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# ENHANCING CAPACITY FOR LOW EMISSION DEVELOPMENT STRATEGIES (EC-LEDS) CLEAN ENERGY PROGRAM

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## Transport sector overview



# Enhancing Capacity for low Emission Development Strategies (EC-LEDS)/ Clean Energy Program

## Transport sector overview

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The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government

This report was developed as one of the components of the technical assistance provided by the “Enhancing Capacity for Low Emission Development Strategies (EC-LEDS)/Clean Energy Program” to the Government of Georgia in the process of preparation of the Low Emission Development Strategy. The main objective of the report is to analyze the energy consumption and emissions from transport sector, compare the energy consumption and emissions of different transport modes and identify the barriers for implementation of energy efficient measures in the transport sector of Georgia. The barriers and conclusions identified in the report will be the basis for elaboration of the Low Emissions Development Strategy and corresponding measures.

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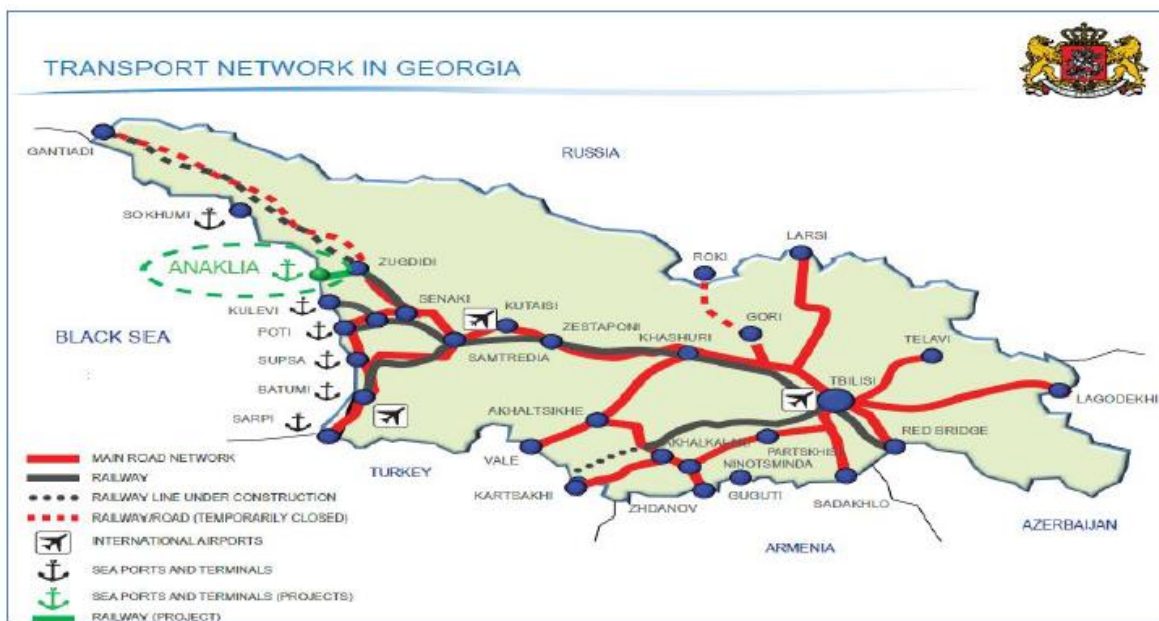
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# 1 Introduction

County's economic development significantly depends on efficient and sound operation of its transportation system. And, as Georgia is situated on the crossroad, where the freight of strategic importance is transported, one of the priorities of the county is to coordinate the operation of its transport system, build and modernize country's transport infrastructure to meet international standards, and to harmonize its transport legislation with international laws. To achieve abovementioned goals, the government carries out important infrastructural projects, which will attract additional freight to Georgia and increase the efficiency of its transportation system.

Currently, Georgia's transport system consists of four main modes: (1) road transport, (2) railway, (3) maritime transport, and (4) aviation. Each part of the state, towns, villages and neighboring countries are connected with to at least one of these modes. Georgian railway is owned by the government but is authorized to gain capital on the market.



**Fig. 1. Transportation net of Georgia<sup>1</sup>**

In 2014 Georgian transport sector employed 27 684 people (10% increase compared to 2000 figure) and its turnover leveled at 1 563.1 million GEL (580% increase compared to 2000 figure).

Land transport (including pipelines) was the strongest contributor to the total turnover (91.2%) and was the biggest employer of the sector too. Despite the development, transport sector still suffers from significant weaknesses, which are discussed below.

<sup>1</sup> Source: Benmaamar, Mustapha; Keou, Oceane; Saslavsky, Daniel Mario. 2015. [Georgia's transport and logistics strategy: achievements to date and areas for improvements](#). Washington, D.C. : World Bank Group.

## 2 Organization of Transport Sector in Georgia

### 2.1 Sector Governance

Ministry of Economic and Sustainable Development has jurisdiction over road transport, maritime transport, railways, and aviation infrastructure and services, with its Transport Policy Department serving as the coordinating body. The Roads Department of Ministry of Regional Development and Infrastructure builds and operates roads classified as international and secondary. Local authorities are responsible for the other roads in the network, which are classified as local roads. They are also responsible for organization of public transport routes on their territories, with some of the municipalities (such as Tbilisi) also owning public transport companies. The Land Transport Agency (LTA), Maritime Transport Agency (MTA), and Georgian Civil Aviation Agency are the technical regulators.

Georgian Railway is state-owned. Private companies operate all the country's ports and two major airports, while the state-owned United Airports of Georgia operates the newest international airport in Kutaisi, and all regional airports.

Table I summarizes the sector organizational structure.

**Table I. Transport sector management structure<sup>2</sup>**

	Roads	Service		Maritime Transport	Aviation	Human Resource Development
		Road	Railway			
Policy	Not Defined					Ministry of Education and Science of Georgia
Strategic Planning	Ministry of Regional Development and Infrastructure of Georgia	Ministry of Economy and Sustainable Development of Georgia				
Regulator <sup>a</sup>	Roads Department	Commercial: Land Transport Agency Motor traffic: Ministry of Internal Affairs of Georgia <sup>b</sup>	Georgian Railway	Maritime Transport Agency of Georgia	Georgian Civil Aviation Agency	

<sup>2</sup> Source: Asian Development Bank. 2014. [Georgia Transport Sector Assessment, Strategy, and Road Map](#). Manila: Asia Development Bank.

Infrastructure Supply and Management	Construction and Maintenance by Private Companies	Bus Stations: Municipality and Private Sector Freight Logistics Centers: Private Sector	Construction and Maintenance by Private Sector	Ports: Poti - MAERSK Georgia Batumi - Batumi Industrial Holdings Supsa - British Petroleum Kulevi - State Oil Company of Azerbaijan Republic	Airports: Kutaisi International and Regional Airports - United Airports of Georgia Tbilisi International and Batumi International - TAV Airport Holdings	Batumi State Maritime Academy Georgian Aviation University Georgian Technical University Free University of Tbilisi
Service	Not Defined	Freight: Private Sector Interurban and International travel: Private Sector	Georgian Railway	Freight: Private Sector Freight Diversion: Private Sector	Airlines: Private Sector	

<sup>a</sup> The scope of regulation provided by these agencies is mainly technical. Economic regulation is limited and undefined.

<sup>b</sup> The Patrol Police Department of the Ministry of Internal Affairs handles motor vehicle administration.

## 2.2 Road Transport

Land Transport Agency (LTA) supervises passenger and freight transport services, and ensures that the bus and freight vehicle operators comply with technical standards. The agency verifies whether freight transport complies to international conventions, it issues certificates and permissions, and implements computerized system to manage and monitor transport system.

The Ministry of Internal Affairs of Georgia (MIA) keeps a track of road accidents and issues driving licenses. Currently, car inspection is not mandatory, while the registration is obligatory only when the ownership changes. As a result, the exact number of vehicle in the country is unknown. Majority of registered cars are second-hand vehicles imported from Europe and only 1% of them are not more than three years old, while 90% are produced 10 years ago or earlier.

Legislative reforms liberalized and abolished almost all market entry requirements for private companies increased the supply of intercity transport service, but precise statistics of corresponding passenger traffic does not exist. Car owners drive most of the intercity transport with no clear timetables or tariffs. Urban and intercity passengers lack the choice of speed, frequency and comfort levels while selecting service providers and the information regarding minor cities is neither published nor controlled. Portion of money from ticket sales is transferred to improve municipality-owned bus stations and control traffic load. Although the service quality has improved, in several cities and villages the quality is unsatisfactory, and an accountability policy in public services or minimal service quality requirements does not exist. Safety and environment protection standards are not controlled and the sanctions for breaking corresponding laws are not clearly defined.



Furthermore, in Georgia taxi registration is not obligatory and the official data about taxi fleet size is not available. Any car owner is allowed to turn his car into taxi and any driver with license of class “B” is allowed to drive it, and government will not impose additional regulations. Current legislation does not require passing specific qualification trainings and cheap yellow taxi signs are sold freely. In 2014, survey of EC-LEDS project, conducted in for monitoring of impacts of Tbilisi Sustainable Energy Action Plan (SEAP), showed that taxis on average travel five time more than private cars. 87% percent of taxis use Compressed Natural gas (CNG) as a fuel and the majority of cars (78%) are of age 10-20, while 16% are older than 20 years and just small amount of them are relatively new.

In 2011 inadequately low tax of 200 GEL was imposed on transit freight trucks that enter the country. Given that field experts believe multi-axes trucks cause road damage of 0.50USD per each kilometer ran, the trucks, which drive 400 kilometers in the country, damage the road worth approximately 200 USD, that is much higher amount than country transit tax — 200 GEL. Statistical data for international transit and domestic freight service providers’ fleet size do not exist. According to national logistics experts, majority of freight service providers are individuals, who enter the market freely and operate without regulations.

Cars fleet and its polluting levels are not controlled in Georgia despite the fact, that cars are the major source of air pollution in the country. They pollute the air mainly with carbon monoxide, hydro-carbonates (NVOCs and methane in small amounts), nitrogen and sulfur oxides, soot, benzpyrene, benzapilene, and carbon dioxide.

### **2.3 Road network**

Total length of Georgian road network is 22 000 km and it is divided into international, secondary and local roads. Country’s road density (318 km per 1000 km<sup>2</sup>) exceeds Armenia’s (279 km per 1000 km<sup>2</sup>) and Azerbaijan’s (223 km per 1000 km<sup>2</sup>) corresponding figures. Two of five international roads, E60 and E70, are part of Caucasian Europe-Asia corridor. These roads start in South from Turkish border, cover 400 kilometers on Georgia’s territory and head to Azerbaijan. Other three roads connect Tbilisi to Armenian border. International roads are approximately 859 km long and 95 km long four-lane section, which is mainly used for transit freight purposes. All other roads are two-lane.

Road E60 bears 60% of total truck transit, which has been increasing 10% annually thanks to an improved road conditions, quick border crossing procedures and harmonized standards. Recent surveys show that average load on Rikoti-Samtredia section at the end of 2018 will reach 20 000 vehicles per year<sup>3</sup>. Roads Department of Georgia, whose sizable project portfolio covers pre-construction and construction stages, is responsible for planning, design, construction and maintenance of the international and secondary roads. International outsourcing companies carry out the main port of construction works.

Despite that in Georgia prices for some road building materials are lower compared to its neighboring countries, total cost of construction and maintenance is higher due to expensive projecting and technical requirements.

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<sup>3</sup> Source: Asian Development Bank. 2014. [Georgia Transport Sector Assessment, Strategy, and Road Map](#). Manila: Asia Development Bank.

State budget and donors finance road construction and maintenance, while the Road Fund, previously funded by fuel and transit taxes levied on individuals or corporations, was abolished in 2005. According to the World Bank’s 20 year development plan and different calculations, the modernization of Georgian road system will cost 3.4 billion USDs (Asian Development Bank, 2014).

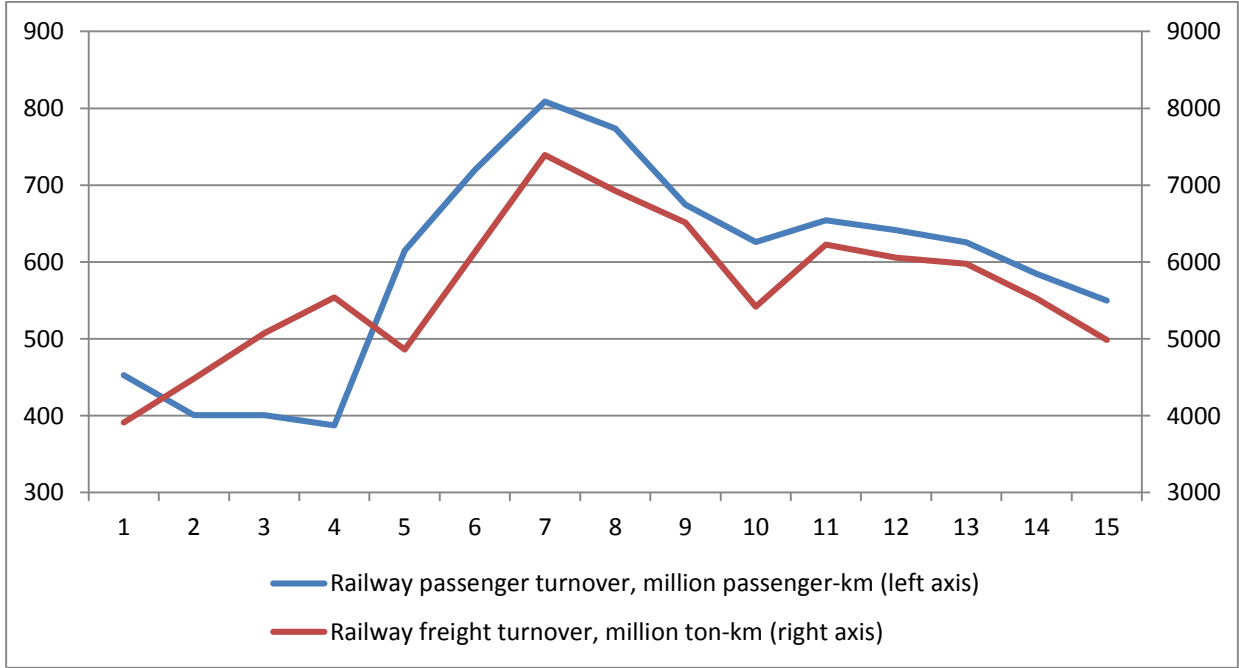
### 2.4 Railway and Metro

Georgian Railway operates three main components: freight, passenger, and railway infrastructure. Each unit is a separate profit center under an executive director reporting to the chief executive and is responsible to the board of directors. The freight and passenger units make an internal ledger payment to the infrastructure unit for track use. The freight unit, being the only unit that is profitable, pays taxes and dividends to the government.

Total length of Georgian railway system is 1 326 km. 293 km of is two-lane and 1 251 km — electrified. Approximately 80% of the railway is situated in mountainous terrain and most of the roads follow narrow gorges that make very expensive the efforts to widen them. Most of the railways can bear 23 tons of loads per axis and the speed is limited to 100km/h for passenger trains and to 80km/h — for freight ones. Most of tunnels and bridges were built more than one century ago, and the train fleet consists of 171 electric and 134 diesel locomotives (Asian Development Bank, 2014).

Recent years observed decrease of passenger and freight turnover. This drop is caused by following reasons:

- Half of the freight turnover in 2010 was a liquid cargo (oil), which is now transferred via pipelines. Nowadays, only 2-3 million tons of oil is transported with rail, compared to 10 million tons in the past;
- Railway loses freight against road transport due to GEL/USD exchange rate (railway is quoted in dollars) and fuel price drops, which make road transportation relatively cheap.



**Fig. 2. Railway passenger turnover in million passenger-km, and railway freight turnover in million ton-km**

Passenger transport is divided into three categories:

- International (between Georgia and other countries);
- Arterial (on main routes);
- Regional transporters (on different dead-end directions).

Although an international passenger traffic has been raising slightly, in the other two categories it has been declining. The last is due to:

- On arterial directions the wagon fleet has declined, for example night trains to Batumi and one train to Poti was abolished. Nowadays the amount of wagon-type trains has decreased from 150 to 38, but some of them were replaced by electric trains. At the moment, only Ozurgeti and Zugdidi are of wagon-type;
- Drop in regional directions is sharper. In addition to wagon fleet reduction, railway is losing competitiveness towards road transport as it is not regulated and cheaper;
- On many directions trains do not go or are very slow due to outdated infrastructure (Borjomi-Bakuriani railway, that will be completely destroyed unless repaired, and some directions to Kakheti are good examples).

Passenger traffic, which has clear seasonal pattern, is subsidized as the costs exceed tariffs.

One of the most efficient mean of passenger transportation in Georgia is Tbilisi Metro that served almost 100 million passengers in 2014 (26% increase since 2009). In the same year, Tbilisi Metro consumed 64281 MWh electricity and 40 tons of gasoline. Various activities in the metro improved service quality and, thus, increased traffic. Currently, wagon fleet consists of 195 wagons.

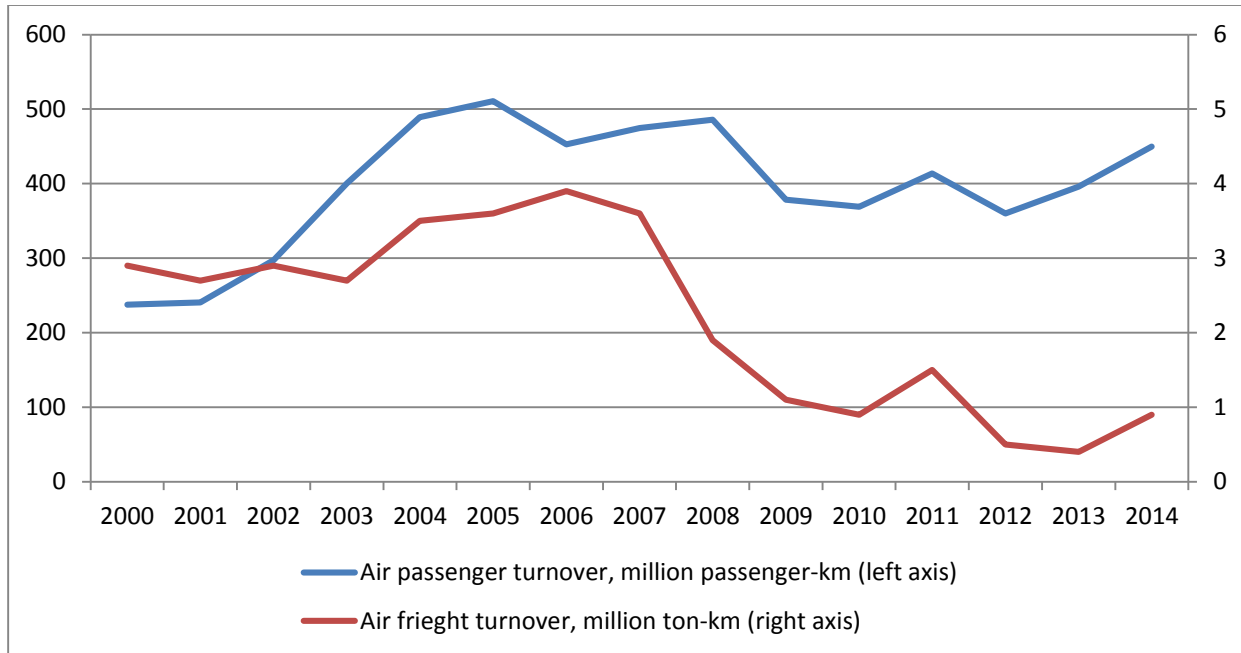
## **2.5 Maritime transport**

Maritime Transport Agency (MTA) was established to form sustainable marine system. It supports productivity boost in the industry, tightening up connections with international organizations and supports Georgian fleet to get the certificate for international operations. MTA cooperates with Batumi State Maritime Academy, which can provide about 250 sailors each year.

In 2011 four Georgian ports handled 22 million (Poti – 7.2 million, Batumi – 6.8 million, Kulevi – 3.4 million, Supsa – 4.0 million) tons of cargo. Currently, Poti and Batumi seaports have regular marine voyages to Bulgaria, Romania, Turkey and Ukraine directions. And despite, that Batumi seaport has capacity of serving 180 000 people per year, in 2011 it served only 21 520 people.

## **2.6 Air transport**

Georgian Civil Aviation Agency (GCAA) awards certificates and licenses to airplanes and their crew if the planes, service quality and the airports comply with Euro-standards. It also provides workforce for sector's need. Air zone and flying safety during plane departures and arrivals at Tbilisi, Batumi, Kutaisi and Mestia airports is under SAKAERONAVIGATSIA's control, while Georgian Aviation University certifies engineering, management, technical and administration staff.



**Fig. 3. Air passenger turnover in million passenger-km, and air freight turnover in million ton-km**

Tbilisi airport is connected to road and railway infrastructure and has a capacity to serve 2.8 million passenger and 160 000 tons of freight per year, while Batumi airport can serve 600 000 passengers. Additionally, Kutaisi airport in 2012 served 13 000 passengers, and there are frequent flight from Mestia to Tbilisi.

Air passenger traffic increased from 237.8 million to 452.9 million passenger-km from 2000 to 2006 that corresponds to 11.3% annual increase. In 2014 the passenger traffic leveled close to 2006’s value. Air freight increased from 2.9 million ton-km in 2000, reached peak of 3.9 million in 2006 and dropped to 0.9 million ton-km in 2014.

## 2.7 Pipelines

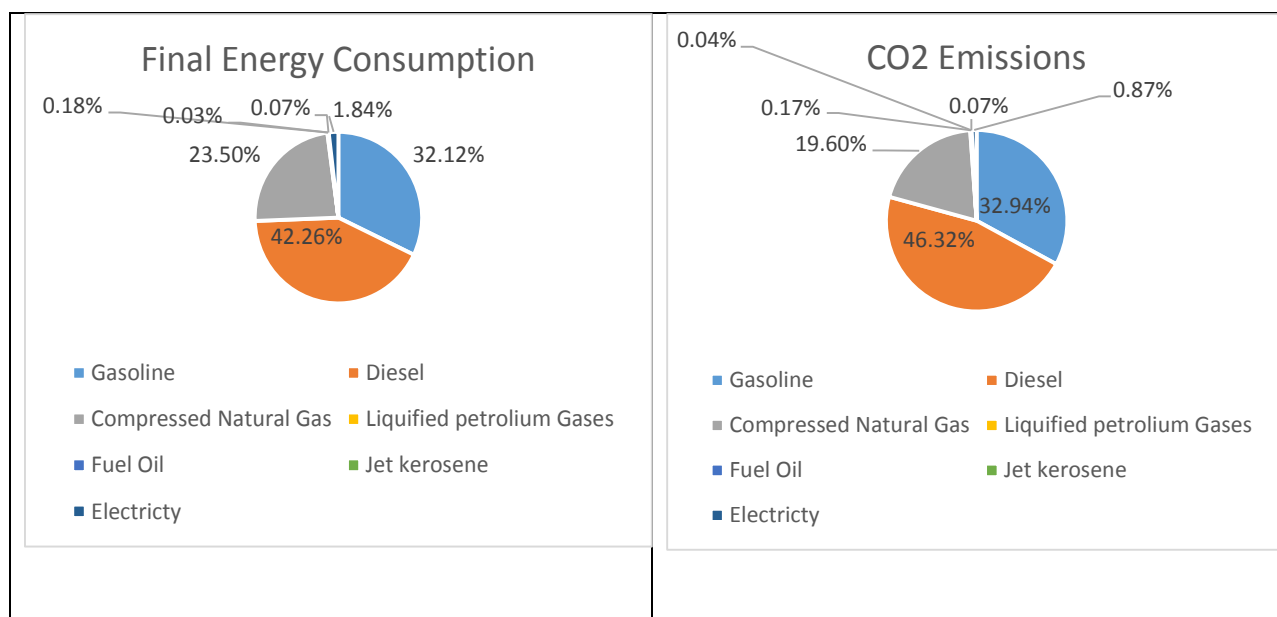
Georgia serves Baku-Supsa and Baku-Tbilisi-Ceyhan international pipelines that deliver Azerbaijani oil to the world market. The Baku-Supsa pipeline is connected to Supsa terminal and has traffic capacity of 7 million tons per year, while the Baku-Tbilisi-Ceyhan is connected to Kulevi port. These two pipelines cost reportedly half that of the northern route via the Russian<sup>4</sup>

<sup>4</sup> Source: Asian Development Bank. 2014. [Georgia Transport Sector Assessment, Strategy, and Road Map](#). Manila: Asia Development Bank.

### 3 Energy consumption and greenhouse gas (GHG) emissions in transport sector

According to Energy balance of the National Statistics Office of Georgia (GeoStat), energy consumption in transport sector reached 55.56PJ in 2014 and 93.8% (52.14PJ) of this amount was country’s internal use. International (bunker) aviation contributed to the rest, but as emissions from this sector do not count as country’s own emissions, it is not considered farther in this report.

In 2014 the most used type of fuel in Georgia’s transport sector was diesel (42.3%), the second most used one was gasoline (32.1%) and natural gas (23.5%) was on the third place. In the same year, transport sector used 0.96PJ electricity (1.84%), but railways’, metro’s and ropeways’ share total consumption is negligible.

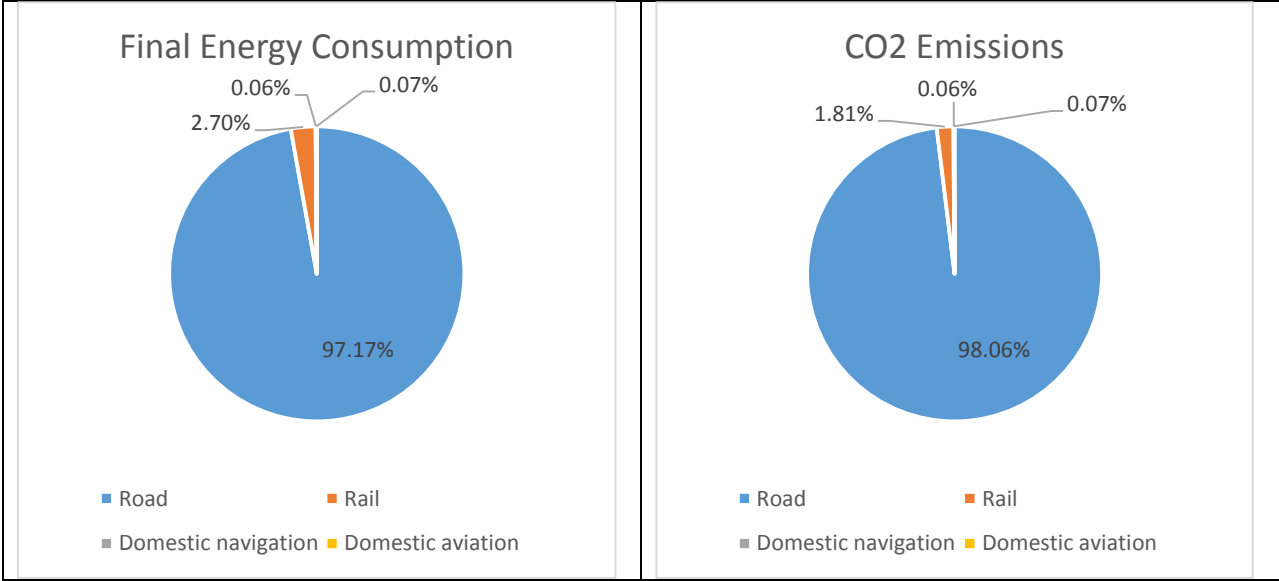


**Fig. 4. Final energy consumption and carbon dioxide emissions by energy carriers in 2014**

Fossil fuel consumption in transport sector emitted 3 487.8 Gg CO<sub>2</sub> equivalent GHG and 99.1% (3 458 Gg) of these emissions was carbon dioxide. Emissions including indirect emissions from electricity consumption<sup>5</sup>, equaled to 3 488.1 Gg and highest shares of this amount was due to diesel and gasoline use. Compared to diesel and gasoline, the shares of natural gas and electricity were much less as they have smaller emission factors.

Fig. 7 shows the shares of different transport modes in total energy consumption and emissions, and road transport is a leader in both of them with 97.17% and 98.06% shares, respectively.

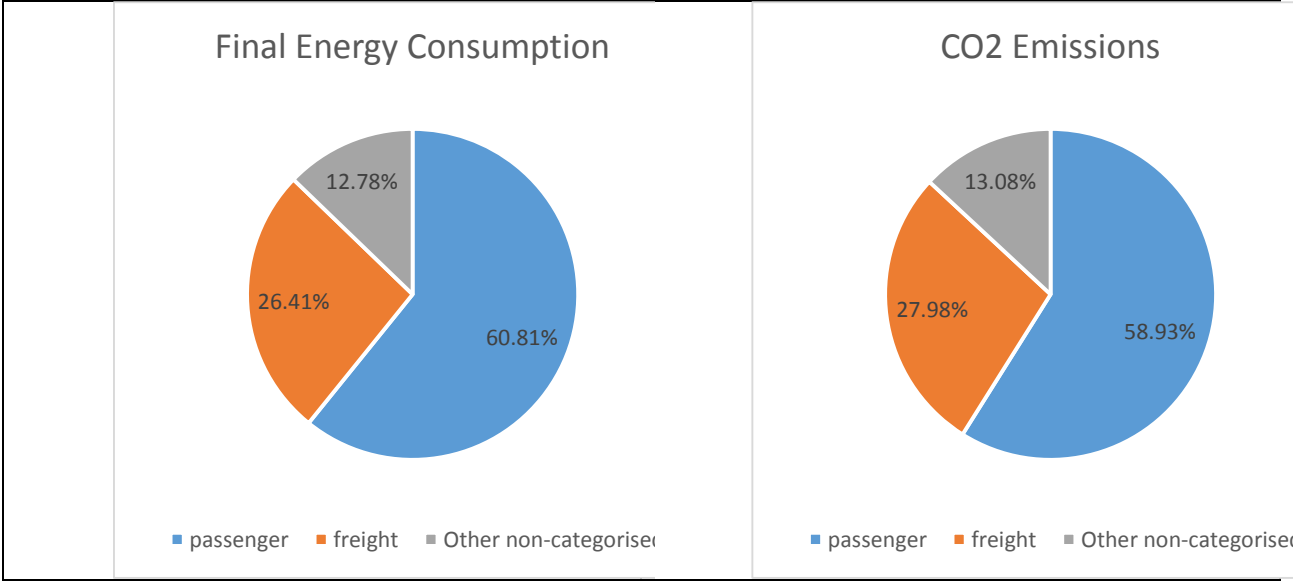
<sup>5</sup> Indirect emissions from electricity consumption are calculated using average grid emission factor – 0.115 tons/MWh



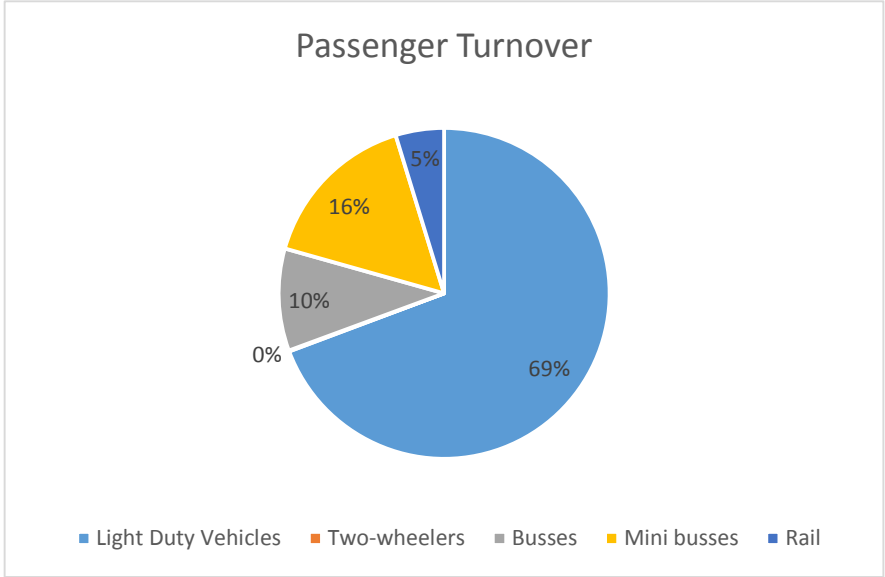
**Fig. 5. Final energy consumption and carbon dioxide emissions in transport sector by transport types in 2014**

In Georgia complete information regarding passenger and freight turnover is not available, despite that both these figures are available in railway sector. Information concerning road transport are contradictive or do not exist at all. Statistics available in statistical yearbook are incomplete and are often based on outdated statistical surveys. To better understand the reasons of energy consumption and emission sources, the information from different relevant sources have been compiled to split energy consumption and emissions by transport mode and services. Although this analyses of current activity and energy intensity in transport sector, which has been performed by EC-LEDS project can provide some insights, further improvement in data collection is necessary to achieve more precise figures. Trucks, private cars, public and transit transport are main concerns. Determining the number of taxis and the amount of fuel they use is also very important. The paragraphs below show the results of this analysis, farther details on data sources and calculations are given in [Appendix 1](#).

Passenger transport contributes to 60.8% of total energy consumption in road transport, while trucks contribute to 26.5% and other types of road transport, such as specialized machines (agriculture machine, firefighting cars etc.) and military transports, contribute to the rest. Fuel consumed by foreign passenger transport falls under this category, and uncategorized fuel consumption could be also counted there.

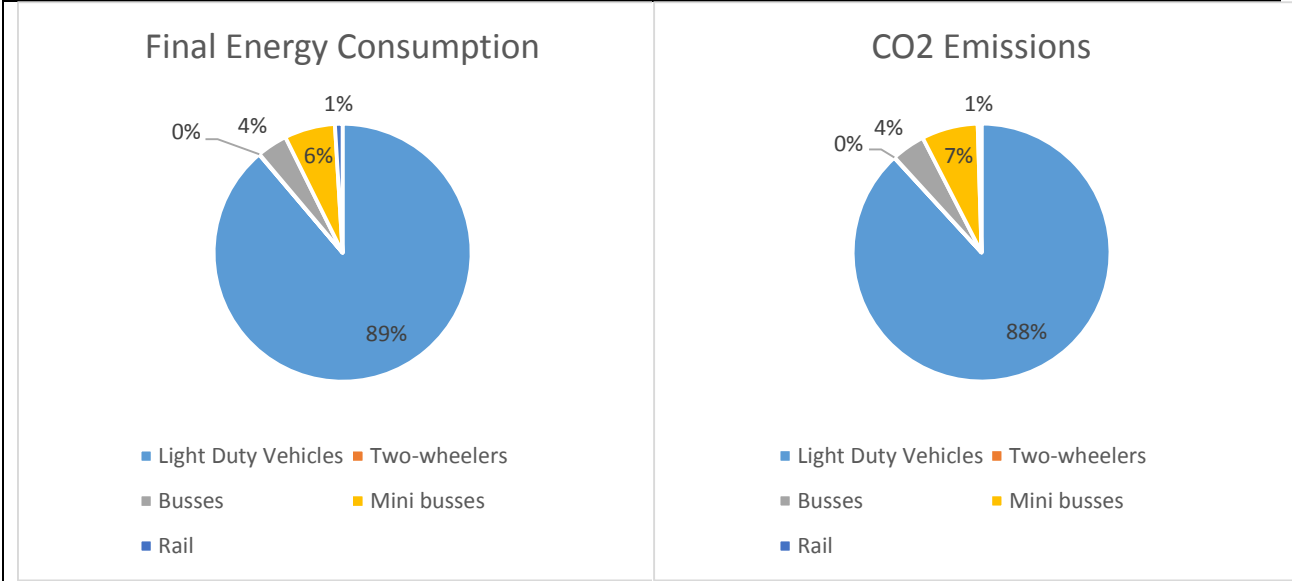


**Fig. 6. Energy use and carbon dioxide emissions by service types in 2014**



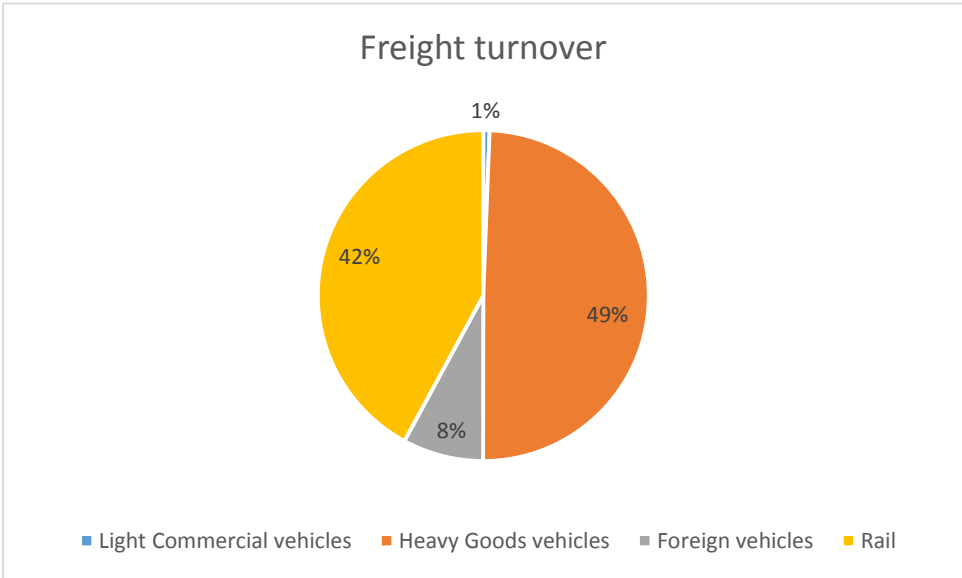
**Fig. 7. Passenger turnover by transport types in Georgia in 2014**

In 2014, passenger turnover reached approximately 25.4 million passenger-km. Lightweight cars contributed to 69% of total turnover, while the share of railway transport was just 5% and half of this amount was Tbilisi Metro’s portion. In energy consumption the share of lightweight cars was even higher as they are less efficient transportation means. According to this data follows that shifting to public transport and railway will efficiently reducing both, energy consumption and emissions.



**Fig. 8. Final Energy Consumption and carbon dioxide emissions by types of passenger transport in 2014**

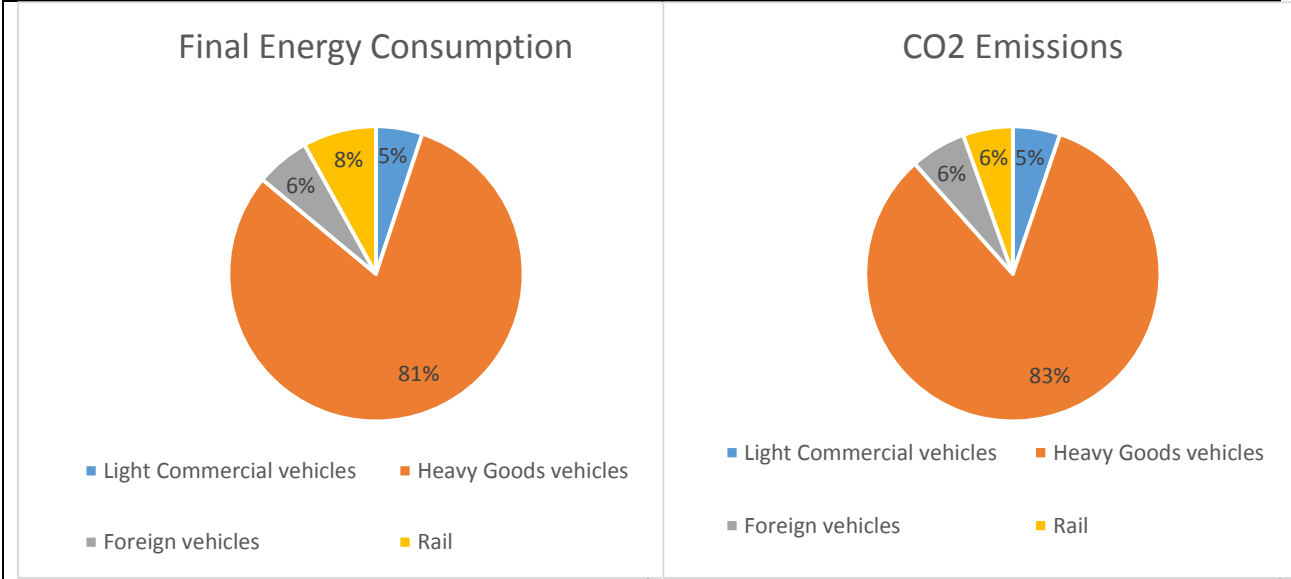
Analysis estimated that in 2014 freight turnover reached 13.3 million ton-km and 58% of this figure was road transport and 42% — railway transport.



**Fig. 9. Freight turnover by transport types in 2014**

As a railway is the most efficient mean of freight transportation in Georgia, its share in total use of electricity (8%) was significantly less than its share in total freight turnover, but its share in total emissions were even lower. Following, increasing railway’s share in total turnover will reduce energy consumption and emissions further.

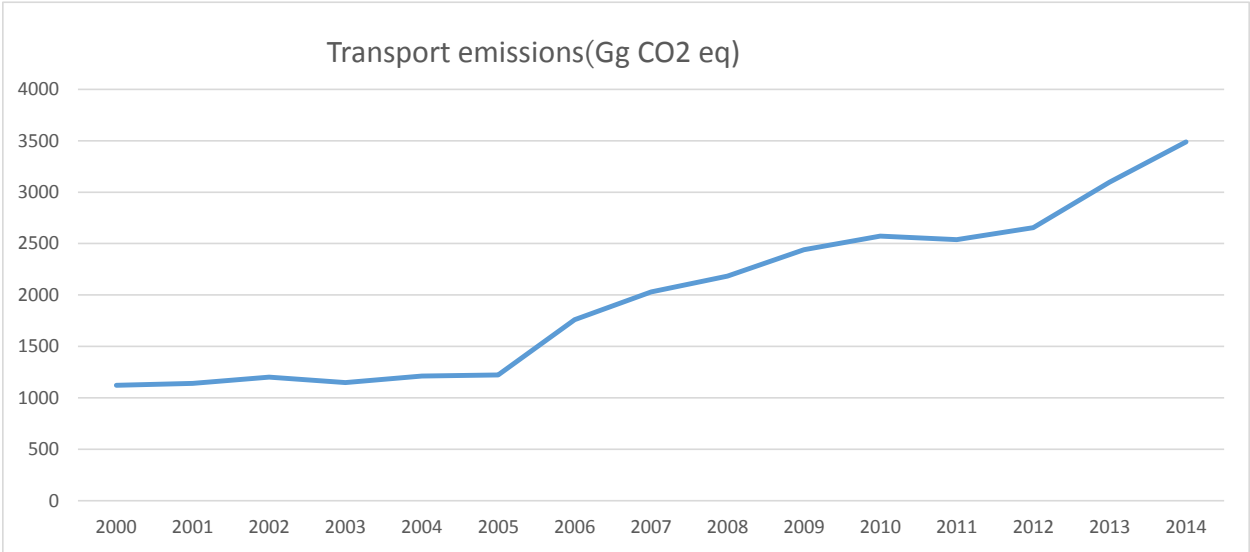




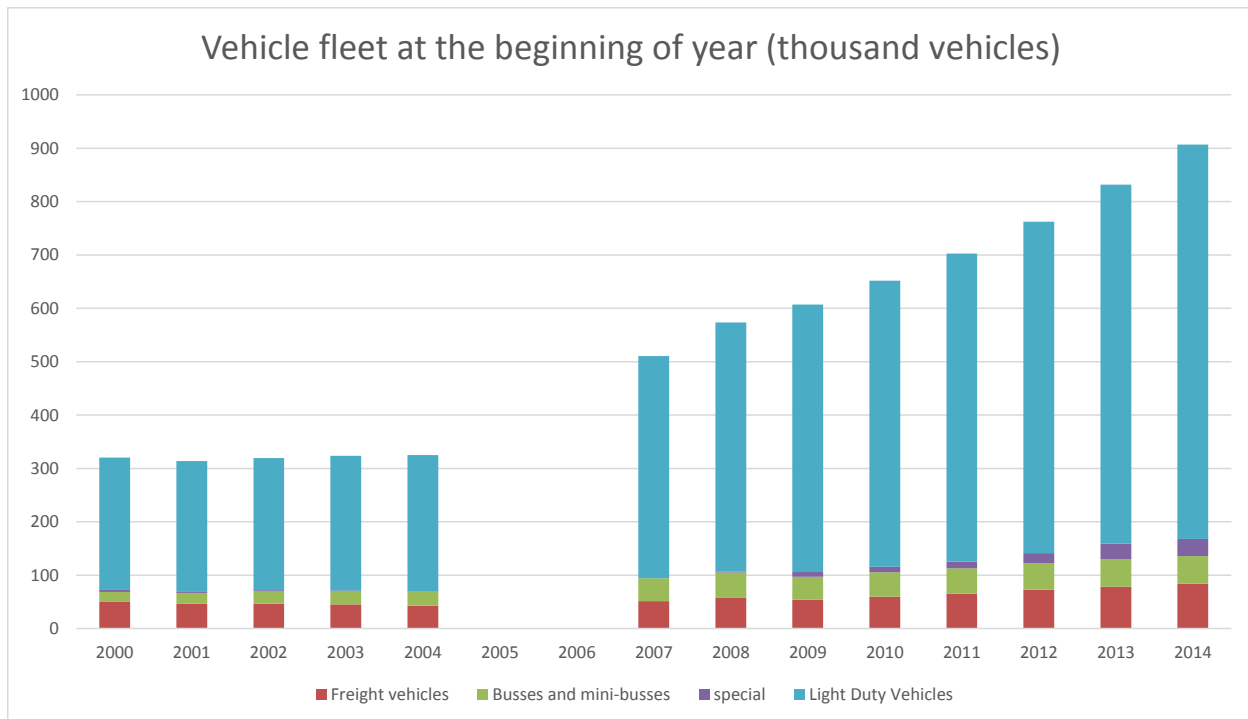
**Fig. 10. Final Energy Consumption and carbon dioxide emissions by types of freight transport in 2014**

### 4 Trends

In recent years transport sector emissions have increased rapidly in Georgia. In 2014, emissions from fossil fuel combustion exceeded 2000's figure by 211.3% and 2010's figure — by 35.5%. In the same period, steadily increasing car fleet size mainly determined GHG emission increase in the road transport: in 2014, number of cars in the country was 198% and 37.8% more 2000's and 2010's figures, respectively.



**Fig. 11. GHG emissions from burning fossil fuel in 2000-2014**



**Fig. 12. Vehicle fleet (at the beginning of the year)<sup>6</sup>**

From 2000 to 2007, an average amount of cars per 1000 people in Georgia exhibited 7.8% annual growth rate: from 72 cars per 1000 people in 2000 to 202 cars per 1000 people in 2007. In contrast, in the EU the same figure equaled to 494 cars per 1000 people in 2013 and the growth rate was on average 0.8% since 2005<sup>7</sup>. So, it is expected, the amount of private cars will increase further in following years in Georgia as well.

Economic development and increased income are the main determinants of increased energy use and car fleet size. GDP growth is highly correlated (94%) with energy consumption in transport sector, but the correlation with per capita GDP is even higher (97%). Clearly, income and economic activity strongly affect emission growth rates in transport sector.

## 5 Current strategy in transport sector

Ministry of Economy and Sustainable Development of Georgia (MESD), highlights several important reforms taking place in transport sector:

- Transport infrastructure improvement and regional centers' development;
- Georgia's integration in international transport system and utilizing transit potential;

<sup>6</sup> 2005 and 2006 data are not published in statistical yearbooks

<sup>7</sup> European Automobile Manufacturers Association, [Passenger Car Fleet Per Capita](#)

- Supporting investments in transport and logistics, and strengthening cooperation between state and private sectors;
- Harmonization of Georgian legislation with European legislation;
- Strengthening cooperation with international organizations and realizing international treatments;
- Forming competitive environment and developing information systems, improving safety policy;
- Forming legislative framework for multimodal freight;
- Increasing competitiveness of Georgia’s marine sector;
- Improving education and certification processes for sailors;
- Improving agricultural infrastructure.

MESD’s plans for sector development include:

- Fulfilling Georgia’s obligations according to “Common Aviation Area Agreement between the European Union and its Member States and Georgia”, harmonizing Georgia’s legislation with the EU legislative system, and ensure GCAA’s active involvement in the process;
- Attracting low-cost airlines in Georgia’s market and increasing competitiveness;
- Recognition of Georgian sailors certificates by the EU to facilitate their employment on the EU territories floated vessels;
- Fulfillment of Geneva Agreement (signed on 1 July of 1970 and enforced for Georgia on 19 November of 2011) regarding international road freight companies’ crews. This convention guarantees improvement of working and safety conditions in road transport sector;
- Starting intergovernmental activities to comply with European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR);
- According to Container Block Train project (Silk Wind), negotiations with Kazakhstan, Azerbaijan and Turkey to develop multimodal transportation net.

## **6 Barriers and Weaknesses**

Transport sector has some serious weaknesses and barriers that hinder the sector low-emission development. These are described below:

1. Transport policy is fragmental. The unified vision, which would consider all transport modes, regions and service types together, does not exist;
2. Unified nationwide policy regarding the organization of urban transport doesn’t exist, neither exists the governmental authority overlooking urban transport (or in general, sustainable urban development), and responsible for development of nationwide urban transport policy, regulations and vision and coordination of municipality-level activities. Municipal government manages urban transport, but gets most of its finances from central government and cannot cooperate with donors without central government’s assistance. Besides, as nationwide policy of urban development does not exist, central

government's assistance is atactic and fragmented and central government cannot evaluate impacts of funded projects as their monitoring is not in place;

3. Statistical data on transport sector is not regularly collected and sector is not monitored on regular basis (only selected economic figures are controlled) that hinders the development of analysis-based transport policy. Data collecting efforts are mainly carried out by donor funded projects, while the same donors do not have access to information sources that are under governmental authorities' or private sector's control. Consequentially, collecting, monitoring and analyzing data is vital for policy making process as well as for impact analysis or monitoring of implemented policies;
4. Regional public transport and passenger railway do not meet passengers' demands, thus vast majority of passenger transportation is carried out by private road transport. Despite that in cities and villages service quality has improved, it does not meet standards yet: minimal service requirements and public service duties do not exist. Safety and environment protection standards are not monitored and relevant sanctions are not clearly defined. Number of passenger trains is limited and is declining over time together with deteriorating infrastructure;
5. Number of taxis is not recorded, nor are they regulated. Taxi drivers do not pay taxes, thus enjoy competitive advantage towards busses, minibuses and especially towards railway;
6. Regular car inspections are not obligatory, there are no standards for vehicles and minimal requirements for fuel quality, one of the major air polluter and GHG emitter, are far below the EU-standards;
7. Division of freight between rail and road is inefficient as railway can increase its load — at present road transport within Caucasus Transit Corridor (CTC) moves twice the number of transit containers as railways;<sup>8</sup> The policy for road freight and rail freight needs to be developed together putting them in competitive market.
8. Whereas some of the closed wagons are seemingly in good condition, much of the platform cars are in obsolete state. Many of the locomotives in Georgian Railway's fleet have past their service life. This contributes to lower speeds in certain sections of the corridor, especially where terrain features require more tractive effort and put a strain on other systems (e.g. braking) that lead to suboptimal operational practices.<sup>8</sup>

These barriers need to be taken into account and adequately addressed by the low emission development strategy for this sector.

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<sup>8</sup> „GEORGIA'S TRANSPORT AND LOGISTICS STRATEGY: ACHIEVEMENTS TO DATE AND AREAS FOR IMPROVEMENTS“, Mustapha Benmaamar, Oceane Keou, Daniel Saslavsky ,World Bank 2015.

[http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/06/01/090224b082ee35f4/2\\_0/Rendered/PDF/Georgia0s0tran0eas0for0improvements.pdf](http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/06/01/090224b082ee35f4/2_0/Rendered/PDF/Georgia0s0tran0eas0for0improvements.pdf)

## Appendix 1: Sources used to analyze passenger and transport freight turnover in transport sector

1. Registered car fleet, bus (also minibus) and railway passenger turnover, railway turnover — Statistical Yearbook<sup>9</sup>;
2. Private lightweight transport by fuel types, annual distance covered by private cars, average consumption of fuel per lightweight vehicles — Residential End-Use Survey<sup>10</sup>;
3. Lightweight car loading factor — Road Map of Georgian Sustainable Urban Transport Project<sup>11</sup>;
4. Average amount of “active” (used for freight or passenger transportation) buses, minibuses and freight trucks by load factors and annual covered distance — 2006 surveys by GeoStat (not official);
5. Distribution of electricity and diesel consumption by passenger and freight transport in railway — GR;
6. Passenger turnover and energy consumption in Tbilisi Metro — Monitoring Report of Tbilisi Sustainable Energy Development Plan;
7. Fuel consumed by buses, minibuses and trucks — Urban Sustainable Energy Development Plans, International transportation models;
8. Number of nonresident (also transit) trucks that enter Georgia in freight-loaded state — Revenue Service of Georgia<sup>12</sup>.

Primary data obtained from abovementioned sources were used to derive figures in Table 2.

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<sup>9</sup> Statistical Yearbook of Georgia -2015, GeoStat, 2015.

<sup>10</sup> USAID Hydro Power and Energy Planning Project (HPEP) Residential End-use survey, 2014

<sup>11</sup> Road Map of Georgian Sustainable Urban Transport Project. SYSTRA. 2010

<sup>12</sup> Loading factor and distance traveled through Georgia for these cars were derived according to some assumptions. Additional assumption is that these cars fill fuel tanks only on one direction.

**Table 2. Road transport, fuel consumption, passenger and freight turnover in 2014**

Vehicles	Light Duty vehicles	Two-wheelers	Busses	Mini-buses	Light commercial vehicles (below 2 tonnes)	Heavy goods vehicles	International freight trucks <sup>13</sup>	Off-road machinery	Total Energy Consumption of Road Transport
by fuel	2014	2014	2014	2014	2014	2014			
on gasoline	448 146	3 864	38.15	1 482.66	1 285.84	1 287.17			
on diesel	51 709		1 861.22	6 301.32	12 512.40	38 558.41		32 200.00	
on LPG	2 461								
on CNG	236 384		174	185	386.84	527.34			
total	738 700	3 864	2 074	7 969	14 185	40 373		32 200	
average annual mileage (km/vehicle)	12 870	5 000	63 000	41 500	9 889	25 645		0	
passenger per vehicle (passenger/vehicle)	1.85	1	19.4	12.2					
annual passenger-kms (millions)	17 588	23	2 537	4 035					
freight per vehicle (tonnes/vehicle)					0.6	6			
annual tonnes-kms (millions)					81	6 485	1 516		
average fuel consumption per vehicle gasoline (liter/100 km)	8.533	3	30.0	18.0	14.2	30.0			
average fuel consumption per vehicle diesel (liter/100 km)	8.0		24.0	16.0	13.0	28.0			
average fuel consumption per vehicle LPG(l/100 km)	13.0								
average fuel consumption per vehicle CNG(cubm/100 km)	9.8		30.0	20.0	19.0	42.0			
total gasoline consumption(liters)	492 186 522	579 600	721 025	11 075 498	1 805 686	9 902 980		0	
total diesel consumption (liters)	52 907 402	0	28 141 657	41 840 772	16 086 137	276 876 258		0	
total LPG consumption (liters)	4 117 647	0			0				
total CNG consumption (cubm)	297 840 627	0	3 292 467	1 538 264	726 865	5 680 035		0	
total gasoline consumption(PJ)	15.97	0.02	0.02	0.36	0.06	0.32		0.00	16.75
total diesel consumption (PJ)	2.03	0.00	1.08	1.60	0.62	10.62	0.81	4.81	21.57
total electricity consumption (PJ)									0.00

<sup>13</sup> Calculations are given in Table 4

total LPG consumption (PJ)	0.09450								0.09
total CNG consumption (PJ)	10.42		0.12	0.05	0.03	0.20		1.43	12.25

**Table 3. Railway passenger and freight turnover and energy consumption in 2014**

Parameter	passenger rail	freight rail	Total
annual passenger-kms (millions)	1 201		
annual tonnes-kms (millions)		5 526	
total heavy fuel oil consumption (PJ)		0.02	0.02
total diesel consumption (PJ)	0.01	0.42	0.43
total electricity consumption (PJ)	0.29	0.67	0.96
Total Consumption	0.30	1.11	1.39

**Table 4. Foreign road transport freight turnover and energy consumption**

Parameter	2014
Non-resident Heavy goods vehicles (HGV) entering Georgia for transit	103661
Non-resident HGVs entering Georgia to carry good to Georgia	59886
Total non-resident HGVs entering Georgia	163547
Transit mileage per trip (km)	500
Mileage to Tbilisi per trip (km)	400
Total mileage of non-resident vehicles (km)	75784900
	During transit
	5 1830500
	For carrying goods to Georgia
	23954400
Average diesel consumption per vehicle (l/100km)	28
Total diesel consumption (liters)	21219772
	During transit
	14512540
	For carrying goods to Georgia
	6707232
Total diesel consumption (PJ)	21219772
During transit	0.56
For carrying goods to Georgia	0.26
Average load factor (tons/vehicle)	20
Total freight turnover (tone-kms)	1516



During transit	1037
For carrying goods to Georgia	479