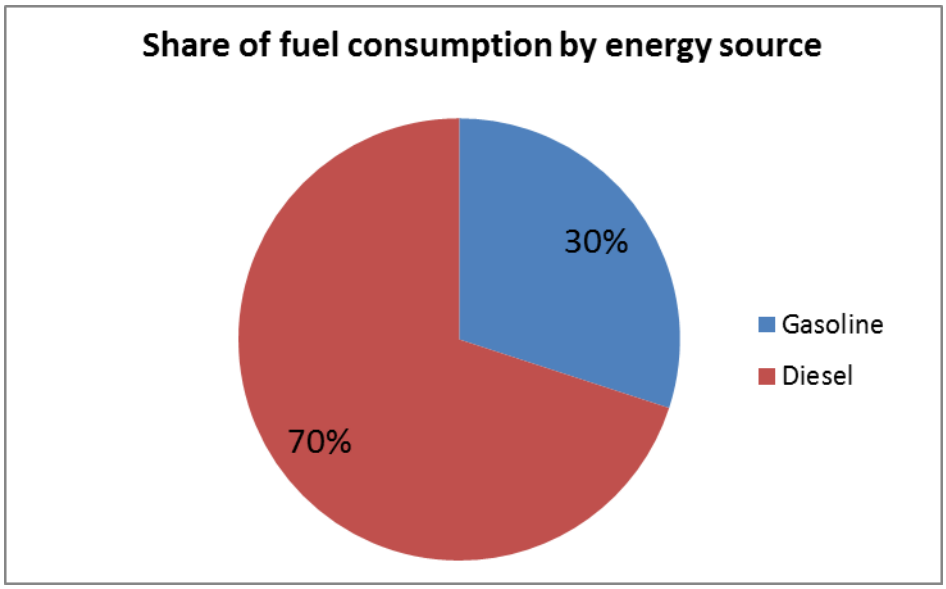
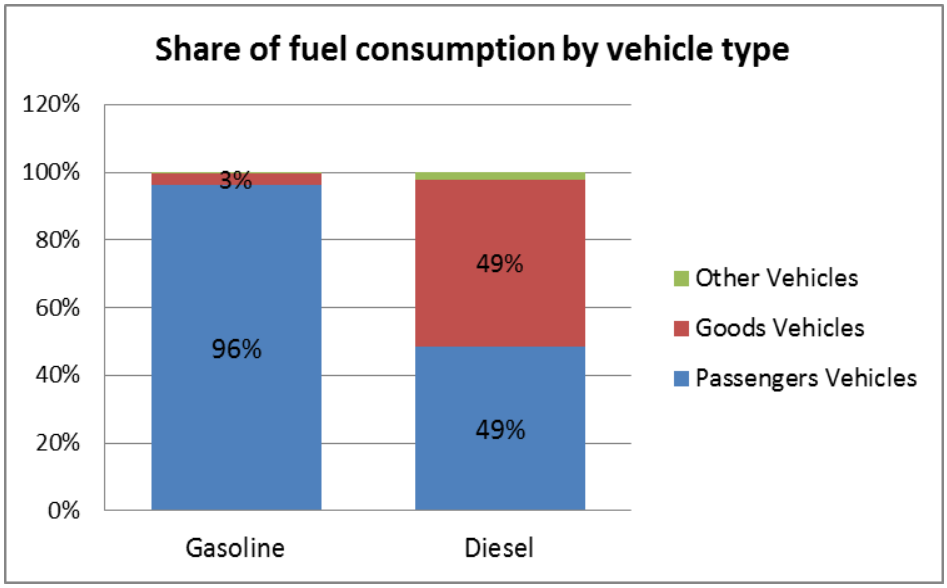


Figure 6.20. Palestine's share of fuel consumption by vehicle type

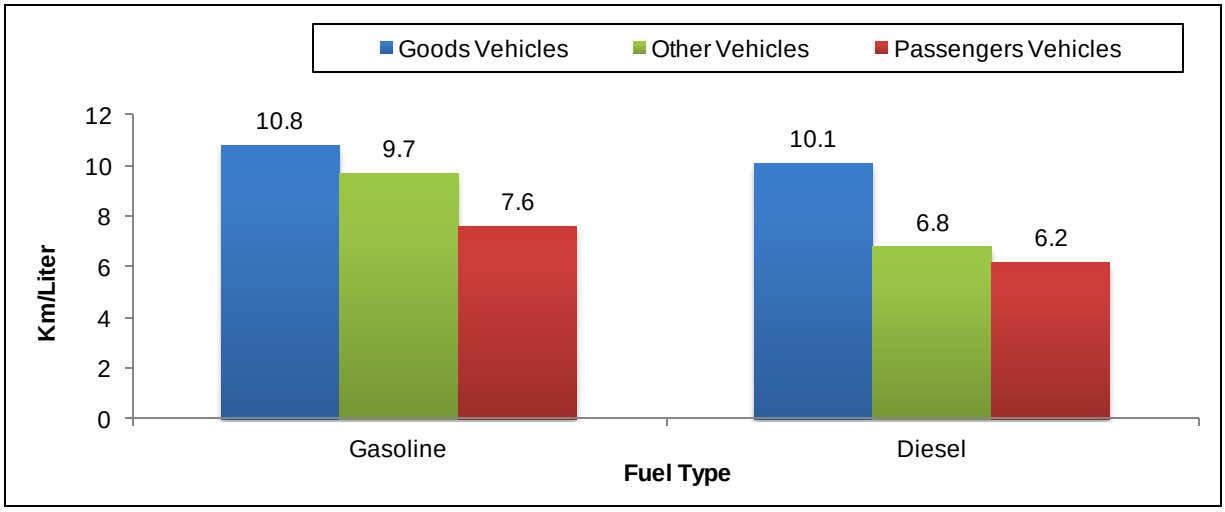


96 % of gasoline is consumed by passenger vehicles whilst diesel consumption is split between goods vehicles at 49 % and passenger vehicles at 49 %.

6.3.3.2 Energy Efficiency Indicators

The results of this survey indicated that passenger vehicles travelled an average of 10.8 km/liter of gasoline, goods vehicles travelled an average 7.6 km/liter of gasoline, and other vehicles travelled an average of 9.7 km/liter of gasoline. Diesel vehicles travelled an average of 10.1 km/liter for passenger vehicles, 6.2 km/liter for the goods vehicles and 6.8 km/liter for the other diesel vehicles

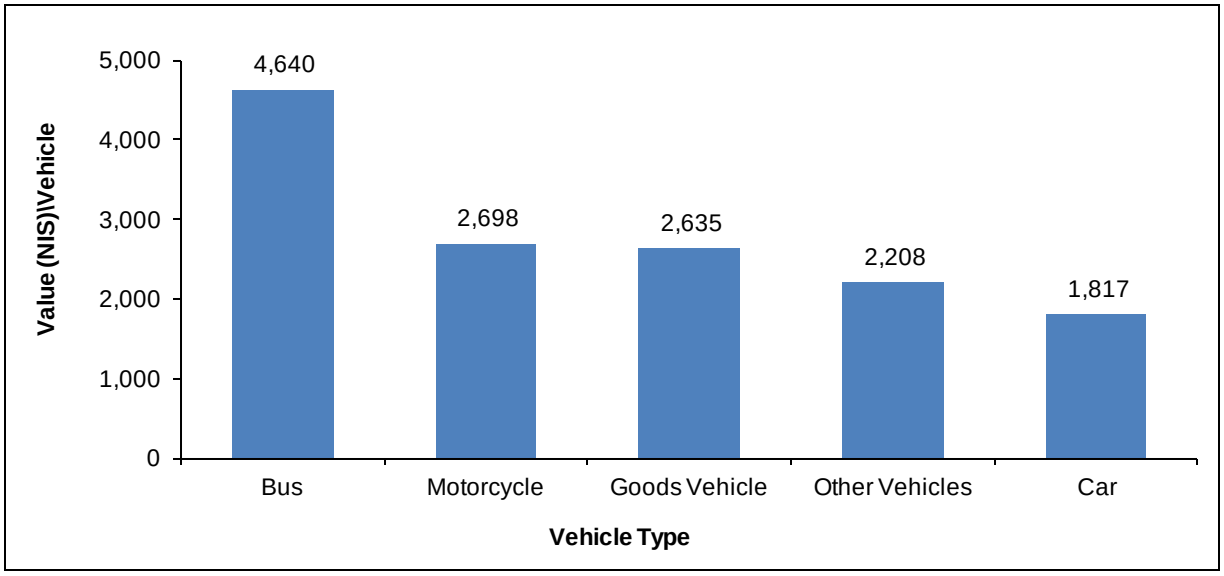
Figure 6.21. Palestine's average number of kilometers traveled per liter by the type of vehicle and fuel type



6.3.3.3 Transport and Economy Indicators

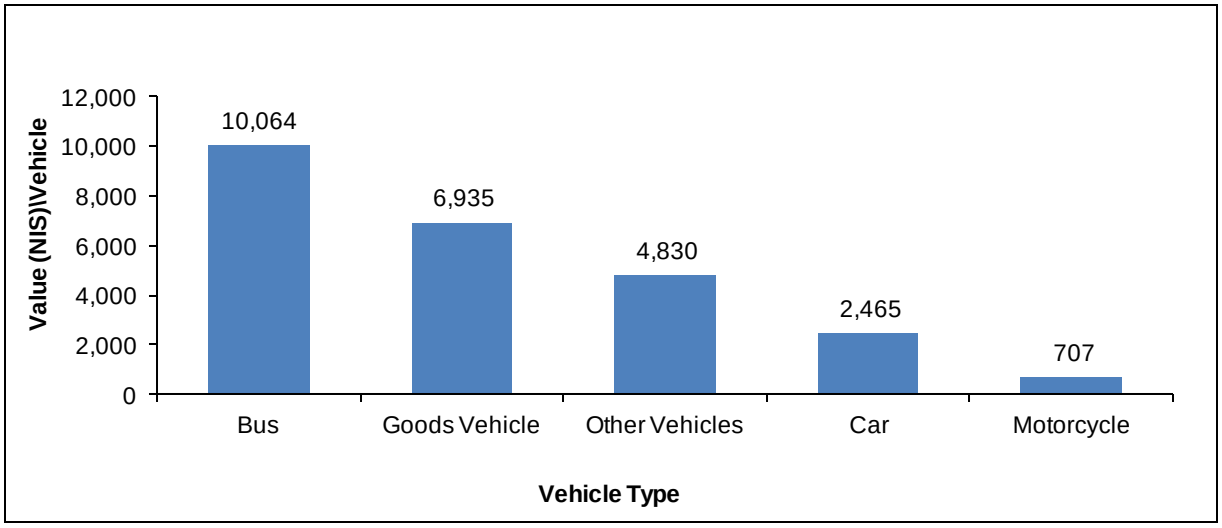
In this paragraph, transport economic indicators are described in terms of insurance value by vehicle type and annual maintenance value. The results of the survey indicated that the average annual insurance of the vehicles in Palestine in year 2014 reached 4,640 (NIS) for buses, 2,698 (NIS) for motorcycles 1,283 (NIS) in the West Bank compared to 2,758 (NIS) in Gaza Strip, 2,635 (NIS) for goods vehicles, 2,208 (NIS) for other vehicles and 1,817 (NIS) for cars (2,043 (NIS) in the West Bank compared to 1,225 (NIS) in Gaza Strip. (1 NIS is equivalent to 0.2 USD)

Figure 6.22. Palestine's average annual insurance value (NIS) of vehicles by the vehicle type



The results of the survey showed that 167,959 cars conducted maintenance in Palestine and that the average annual maintenance value of the car was 2,465 (NIS), 21,267 motorcycle conducted maintenance, and the average annual maintenance value of the motorcycle was 707 (NIS), 1,989 buses conducted maintenance, and the average annual maintenance value of the bus was 10,064 (NIS), 37,503 goods vehicles conducted maintenance and the average annual maintenance value of the goods vehicle was 6,935 (NIS), and 2,757 from other vehicles conducted maintenance, and the average annual maintenance value of the other vehicle was 4,830 (NIS) during the year 2014.

Figure 6.23. Palestine's average annual maintenance value (NIS) of vehicles which conducted the maintenance process by the vehicle type



Maintenance is necessary to keep the energy efficiency of a vehicle at an acceptable level. Therefore, it is recommended to encourage vehicle maintenance through special programs and subsidized maintenance programs, especially if the renewal of the current fleet is not possible.

7 Conclusion and Recommendations

Within the global objective of the United Nations Economic and Social Commission for Western Asia to strengthen the capacity of the national statistical offices of Arab countries to improve the quality of statistical data on energy use in the transport sector, this report has introduced a relationship between energy surveys and national energy policies in the transport sector for the three selected member countries Egypt, Jordan and Palestine.

After the review of successful transport survey experiences from the United Kingdom and Australia followed by a presentation of the transport surveys conducted in Tunisia and Morocco recently, the study showed the readiness of Egypt, Jordan and Palestine's national statistical offices to conduct field surveys to collect the relevant data related to energy consumption in the transport sector. The analysis and interpretation of the information collected by the three national statistical offices for Egypt, Jordan and Palestine provided a number of key indicators related to energy consumption in the transport sector. These indicators were then analyzed in the context of each country's transport sector current status and recommendations related to national transport policies aimed at improving the transport sector's energy efficiency were developed accordingly.

It is recommended that the three member countries Egypt, Jordan and Palestine, conduct periodic national transport surveys to monitor the development of their transport sectors and the effect of their national transport policies' implementation on energy consumption.

It is also recommended that the three member countries develop a set of national transport policies and strategies in the view to improve the energy efficiency of their transport sectors which will fall under the following four main axes:

- Modal shift
- Energy efficiency improvement of the existing vehicles,
- Fleet renewal – i.e. replacement of old vehicles by new ones more efficient,
- Improve the way the vehicles are used.

For example, this can be done through the implementation of the following measures:

- Public transport services improvements in terms of organization, safety, and diversity,
- Transport infrastructure developments (roads, bridges, public transport infrastructure…),
- Promotion of energy efficiency in vehicles through special programs (drivers training and education) and subsidized maintenance programs providing logistical expertise, especially if the renewal of the current fleet is not possible,
- Voluntary agreements with public transport or freight transport companies in order to improve the energy efficiency of their vehicles through periodic maintenance or the replacement of their vehicles by new ones more efficient,
- Proposition of financial and non-financial incentives for the purchase of alternative fuelled vehicles (e.g. electric ones),
- Proposition of financial and non-financial incentives for the purchase of new efficient vehicles,
- Financial incentives for old vehicle scrapping,
- Adoption of an annual taxation scheme by carbon emissions,
- Implementation of new parking policies.

Finally each country has its own characteristics:

- In the case of Egypt, the fleet is composed of about 7 million vehicles and the government's main objective is currently to assess the real energy consumption

of the road transport mode through the smart cards system. This is expected to help organize the fuel subsidies in the country,

- In Jordan motor vehicles are mainly concentrated in the capital Amman. It is therefore proposed to set out measures focusing on the development of public transport (bus, tram, and subway) to encourage modal shift from individual to more collective transport modes. Also policies relating to decentralization should be considered,
- Palestine's transport energy consumption is not well understood due to the illegal import of different fuels to the country. However the surveys have shown that most of the trips are done inside the localities by passenger vehicles. Attention should therefore be given to develop public transport to encourage modal shift from individual to more collective transport modes,

In addition to this, awareness campaigns and the dissemination of the national transport survey results are expected to help in reducing energy consumption and improving energy efficiency in the transport sector.

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