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Mitigation of greenhouse gas emissions from the Transport sector (TS) in Syria

(INC-SY_Mitigation_ Transport opportunities-En)

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This report has been approved unanimously by the technical committee, during the Technical Workshop which took place on 28.2.2010, in Samiramis Hotel, Damascus.

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- All ships will be converted to nuclear power. Submarines will carry the heaviest loads with higher speeds because the resistance forces to the motion of ships on the water surface are not available under the water.
- The water plane which is already in operation for a long time was developed not enough. It will be developed to become like an express bus and will commute through oceans. Water planes can operate on shallow water; therefore they can continue and supplement the work of international bunkers, taking their charges, delivering them to any sea or river port.
- Vehicles on air layer: they run few centimeters above the surface of land or water, therefore they can reach any place that could not be reached by land transport. They can deliver frozen food and medicaments to people in isolated areas.
- HEVs, FCVs and biofuels will spread and become popular.

2. Some Aspects of Transport in Syria

Fig .1 shows TS and related authorities

The number of workers in the Ministry of Transport and related authorities in 2008 is 42915 workers and in the private sector is 320259 workers.

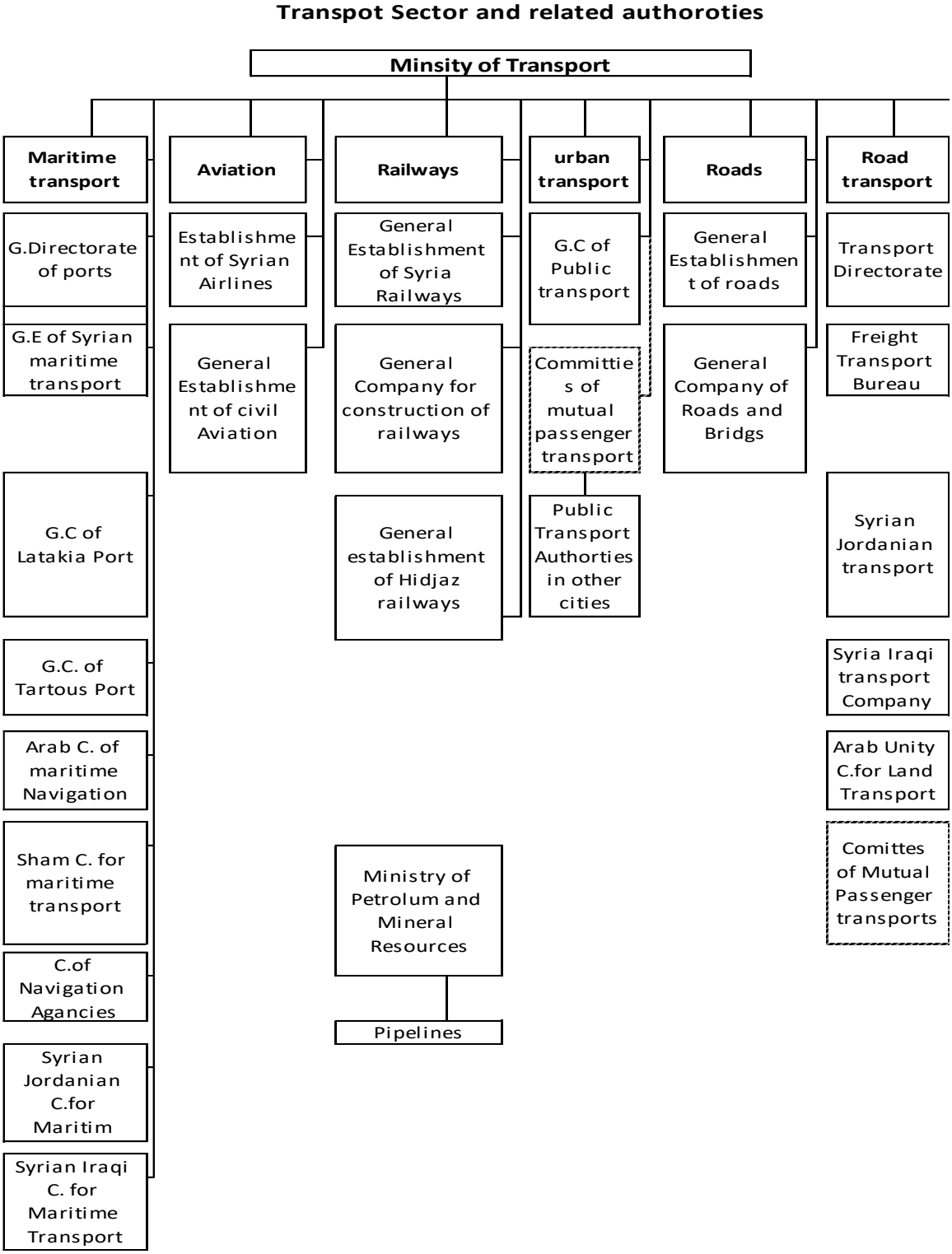


Fig.S1. Transport Sector and Related Authorities

The development of TS is going on according to the market economy towards which Syrian economy was transferring since 2005.

Number of cars was quickly increasing due to the reducing of custom charges. It was increased 4 times in the period 1994-2008,2 times in the period2004-2008. It is now 28 cars per 1000 inhabitants.

Fig No.2 demonstrate the number of vehicles due to their groups and type of fuels in the year2008

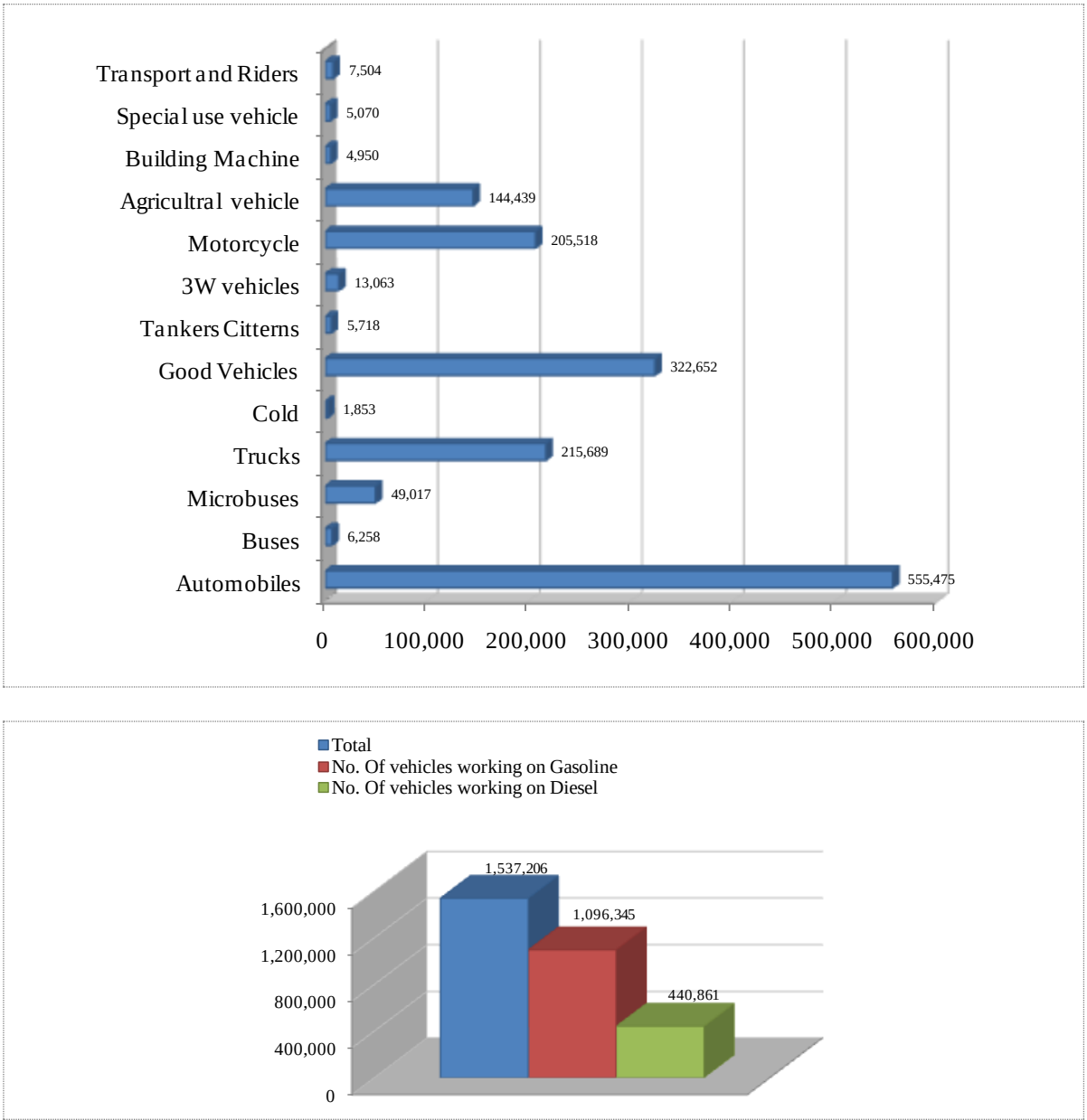


Fig.S2. Number of Vehicles due to their Groups and the Total in the period 2000-2008

Road transport is playing the main role in transportation. It is share is about 90%. It is still ruled by old legislations, individual form of ownership and operation.

It is planned to enlarge the network of highways on BOT basis. The maintenance of roads network is weak because of the lack of the assigned money. The possibility to enlarge roads network inside cities is very limited.

Microbuses still play the main role in urban transport. It is ruled by the old decree 112 of the year 1953. The form of ownership and operation is individual. It is proved all over the world the need to establish a comprehensive modern public transport system in every city including electric modes in big cities.

Nearly one half of the people are living in cities, therefore it is necessary to develop the structure of urban transport by renewal of its' legislations.

The huge increase of individual cars in cities has produced many problems for which very difficult to find solutions. Cars are standing along the two sides of roads using the space as a garage. The capacity of roads has been weakened sharply and the rush hours are now longer. The speed of traffic flows during the rush hours goes down in some areas to become equal to speed of the pedestrians. This also proves the need to establish a comprehensive modern public transport system in all cities.

The GE of Syrian railways is aiming to increase its share in transportation from 10% now to 26% in 2030, and to connect the Syrian railways with the neighbor networks. This plan faces the problem of lack of financing. The railways sector is completely a state sector.

Fuel consumption is 4 times less per tkm, and 2 times less per pkm when comparing railways with road trucks and buses

The air transport is transferring. It is opened now to the private sector. The airplanes of Syrian Air are old and many of them are out of service.

Sea transport is opened also to the private sector. It is necessary to modernize the fleet of ships.

Fuel consumption in cars and GHG emissions from them during the rush hours in cities (when the speed is about 5 km/h) is 3 times more than in the normal situation when the speed is about 25 km/h.

Diesel consumption in the transport sector in 2005 was 2.7293 Mt or 38.71% of total consumption in Syria.

Gasoline consumption in Syria in 2005 was 1518228 m3 supper and 101053 m3 ordinary. Most of them is in transport sector.

Fig No.3 shows diesel, gasoline and kerosene consumption in 2005 and 2008

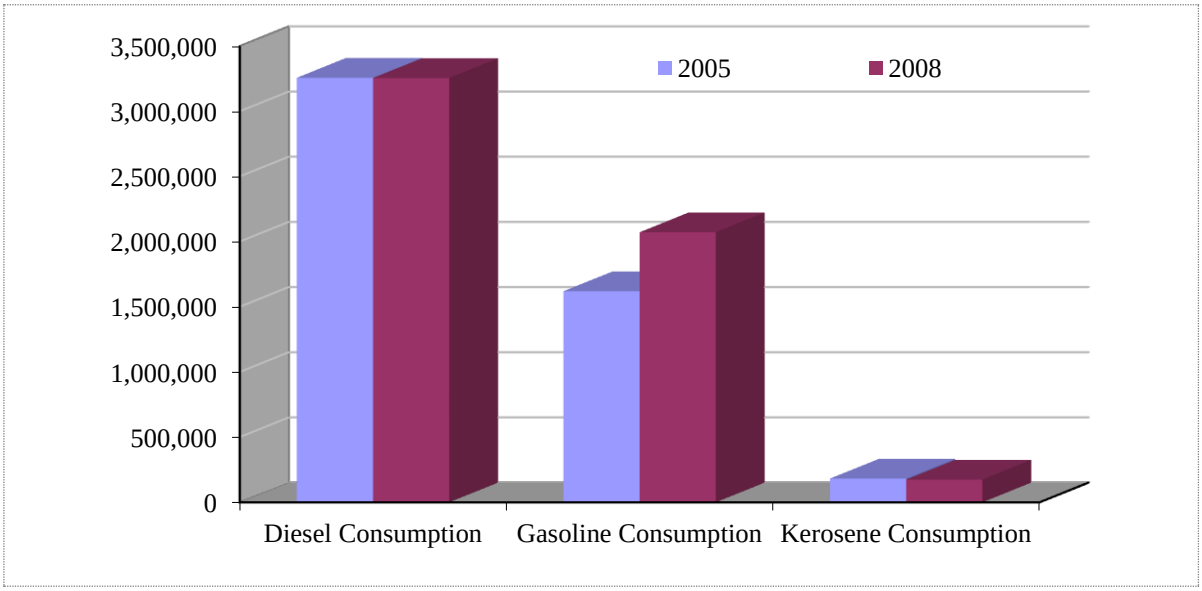


Fig.S3. Diesel, Gasoline and Kerosene Consumption in 2005 and 2008

The total fuel consumption in the TS in 2005 was 4.538 mtoe. It is expected that this figure will rise to 9.493 in the year 2020 and 15.87 in the year 2030.

The GHG emissions in the TS in 2005 were 12.5 mtCO2eq. It is expected that this figure will rise to 15.5 in 2010, 21 in 2020 and 26.5 in 2030 supposing that the situation will continue developing as it is now.

3. Efficiency Technology Options

In the year 2003 the European manufacturers were producing the least polluting vehicles, with 163 grams of CO2 emitted on average every test cycle kilometer (g/km). By comparison, cars from Japanese automakers emitted an average of 172 g/km, and Korean cars 179 g/km (European commission, 2005)

European, Japanese and Korean car makers have all committed to reducing CO2 emissions from passenger cars to an average 140g/km in 2008(in 2009 for Asian makers).The ultimate objective is to reduce emissions to120 g/km by 2012. This would represent a 25% reduction in fuel demand against current levels in new cars.

Five main types of approach can be singled out that improve fuel efficiency.

1. Improvements in existing engines
2. Switching from gasoline to diesel
3. Hybrid electric Vehicles
4. Fuel cell vehicles
5. Other technologies

4. Alternative fuels

Biofuels merit special focus. They can contribute to both supply security and CO2 reduction while demanding no substantial adjustments in car technology. Rising oil prices have again heightened interest in bio fuels for the transportation sector. This follows an ongoing trend over the past three decades that swelled the share of Bio fuels in total transportation sector energy use to 0.8% (0.6 exajoules [EJ]) in 2003.

Further rapid increases are likely. Currently, two forms of bio fuel dominate: ethanol and biodiesel. Ethanol production worldwide is estimated to have reached 46 billion liters at the end of 2005, with 80% (0.78EJ) for fuel use. 40% of current production takes place in the United States, 40% in Brazil and 7% in Europe. Production of biodiesel is smaller, at some 3 billion liters (0.1 EJ), and concentrated largely in Europe, which accounts for some 2 billion liters.

While ethanol production from sugar cane is already cost-effective in countries such as Brazil and India, this is not the case elsewhere.

Currently the ethanol production process involves between 60% and 90% less CO2 emissions than production of gasoline.

Table no.1shows Percentage of mitigation CO2 emissions according to technology and type of fuel

Table S1. Percentage of Mitigation CO2 Emissions according to Technology and Type of Fuel

Technology	Ratio (%)
Improving engines	12 – 25
HEVs	10 – 30
FCVs	75 – 100
Additional technical improvements	8
Diesel vs. Gasoline	14
Biodiesel	100
Ethanol	100
Elastic Ethanol (Mix. Ethanol and Gasoline)	0 – 10

Source: Ref [17]

5. Directions of Improvement of the Road Transport Efficiency

- Improvement of road transport indicators (reducing time and cost, fuel consumption of transportation)
- Renewal of old fleet of trucks and buses. This action needs the support of the government to the fleet owners by eliminating the customs taxes related to this process.
- Renewal of road transport legislations
- Encouraging replacement of individual form of investment and operation by companies including stock market companies.
- Annulment of transport bureaus ruling the road transport activities
- Activation of the role of new established union of transport companies.
- Encouraging the establishment of multimodal transport companies.
- Liberalization of transportation between Arab countries and annulment of all kinds of taxes and charges.
- Introducing the utilization of the developed communication systems in transportation.
- Participating in all international transport conventions and agreements.
- Simplifying the procedures in the crossing border centers, the organization of convoys.
- Controlling the axel loads of trucks to maintain the roads
- Improvement of roads and traffic efficiency, permanent maintenance of roads.

6. Measures for Improvement Efficiency of Urban Transport

- Developing structural organization of the sector
- Developing urban transport systems
- Developing traffic systems
- Measures of reducing transport demand

- Controlling the technical readiness of vehicles
- Improving the quality of fuels

7. Developing Structural Organization of the Sector

- ✓ Putting limits to urban development in Damascus and other old cities. Development of new small and medium cities taking into consideration the criteria of international urban planning.
- ✓ Transport and traffic planning should be an essential part of the master plans of all cities.
- ✓ Public transport is a vital necessity in all cities.
- ✓ Renewal of urban transport legislations.
- ✓ Attracting public opinion to participate in the definition and implementation of improval measures.
- ✓ Supplying the financial needs to this sector.
- ✓ Replacement the individual form of ownership and operation of means of transport by modern companies.
- ✓ Coordination and cooperation among public, private and mutual sectors in the development of urban transport.
- ✓ Establishment of faculty of transport and traffic engineering and economics with three departments.
  - Construction department (roads, bridges, tunnels, railways, airports, ports and pipeline).
  - Operation department of transport modes (urban transport, road transport, maritime transport, pipeline transport).
  - Department of transport economics.
- ✓ Renewal of transport fleet
- ✓ Reviewing the prevention of utilization diesel fuel in cars and pickups taking into consideration the needs for emissions mitigation.
- ✓ Reviewing the subsidation policy of fuel products
- ✓ Separating diesel of vehicles and diesel for heating

Developing Urban Transport System

- ✓ Implementation of utilization CNG in buses and cars.
- ✓ Implementation of electric modes of transport (metro, monorail, tramways) in Damascus and other cities.

- ✓ Construction of new train station in the northern part of Damascus.
- ✓ Supplying new buses to all Syrian cities
- ✓ Improvement of bus and microbus networks.
- ✓ Establishment of database and information system for urban transport.
- ✓ Utilization of wireless communication for managing the activity of taxis.
- ✓ Encouraging bikes and walking.
- ✓ Encouraging the utilization of HEVs and FCVs.

Developing Traffic System

- ✓ Separation the motion of pedestrians by construction of upper or under passages
- ✓ Establishment central traffic control unit
- ✓ Separation of traffic flows intersecting in round central squares, development of other road junctions.
- ✓ Solving the problem of cars using streets as garages
- ✓ Implementation measures for improving organization of traffic flows: specialized lanes for buses and microbuses, preventing motion of vehicles in some areas, implementing green wave of signals.
- ✓ Improvement of the quality and maintenance of roads and all facilities and networks connected with roads.
- ✓ Construction garages under parks and squares and in the passenger terminals.
- ✓ Completion of circular roads in Damascus
- ✓ Renewal the traffic study done by JICA.

Measures of Reducing Transport Demand and Smoothing Rush Hours

- ✓ Simplifying system of paying different charges or taxes including annual charges for vehicles enabling people to pay them in the living area or through banks
- ✓ The movement of start time of work in different ministries establishments, companies, etc.
- ✓ Simplifying measures ruling the organization of services to people.

Controlling the Technical Readiness of Vehicles

- ✓ Equipping and putting into operation vehicles inspection centers in all transport directorates

- ✓ Participating the private sector in establishing vehicles inspection and maintenance centers .
- ✓ The vehicles running in streets to be checked by specialized personnel.
- ✓ Training drivers on principles and methods of energy efficient driving.

Improving the quality of fuels

- ✓ Using unleaded gasoline in all gasoline vehicles
- ✓ Reducing the amount of lead added to gasoline
- ✓ Reducing sulffer in diesel fuel
- ✓ Experimenting the possibility of introducing biofuels in the Country.
- ✓ To prevent using the old refined oils in vehicles.

The development strategy of railways

- ✓ The development strategy of the GE of Syrian railways till 2025 aims to:
- ✓ Rehabilitation of the present network and available means of transport.
- ✓ Construction of new lines and connections of Syrian railways networks with the neighboring countries.
- ✓ Import of new means of transport.
- ✓ Utilization of electric power
- ✓ Separation of ownership at operation in some activities. The estimated cost is about 172 billion S.P.
- ✓ The strategy will ensure increasing the share of railways in transportation from 10% now to 26% in 2020.

8. Air and Sea transport

Some activities were opened to the private sector. The expected development in air and sea transport is summarized as follows: Fleet renewal, renewal of airports and ports equipments and communication system, improval of management, planning and operation systems. The expected reduction of emissions related to these measures is about 30%.

9. Summary of the amounts of GHG emissions mitigation resulting from implementation of the suggested measures

Table No.2 shows Ratio and the amounts of reduction GHG emissions in 2020 and 2030

Table S2. Ratio and the Amounts of Reduction GHG Emissions in 2020 and 2030

Suggested measures	Ratio of GHG mitigation %		The amount of reduction GHG emissions (ktonCO2eq)	
	2020	2030	2020	2030
Efficiency technology options and alternative fuels	34.2	68.4	2069	5220
Renewal of the fleet of vehicles, maintenance of roads, managing, organizational and planning measures	30	45	4233	8010
Development of urban transport systems	36	60	2178	4579
Development of railways	30	35	785	553
Total			**9265**	**18362**

Source: Ref [author]

It is clear from table No.2 that reduction of GHG emissions is 44% in 2020 and 69.29% in 2030. It is expected that the mitigation of GHG emissions in TS and other sectors, will have an important effect on climate change which took place in the country in the last years.

Fig No.4 shows Ratio and the amounts of GHG emissions (KtonCO2eq) 2020 and 2030

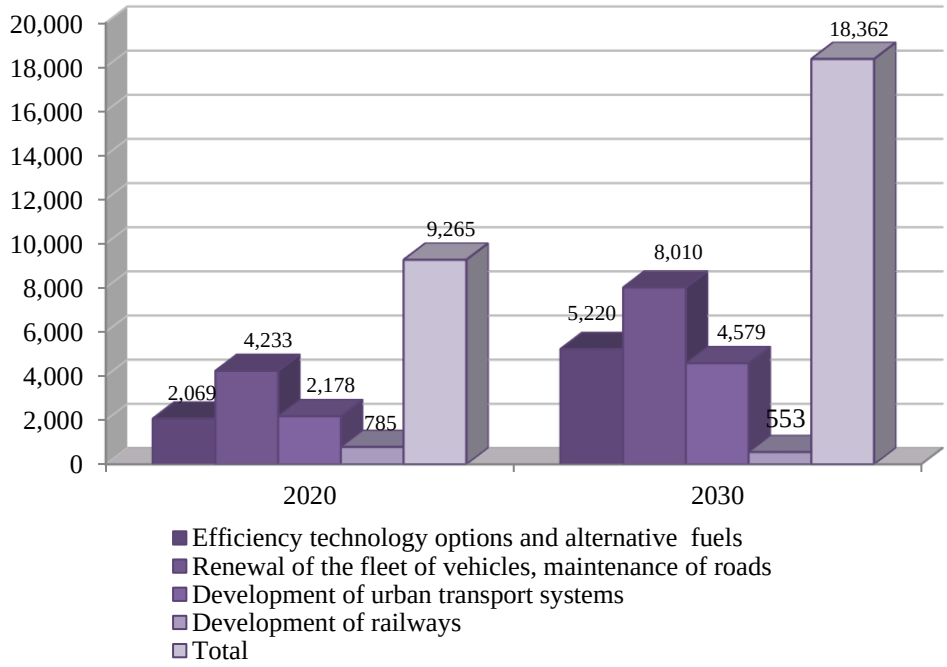


Fig. S4. Ratio and the Amounts of GHG Emissions (KtonCO2eq) in 2020 and 2030

In general reduction of fuel consumption and GHG emissions mitigation in the TS can be achieved through improving the efficiency of transport systems according to the content of the section No.5, through international experience and the help of international organizations. This need:

- ✓ Joint financing public and private
- ✓ To make available specialists, experts, specialized administrations
- ✓ Plans and programs depending upon national and international experience.

- ✓ Attracting the civil society to participating in implementing the mentioned plans and activities.

1. Brief Abstract about the Transport Sector in Syria

Sustainable development is becoming popular. It is now considered as an essential principle for the economic development, scientific and technical progress all over the world. We can mention here some of the directions of the perspective development of the (TS) in the 1st half of the 21st century.

- ✓ Developing Transport without wheels (on magnetic layer) speed of which can reach 500 km/h. These systems are now under implementation.
- ✓ A little attention was paid to the utilization of rockets in transportation. It is expected that in the 21st century we shall witness the production of vehicles carried by rockets to transport freight and passengers across very far origins and destinations on our planet.
- ✓ All ships will be converted to nuclear power submarines will carry the heaviest loads with higher speeds because the resistance forces to the motion of ships on the water surface are not available under the water.
- ✓ The water plane which is already in operation for a long time was not developed enough. It will be developed to become like an express bus and will commute through oceans. Water planes can operate on shallow water; therefore they can continue and supplement the work of international bunkers, taking their charges, delivering them to any sea or river port.
- ✓ Vehicles on air layer: they run few centimeters above the surface of land or water, therefore they can reach any place that could not be reached by land transport. They can deliver frozen food and medicaments to people in isolated areas.
- ✓ Transport sector is considered as one of the main sectors of the national economy. It is classified in some countries as one of the sectors of material production. Transport sector has some characteristics: the most important of them is that its product does not have weight or dimensions as it is in the case of the industry or agriculture. The process of transportation of goods and people through distance and time is an essential condition to complete the process of production. Another specific aspect of the transport sector is the motion of vehicles constantly loaded or empty between points of origin and destination.
- ✓ The operation and management of transport sector aims to reach a high level of efficiency between three components of transportation:

    1) Goods and Passengers
    2) Vehicles or means of transport
    3) Roads, bridges and tunnels, railways, ports, airdromes, pipelines.

Transport sector is divided into subsectors as follows:

a) Road transport

b) Roads

c) Urban transport

d) Railways

e) Aviation

f) Maritime transport

g) Pipelines

Each subsector has governmental authorities controlling its activities. All subsectors are under the supervision of the ministry of transport, except pipelines which relate to the ministry of petroleum and mineral recourses (Fig.1).

Tab.1 shows the number of workers in the ministry of transport and related authorities in 2008

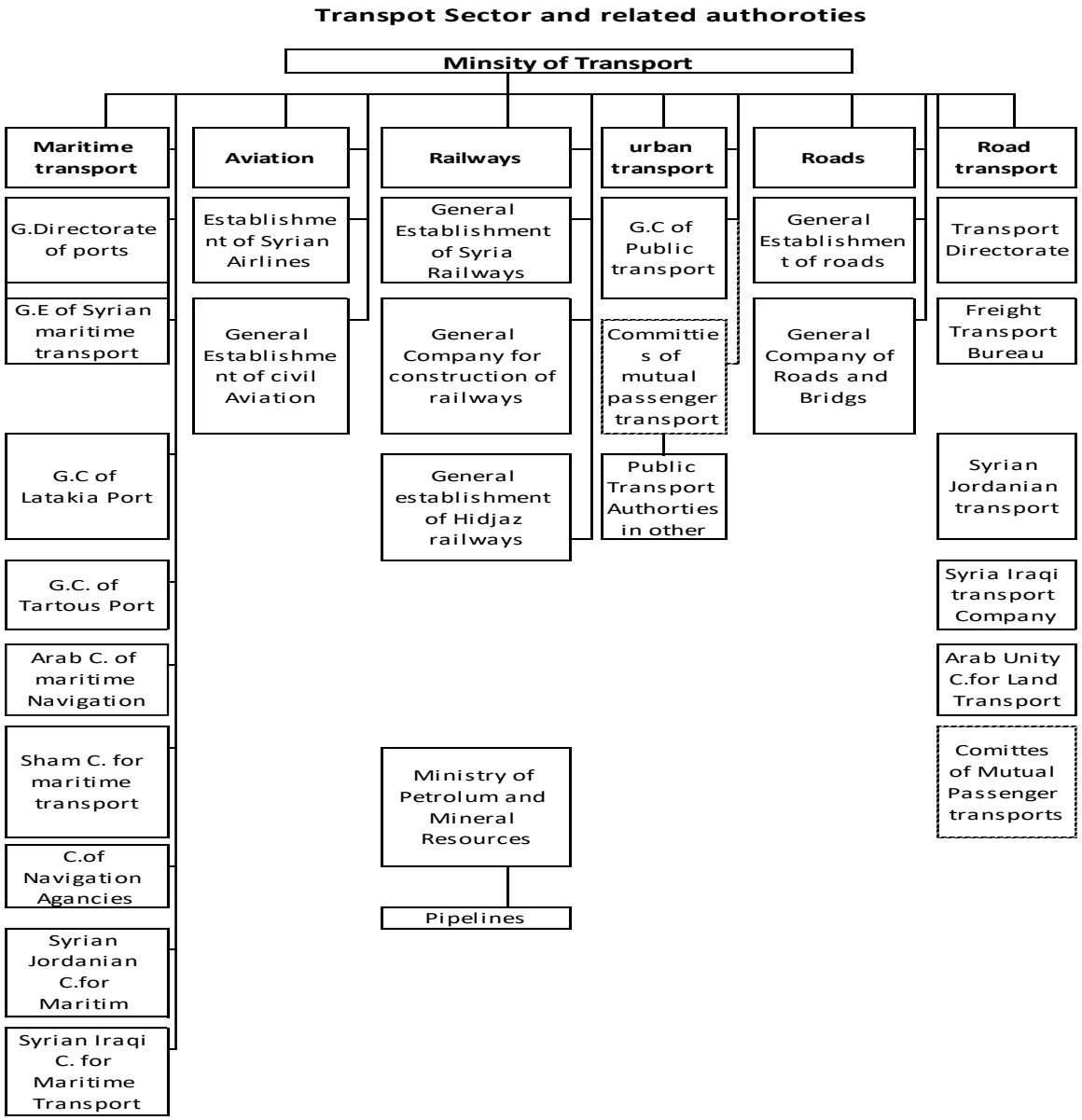


Fig.1. Transport Sector and Related Authorities

Table 1. Human Resources in the Ministry of Transport and related Authorities in 2008

Governmental authority	Number of workers
MOT Headquarters	432
Transport directorates	1388
Freight Transport bureaus	470
Establishment of Syrian airlines	5554
G EST. of civil aviation	1659
G.E. of Syrian railways	12203
G.E. of Alhigaz railways	758
G.C for construction of railways	1147
G.C of Lattakia Port	2696
G.C of Tartous Port	2901
G. Directory of Ports	274
Navigation company	528
G.E of maritime transport	208
G.C for urban transport in Damascus	1888
G.C for urban transport in Homs	434
G.C for urban transport in Aleppo	1006
G.C for urban transport in Lattakia	477
G.E. of roads	1337
G.C of roads and bridges	7555
Total	**42915**

Source: Ref [1] www.mot.gov.sy figures and numbers

1.1. Road Transport

Road transport covers three subtitles:

1) Vehicles issues
2) Freight transport
3) Passenger transport

Supervision of the road transport belongs to the road transport directory in the Central administration of the ministry of transport which controls the activity of the transport directorates (TD) and the transport bureaus (TB).

Syria is divided into 14 governorates. In each governorate there is a transport directorate responsible for the vehicles issues, and a transport bureau responsible for the freight transport.

1) Vehicles Issues

Transport directorate in each governorate is responsible for the vehicles issues (the vehicles of the army and police are not included)

Statistics of vehicles

Table 2. Demonstrate the Number of Vehicles Registered in each Governorate due to Groups of vehicles, types of plates, kind of fuel, 2008

Table 2. Number of Vehicles Registered in each Governorate due to Groups of vehicles, types of plates, kind of fuel, 2008

Fuel Type		Total	Quneitra	Sweida	Dar'a	Hasaka	Deir-ez-zor	Rakka	Aleppo	Idleb	Lattakia	Tartous	Hama	Homs	Damascus Rural	Damascus	Mohafazat / Kind of Vehicles
Diezel	Gasoline																
4975	550500	555475	577	9176	7259	8832	6937	6086	101383	\	34892	30878	18144	39293	18512	267029	Automobiles
1311	435052	436363	405	6345	3621	3291	3163	1996	81745	4145	24568	25789	13447	32939	13369	221540	Private cars
1307	433576	434883	404	6323	3581	3245	3147	1985	81479	4099	24484	25661	13380	32852	13352	220891	خاصة
0	289	289	0	2	1	1	0	0	13	4	15	16	1	15	0	221	مشوهي حرب
4	1037	1041	1	18	39	45	16	11	232	42	69	107	63	72	17	309	معوقين
0	150	150	0	2	0	0	0	0	21	0	0	5	3	0	0	119	مجلس الشعب
2209	79425	81634	47	2368	3151	3858	2826	3306	16453	1818	9045	3947	3774	4646	3338	23057	Taxis
1960	78827	80787	47	2356	3135	3779	2824	3262	16244	1809	8910	3920	3724	4505	3215	23057	سياحية لوحة مستأجرة
249	598	847	0	12	16	79	2	44	209	9	135	27	50	141	123	0	سياحية لوحة حرة
0	565	565	0	0	0	0	0	0	0	1	0	284	0	0	0	280	سياحية رانت كار
747	18921	19668	120	370	420	1526	610	324	3063	510	1070	802	903	1663	636	7651	سياحية حكومية
379	3238	3617	0	5	0	28	333	3	120	13	41	41	14	41	1132	1846	سياحية إدخال مؤقت
329	13299	13628	0	88	67	129	0	457	2	0	168	15	6	4	37	12655	جيب حقلية
6133	125	6258	43	101	90	202	88	181	1530	112	358	136	312	553	446	2106	Buses
257	21	278	0	3	21	11	4	0	76	0	12	4	3	14	38	92	باص خاص
2205	24	2229	25	55	29	44	20	44	668	73	144	33	155	207	312	420	باص عام
649	22	671	12	17	0	42	11	4	203	47	26	5	96	71	137	0	باص لوحة حرة
1340	2	1342	4	29	29	2	9	39	357	26	103	28	35	128	133	420	باص لوحة مستأجرة
364	0	364	9	9	0	0	0	1	108	0	15	0	24	8	42	148	بولمان سياحي
1240	80	1320	12	13	11	125	17	104	291	6	41	59	26	168	82	365	باص حكومي
57	0	57	0	0	0	0	16	0	5	1	0	2	0	4	7	22	باص إدخال مؤقت
2226	0	2226	6	30	29	22	31	33	490	32	161	38	128	160	7	1059	شركات النقل الداخلي
46833	2184	49017	380	953	1976	2446	1844	1456	7474	1966	3720	3370	2636	4951	8290	7555	Microbuses
1046	1089	2135	0	14	101	55	10	4	243	7	100	148	36	91	422	904	ميكروباص خاص
41562	267	41829	323	900	1793	2031	1708	1364	6468	1880	3340	2947	2413	4222	7676	4764	ميكروباص عام
1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	ميكروباص لوحة حرة
41561	267	41828	323	900	1793	2031	1708	1363	6468	1880	3340	2947	2413	4222	7676	4764	مكيرو باص لوحة مستأجرة
339	1	340	7	1	0	0	4	1	0	20	0	0	2	274	2	29	ميكروباص بولمان
3809	777	4586	50	38	82	351	93	87	763	59	273	270	185	364	173	1798	ميكرو باص حكومي
77	50	127	0	0	0	9	29	0	0	0	7	5	0	0	17	60	ميكرو باص إدخال مؤقت
212902	2787	215689	2016	4797	18198	14210	8330	8938	40406	16923	8983	11647	19841	23342	25832	12226	Trucks
158949	411	159360	1612	4059	15549	11103	6418	7259	25324	14551	5768	8476	16899	17162	18826	6354	شاحنة خاصة
142571	398	142969	1547	3893	14356	11003	6225	7058	22898	14119	5025	7535	6371	16478	16225	236	زراعي
6358	8	6366	46	144	781	80	108	82	870	385	612	761	208	302	1745	242	صناعي
2951	5	2956	19	7	412	20	85	119	273	47	131	180	212	294	856	301	تجاري
2	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	شاحنة صغيرة مرسوم 29
7067	0	7067	0	13	0	0	0	0	1283	0	0	0	108	88	0	5575	شاحنة صغيرة مرسوم 256
44456	1339	45795	251	504	2029	1288	1512	905	13098	2079	2614	2424	2474	5247	6632	4738	شاحنة صغيرة عامة
2673	35	2708	0	2	65	79	96	50	1072	37	257	21	294	473	262	4738	شاحنة صغيرة لوحة حرة
41783	1304	43087	251	502	1964	1209	1416	855	12026	2042	2357	2403	2180	4774	6370	0	شاحنة صغيرة لوحة مستأجرة
9336	1034	10370	153	234	620	1808	335	771	1984	293	601	742	467	930	373	1059	شاحنة صغيرة حكومي
161	3	164	0	0	0	11	65	3	0	0	0	5	1	3	1	75	شاحنة صغيرة إدخال مؤقت

Fuel Type		Total	Quneitra	Sweida	Dar'a	Hasaka	Deir-ez-zor	Rakka	Aleppo	Idleb	Lattakia	Tartous	Hama	Homs	Damascus Rural	Damascus	Mohafazat
Diezel	Gasoline																Kind of Vehicles
1805	48	1853	21	1	445	4	1	0	182	6	14	0	34	38	785	322	Cold Storage Lorray
38	0	38	0	0	0	1	0	0	0	0	0	0	0	0	0	37	خاصة
82	1	83	0	0	0	3	0	0	20	0	0	0	10	28	4	18	براد حكومي
1685	47	1732	21	1	445	0	1	0	162	6	14	0	24	10	781	267	براد عامة
1678	47	1725	18	1	445	0	1	0	158	6	14	0	24	10	781	267	براد لوحة مستأجرة
7	0	7	3	0	0	0	0	0	4	0	0	0	0	0	0	0	براد لوحة حرة
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	براد لوحة إدخال مؤقت
7213	315439	322652	1938	10132	8438	18905	6922	8972	71373	13179	15797	13383	18650	31362	50610	52991	Small Good Vehicles
3937	250419	254356	1762	8883	7720	17799	6086	8042	52342	12038	13097	12327	16950	27321	33708	36281	شاحنة صغيرة خاصة
3266	139931	143197	741	6588	5660	17698	5899	3521	43255	7273	8588	4079	9561	9502	20073	759	زراعي
57	2803	2860	0	56	147	101	97	48	375	32	150	25	45	370	1194	220	صناعي
48	1694	1742	9	12	92	0	90	33	242	6	15	8	83	213	697	242	تجاري
493	42432	42925	606	1369	1620	0	0	0	8470	1436	4344	8215	2398	6625	4291	3551	شاحنة صغيرة مرسوم 29
73	63559	63632	406	858	201	0	0	4440	0	3291	0	0	4863	10611	7453	31509	شاحنة صغيرة مرسوم 256
1145	54647	55792	91	964	362	427	348	556	17207	701	1947	460	1014	2915	16425	12375	شاحنة صغيرة عامة
17	435	452	0	3	0	2	2	0	0	0	25	0	71	0	349	0	شاحنة صغيرة لوحة حرة
1128	54212	55340	91	961	362	425	346	556	17207	701	1922	460	943	2915	16076	12375	شاحنة صغيرة لوحة مستأجرة
1981	10271	12202	85	285	356	679	422	374	1819	439	746	595	686	1123	462	4181	شاحنة صغيرة حكومي
150	102	252	0	0	0	0	66	0	5	1	7	1	0	3	15	154	شاحنة صغيرة إدخال مؤقت
5693	75	5718	137	65	165	183	204	349	1668	66	259	111	206	1315	408	582	Citern
106	1	107	0	0	0	0	0	4	0	0	0	0	0	97	0	6	صهريج خاص
3634	4	3638	94	10	125	37	110	209	1389	25	166	38	76	998	270	91	صهريج عام
1021	0	1021	8	0	0	0	20	20	162	2	16	0	6	783	4	0	صهريج لوحة حرة
2613	4	2617	86	10	125	37	90	189	1227	23	150	38	70	215	266	91	صهريج لوحة مستأجرة
1907	20	1927	43	55	40	146	86	136	279	41	93	72	130	209	137	460	صهريج حكومي
46	0	46	0	0	0	0	8	0	0	0	0	1	0	11	1	25	صهريج إدخال مؤقت
30	13033	13063	0	19	60	1820	9	3808	2509	1828	19	177	1559	379	816	60	3 Weels Pickups
14	2929	2943	0	13	59	868	0	608	150	1114	13	43	1	29	43	2	دراجة آلية شاحنة خاصة
16	10031	10047	0	6	1	952	9	3200	2359	714	6	134	1558	336	772	0	دراجة آلية شاحنة عامة
0	73	73	0	0	0	0	0	0	0	0	0	0	0	14	1	58	دراجة آلية شاحنة حكومي
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	دراجة آلية شاحنة إدخال مؤقت
641	204877	205518	1220	7245	22288	16948	12891	12124	14955	13060	9437	19200	15647	23119	32069	5315	Motorcycles
610	183029	193639	860	6674	21011	15492	11153	10527	11969	11190	8120	17946	13003	21359	31242	3093	دراجة آلية خاصة
31	21848	21879	360	571	1277	1456	1738	1597	2986	1870	1317	1254	2644	1760	827	2222	حكومي
0	195	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	دراجة آلية شاحنة إدخال مؤقت
144180	259	144439	2216	4650	9333	12025	9966	9000	36356	14562	5242	5057	17465	12057	11019	491	Agricultural Vechicles
134215	84	134299	2115	4442	8955	8522	9456	8385	34929	14028	4806	4753	11674	11568	10527	139	جرارات زراعية
4536	159	4695	0	23	28	2936	4	179	1012	227	0	0	237	0	46	3	حصادات زراعية
5357	16	5373	101	185	350	558	506	436	367	303	436	303	548	489	446	345	جرارات حكومية
67	0	67	0	0	0	9	0	0	48	4	0	0	6	0	0	0	حصادات حكومية
5	0	5	0	0	0	0	0	0	0	0	0	1	0	0	0	4	جرارات إدخال مؤقت
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	حصادات إدخال مؤقت

Fuel Type		Total	Quneitra	Sweida	Dar'a	Hasaka	Deir-ez-zor	Rakka	Aleppo	Idleb	Lattakia	Tartous	Hama	Homs	Damascus Rural	Damascus	Mohafazat / Kind of Vehicles
Diezel	Gasoline																
4940	10	4950	29	149	292	258	219	169	1319	245	129	340	421	100	957	373	Building Machines
2745	7	2752	17	14	124	105	162	63	466	180	7	245	375	64	926	4	مركبة أشغال خاصة
229	0	229	3	66	0	0	4	0	70	8	3	15	0	0	0	60	مركبة أشعال عامة
1908	3	1911	9	69	168	105	49	106	783	57	119	80	46	32	31	257	مركبة أشغال حكومية
58	0	58	0	0	0	48	4	0	0	0	0	0	0	4	0	2	مركبة أشغال إدخال مؤقت
3921	1149	5070	31	29	152	61	187	175	935	44	382	367	248	603	561	1295	Specialized Vehicles
728	124	852	1	3	40	8	24	2	112	8	9	210	10	46	190	189	سيارة ذات استعمال خاص خاصة
1066	173	1239	5	6	32	53	17	1	255	9	164	33	105	114	210	235	سيارة ذات استعمال خاص عامة
1989	832	2821	25	20	80	0	85	172	568	26	209	120	133	443	158	782	سيارة ذات استعمال خاص حكومية
138	20	158	0	0	0	0	61	0	0	1	0	4	0	0	3	89	سيارة ذات استعمال خاص إدخال مؤقت
1595	5909	7504	35	30	37	325	540	66	1653	19	501	219	212	548	358	2961	Transport and Riders
298	4269	4567	6	13	16	185	21	6	1410	14	377	140	111	320	275	1670	نقل وركوب خاص
3	1	4	0	3	0	0	0	0	0	0	0	0	0	0	0	1	نقل وركوب عامة
606	1505	2111	29	14	18	140	52	60	243	5	122	79	100	228	63	958	نقل وركوب حكومية
688	134	822	0	0	0	0	467	0	0	0	2	0	1	0	20	332	نقل وركوب إدخال مؤقت
440861	1096345	1537206	8638	37347	68733	76219	48132	51324	281743	68497	79733	84885	90375	137660	150663	353256	Total
Means of Transport imported according to the Investment Law No. 10																	
8	2745	2753	0	33	141	28	0	37	954	28	74	180	54	93	146	985	Automobiles
2497	2	2499	6	14	35	254	88	15	614	99	32	237	143	23	145	794	Buses
2306	41	2347	0	7	15	43	2	25	401	145	54	412	113	84	289	757	Microbuses
7795	2	7797	16	15	70	15	125	11	1720	41	0	1144	1342	1628	1475	195	Trucks
139	0	139	0	0	20	0	5	3	34	0	11	6	14	21	17	8	Citern
1227	161	1388	0	10	10	0	0	0	42	145	959	1	18	13	2	188	Small Good Vehicle
252	1	253	0	0	6	0	0	0	129	0	0	7	8	36	1	66	Cold Storage Lorray
11	2	13	0	0	0	0	0	0	1	0	0	0	0	0	10	2	Building Machines
16	0	16	0	0	0	0	0	0	0	0	2	0	0	14	0	0	Specialized Vehicles
2	3	5	0	0	0	0	1	0	0	0	1	0	1	0	1	1	Transport and Riders
14253	2957	17210	22	79	297	340	221	91	3895	458	1133	1987	1693	1912	2086	2996	Total - Inv. Law
455114	1099302	1554416	8660	37426	69030	76559	48354	51415	285638	68955	80866	86872	92068	139572	152749	356252	Total

Source: Ref [Statistics of MOT]

Table No.3 demonstrate the number of vehicles due to their groups in the period 1994-2008

Table 3. Number of Vehicles due to their Groups in the period 1994-2008

Kind of Vehicles	1994	1995	1996	1997	1998
By road:					
Automobiles	130829	136160	139592	138460	138900
Buses	5282	5239	5199	4835	5147
Micro Buses	23034	25145	28771	32618	34996
Good Vehicles	45228	58717	70556	72819	81023
Pick-Ups	140078	161747	177404	192696	197866
Tankers citterns	3102	3567	3491	3545	3775
Motorcycles	87070	89038	88453	87361	88121
Various Vehicles of Temporary Entrance	6353	7163	7081	6770	4802
Total	**440976**	**486776**	**520547**	**539104**	**554630**

Kind of Vehicles	1999	2000	2001	2002	2003
By road:					
Automobiles	138574	138823	148884	181017	200933
Buses	5164	4757	4605	4758	4767
Micro Buses	36922	38167	39974	41802	42617
Good Vehicles	104300	126442	126749	138145	146949
Pick-Ups	205248	215131	217728	224247	229594
Tankers citerns	3898	4040	4211	4656	5197
Motorcycles	90120	91399	105150	99009	104732
Various Vehicles of Temporary entrance	4062	4470	4881	5217	5918
Total	588288	623229	652182	829141	746343
Various Vehicles	120828	123291	126523	130290	133833
Total	709116	746520	778705	959431	880176
Investment means	15210	15499	16616	16106	16818

Kind of Vehicles	2004	2005	2006	2007	2008
By road:					
Automobiles	227639	278866	358032	446132	555475
Buses	4742	4907	5179	5154	6258
Micro Buses	43199	44237	45923	45655	49017
Good Vehicles	155206	168248	183848	196490	215689
Pick-Ups	233510	268870	292227	319677	322652
	5164	5259	5731	6547	7504
Tankers citterns	4922	5226	5432	5616	5718
Motorcycles	122323	145390	165281	186945	205518
Various Vehicles of Temporary Entrance	6390	6169	6433	5259	-
Total	803095	927172	1068086	1217475	1367831
Various Vehicles	135239	140357	144948	150292	169375
Total	938334	1067529	1213034	1367767	1537206
Investment means	19252	19252	13583	15957	17210

Source: Ref [9]

The vehicles of the army and police are not included in the above statistics, and the data about them is not available. We estimate their number as 20% of the total.

Fig No.2 demonstrate the number of vehicles due to their groups and type of fuels in the year2008

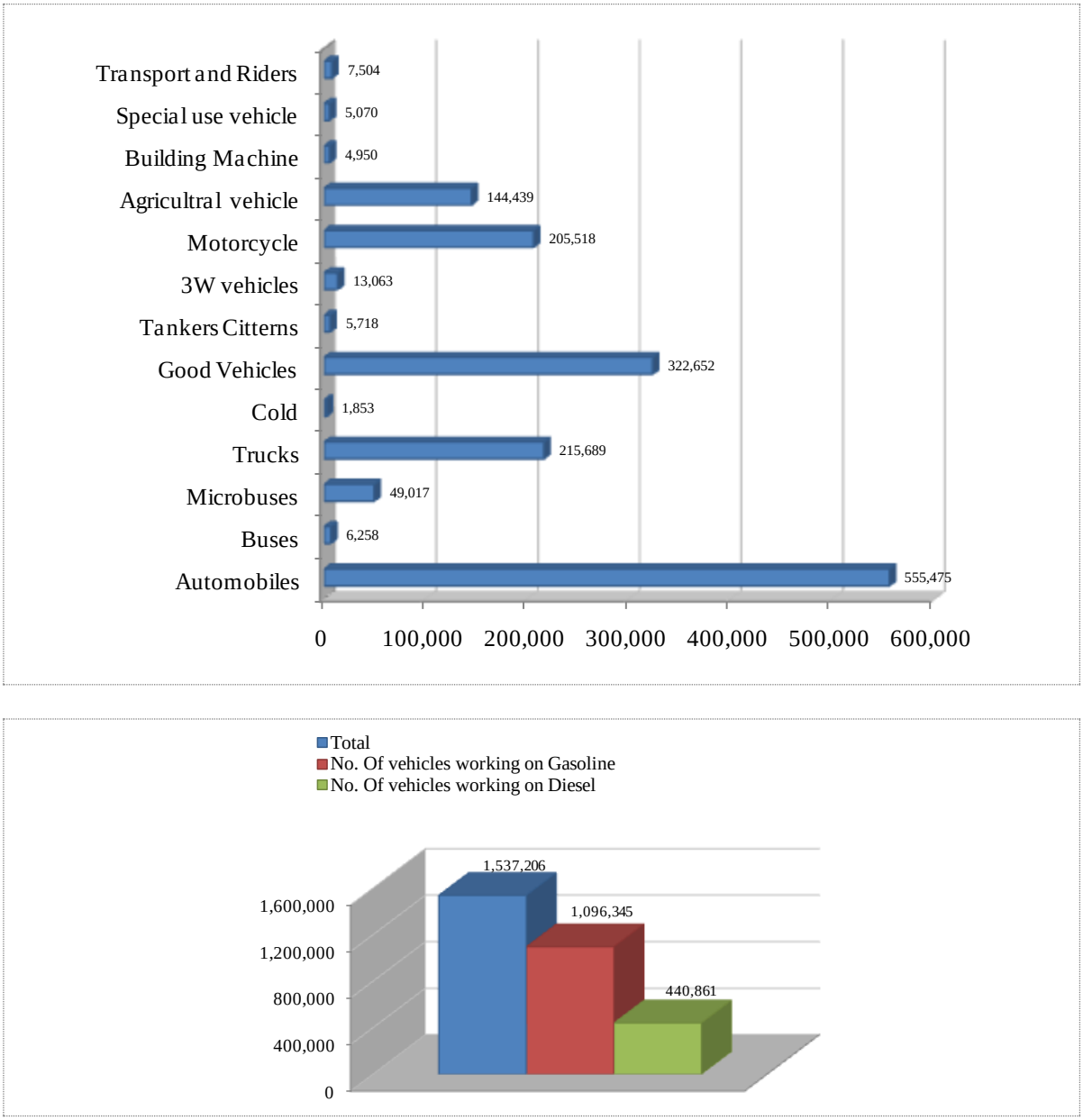
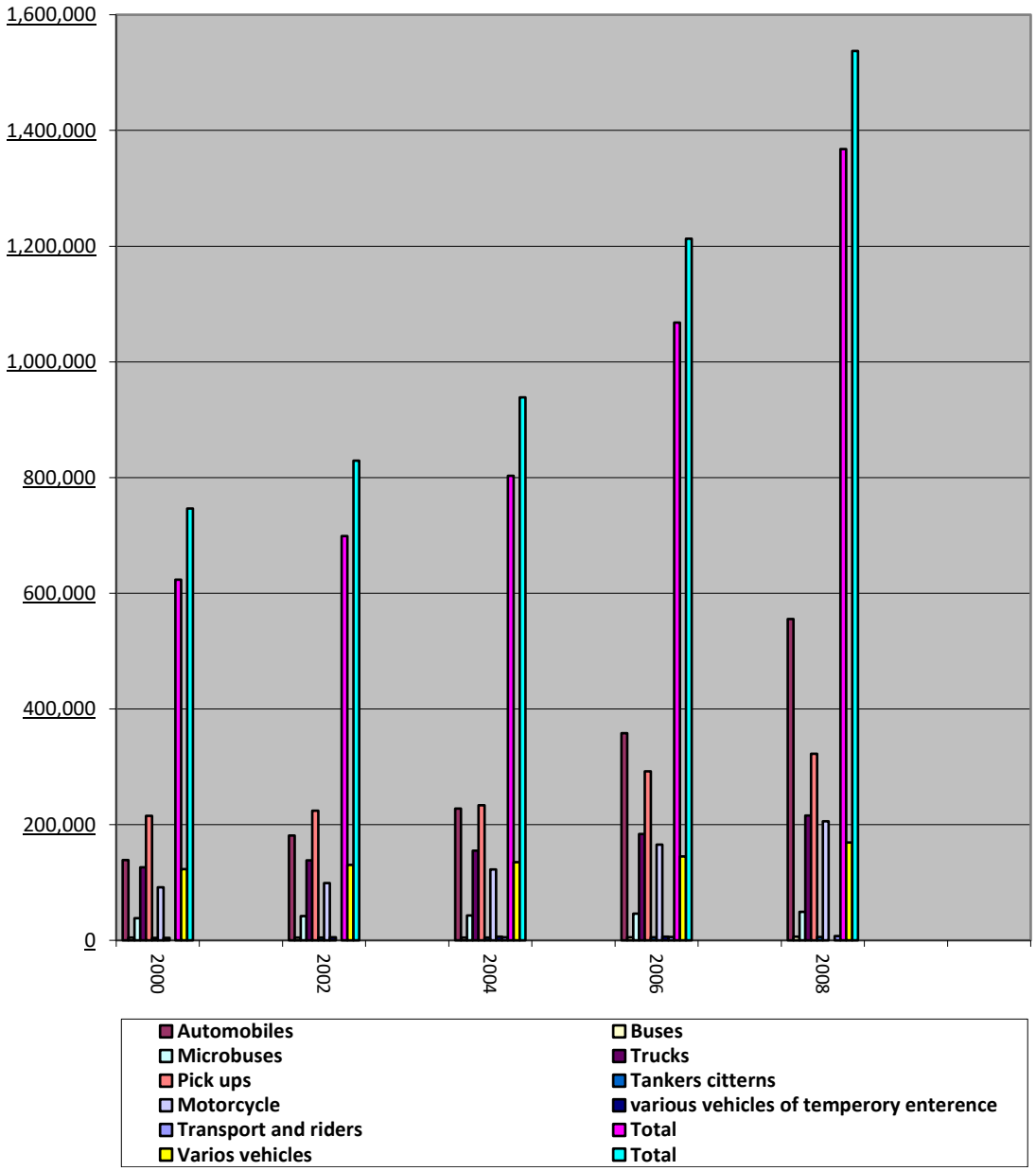


Fig.2. Number of Vehicles due to their Groups and the Type of Fuels in the period 2000-2008

Fig No.3 demonstrate the number of vehicles due to their groups and the total in the period 2000-2008

I change it


1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
2000
2002
2004
2006
2008
Automobiles
Microbuses
Pick ups
Motorcycle
Transport and riders
Varios vehicles
Buses
Trucks
Tankers citterns
various vehicles of temperory enterence
Total
Total

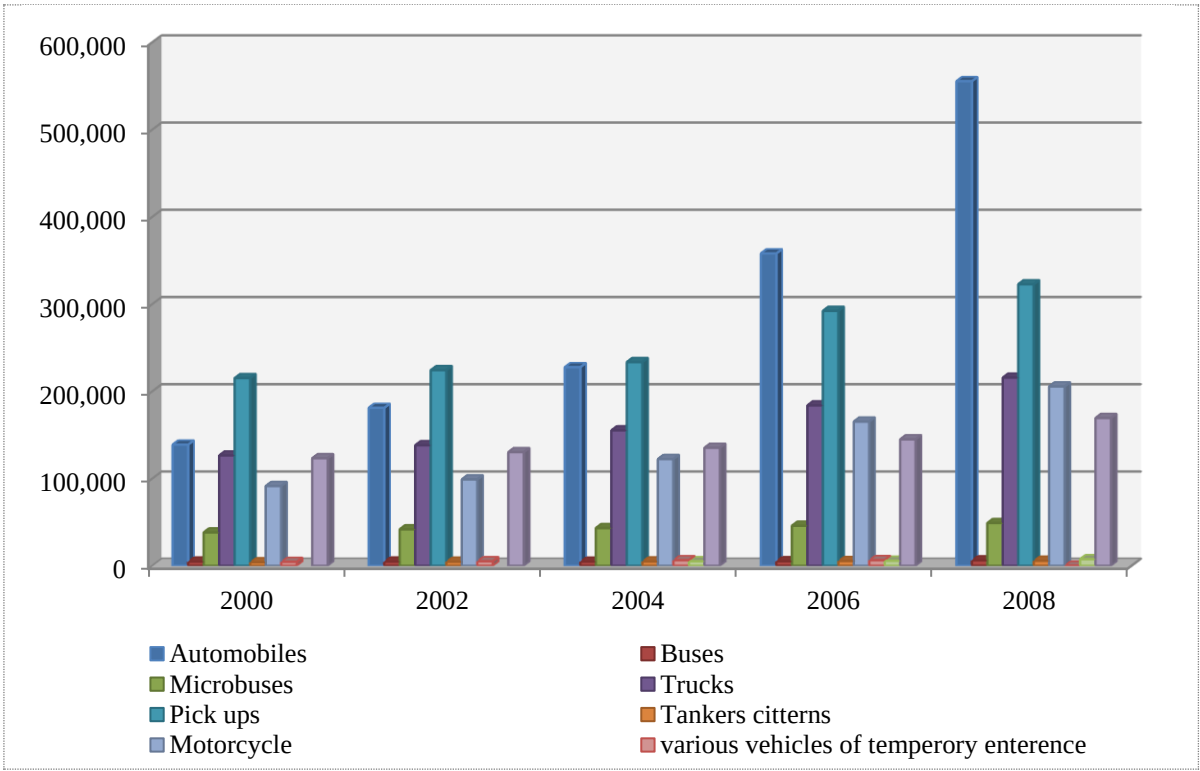


Fig.3. Demonstrate the Number of Vehicles due to their Groups and the Total in the period 2000-2008

2) Freight Transport

Freight transport is controlled by transport bureaus

✓ Transport Bureaus

They were established by the decree N 66 of the year 1964. They operate due to specific regulations issued and modified by the Ministry of Transport.

✓ The activities of transport bureaus are controlled directly by the Directory of road transport in the ministry of transport.

Table No.4 demonstrate quantities of goods transported inside and outside Syria in the year 2007

Table 4. Quantities of Transported Merchandise Inside & Outside Syria during 2007

Office of Merchandise Transport in Mohafazat	Quantity of (Transported (Merchandise (ton)		No. of Transport Vehicles	
	Inside the Country	Outside the Country	Inside the Country	Outside the Country
Damascus& Rural	282460	301940	14123	14983
Hama	809944	88241	29998	3322
Homs	1603784	738227	61684	22335
Aleppo	1557025	212690	62281	10648
Idleb	495419	31120	29545	1556
Tartous	21507234	430750	81137	17230
Lattakia	2163162	337818	89075	12993
Al-Rakka	527508	2552	23599	126
Deir-ez-zor	373817	5720	15418	266
Al-Hasakeh	2035891	28773	88490	866
Dara	64300	473450	2572	18938
Al-Sweida	17784	720	1180	36
Total	31438328	2652001	499102	103299

Source: Ref [6]

Table No.5 demonstrate quantities of transit goods and trucks across Syria in the period 2000-2007

Table 5. Quantities of Transit goods and Trucks Across Syria in the period 2000-2007

Year	Quantity of Transited Goods 1000 MT	Number of Trucks
2000	1924	96000
2001	2606	130000
2002	4238	212000
2003	4292	215000
2004	6339	317000
2005	5548	278000
2006	5365	268000
2007	2307	115000

Source: Ref.[9]

3) Passenger Road Transport

Legislations ruling passengers transport are:

- ✓ Decree No.112 of the year 1953 due to which this sector is controlled by committees called committees of mutual passenger transport. One committee headed by the governor in each governorate.
- ✓ Decree No.171 of the year 1963 due to which minister of communication (now minister of transport) is responsible for the travel tracks.

- ✓ Ministerial decision No.430 of the year 1983 due to which mutual passenger committees are responsible for the activities of busses and microbuses.

The above mentioned legislations are old. Therefore a new law for passengers transport is prepared and to be issued later.

The means of passenger transport are: buses, microbuses and cars which are mainly owned by the private sector.

The main form of ownership is the individual form.

Table .6 demonstrates the numbers of means of passengers transport in the year 2007 due to the type of Plates (private, public, governmental, urban, state bus company).

Table. 6. Numbers of Means of Passengers Transport in the year 2007 due to the Plates Type

Cars Category	Private	Public	Governmental	Urban Buses Company	Total
Buses	276	2229	1241	1647	**5393**
Minibuses	1629	41408	4385	–	**47422**
Automobiles	347032	79802	27871	–	**454705**
Motorcycles	166712	–	20243	–	**186955**

Source: Ref [9] statistical yearbook 2008

1.2.Roads

General establishment of roads and general company of roads and bridges are responsible of this sector: preparing studies, construction and maintenance of roads 1st class, technical supervision of roads 2nd and 3d classes. Roads 2nd and 3d classes belong to ministry of rural affairs.

Table.7 shows the development of roads in the period 1975-2007

Table 7. Development of Roads in the period 1975-2007

Kinds of roads Year	Asphalted roads	paved non asp roads	Leveled roads	Total	Index Number 100=2000
1975	10740	1500	2364	14604	33
1980	12969	4172	2678	19819	44
1985	20732	5467	2197	28396	64
1990	23779	7305	2129	33213	75
1995	27769	9327	2237	39333	88
2000	32028	9405	3142	44575	100
2003	35092	9289	3033	47414	106
2004	36412	9711	2644	48767	109
2005	37554	9999	2424	49977	112
2006	38923	10833	2211	51967	117
2007	40032	11146	3836	55041	123

Source: Ref [9] statistical yearbook 2008

1.3.Urban Transport

Four general establishments for passenger transport in the main four cities in Syria were formed by these legalisations:

- ✓ Decree No. 930 in 1962 –Damascus
- ✓ Decree No. 931 in 1961- Homs and Lattakia
- ✓ Law No. 20 in 1966 – Aleppo

Establishments were changed to companies by the decree No.340 in 1975. Their activity is limited in the four cities. Except buses owned by the mentioned city companies, big quantity of microbuses individually operate in these cities and all other cities in Syria. Supervision of their activity belongs to the mutual passenger transport committees headed by governor in each governorate. These committees are found due to the decree No. 112 of 1953.

Table No.8 shows the quantity of old buses and new ones available in the four cities bus companies in 2008

Table 8. Quantity of old Buses and new ones available in the four cities bus companies in 2008

Items	Damascus	Aleppo	Homs	Lattakia	Total
Quantity of old buses	744	320	110	91	**1465**
Quantity of new buses	315	170	50	65	**600**
Total	**1059**	**490**	**160**	**156**	**2065**

Source: Ref:[3]

Electric modes of transport (Metro, monorail) have passed some stages of study. They are not scheduled yet in the governmental plans.

In the past since 1906 six lines of tramways were introduced and operated in Damascus till 1960-s. In Aleppo tramways were introduced in 1935 and were eliminated also in 1960-s.

Fig No. 4 shows quantity of available buses and in operation buses in the four city bus companies in the year 2008

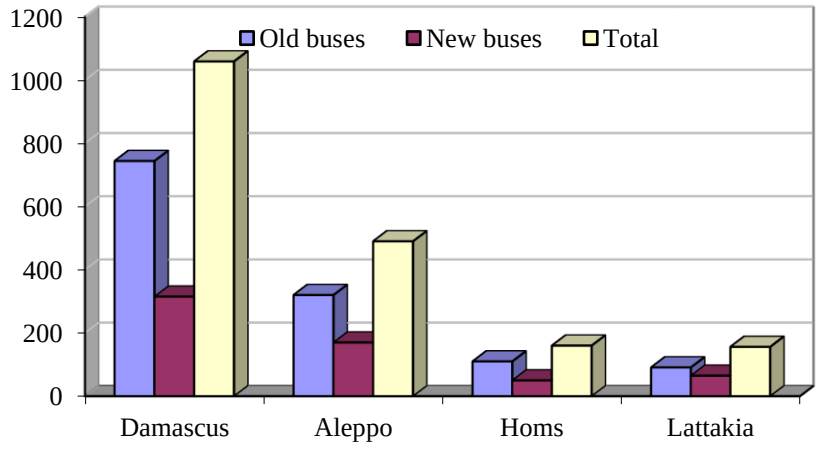


Fig.4. Quantity of Available Buses and in Operation Buses in the four City Bus Companies in the year 2008

1.4.Railways

This sector is followed up by the directory of railways in the ministry of transport headquarters. It is formed of the next bodies:

1. General establishment of Syrian railways responsible for railways of the width 1435 mm. Their total length is 2495 km (2007)
2. General establishment of Hidjaz railway responsible of narrow railways of the width 1055 mm. Their total length is 338 km (2007)
3. General company for construction and maintenance of railways

Table No.9 shows the available fleet in the period 2003-2007

Table 9. Available Fleet in the period 2003-2007

Vehicles	2003	2004	2005	2006	2007
Locomotives	281	273	273	273	273
Passengers Vehicles	539	539	537	537	537
Goods Wagons	4212	4167	4167	4122	4122
Fuel Wagons	945	972	949	943	943
Other Wagons	276	276	294	371	371
Total	**6253**	**6227**	**6220**	**6246**	**6246**

Source: Ref [9] statistical yearbook 2008

Table No.10 and fig No.5 demonstrate the indicators of passenger and cargo transport by railways in the period 2003-2007

Table 10. Demonstrate the Indicators of Passenger and Cargo Transport by Railways 2003-2007

Item	2003	2004	2005	2006	2007
Passengers (000)	1922	2303	2012	2148	2492
Passengers Per K.M (000)	525357	691916	606972	658605	744110
Goods (000)ton	6414	7232	8187	8752	9450
Goods Per Km (000)	1884661	1922829	2255826	2458088	2550742
Passengers Index per 100=2000 K.M	267	352	308	335	379
Goods Index Per K.M 100=2000	120	122	143	157	163

Source: Ref [9] statistical yearbook 2008

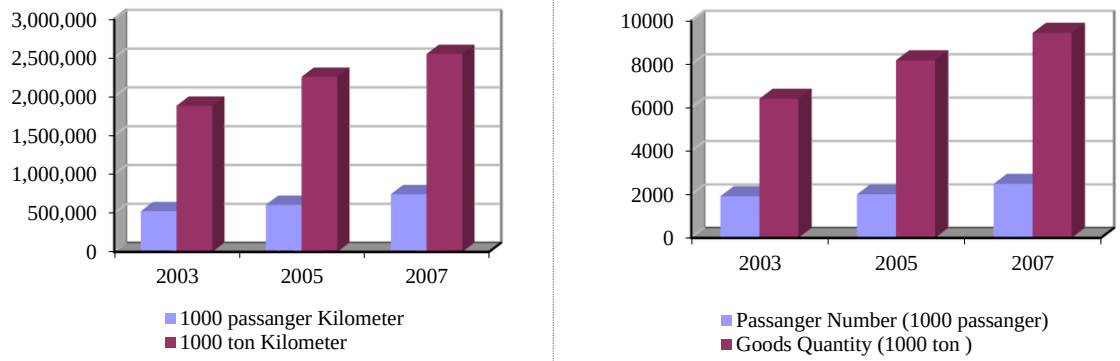


Fig.5. The Indicators of Passenger and Cargo Transport by Railways in the period 2003-2007

Table No. 11 shows the length of railways in the period 2003-2007

Table 11. Length of Railways in the period 2003-2007

Gauge	2003	2004	2005	2006	2007
Ordinary Line	**2461**	**2495**	**2495**	**2495**	**2495**
Lattakia-Aleppo-Al-Kamishli	1041	1044	1044	1044	1044
Al-Kamishli- Al-Yarubieh	90	90	90	90	90
Aleppo- Hama- Homs	303	304	304	304	304
Akkari- Homs- Damas	407	407	407	407	407
Aleppo-Midan Ekbes- Ral	190	190	190	190	190
Homs- Kseyr	45	45	45	45	45
Akkari- Lebanese Boarder	5	5	5	5	5
Mahin- Phosphate mines	154	154	154	154	154
Tartous – Akkari	92	92	92	92	92
Tartous- Lattakia	134	134	134	134	134
Deir-ez-zor-Al Tabia	0	30	30	30	30
Narrow Line	**338**	**338**	**338**	**338**	**338**
Damascus- Dar'a	127	127	127	127	127
Dar'a- Nasseb	13	13	13	13	13
Kumm Garz –Busra	34	34	34	34	34
Dar'a – Al-Shajara	42	42	42	42	42
Al-Shajara – Al-Hummeh	24	24	24	24	24
Sergaya – Damascus	58	58	58	58	58
Al-kadam- Qatana	33	33	33	33	33
Sergaya – Lebanese Border	7	7	7	7	7
Total	2799	2833	2833	2833	2833

Source: Ref [9] statistical yearbook 2008

1.5.Aviation

This sector is followed up by the directory of aviation in the ministry of transport headquarters. It is formed of two general establishments:

1. The Syrian establishment of airways
2. General establishments of civil aviation

Table No. 12 shows the fleet of the Syrian airlines

Table 12. Fleet of the Syrian Airlines

Aircrafts Type	Number	Manufacturing Year
Airbus planes	7	1998-1999
Boeng planes	2	1976-1981
Topolif Planes	3	1982-1985
Freight Elioshen Planes	3	
Yak planes for domestic flights	5	
Antinof planes for charge cargo	6	

Source: Ref [www.wikipedia.org] November 2009

Referring that most of the aircrafts are out of service right now

Table No.13 shows activities of air transport in the Syrian airports in the period 2006-2007

Table 13. Activities of Air Transport in the Syrian Airports in the period 2006-2007

Airports	Taking off	Landing	Number of Passengers				Freight (T)	
			Departure	**Arrival**	**Transit**	**Total**	**Loaded**	**Unloaded**
2006								
Damascus	16554	16388	1558417	1431114	1289	2990820	16530	16050
Aleppo	3807	3845	187158	193107	27155	407420	552	0
Bassel Al-Assad	848	850	16660	10917	7275	34852	0	1007
Deir-ez-zor	207	207	6558	6044	0	12602	0	0
Al- Kamishli	306	306	19858	20063	0	39921	0	0
Total	21722	21596	1788651	1661245	35719	3485615	17082	17057
2007								
Damascus	15168	15242	1702999	1662731	0	3365730	15099	15983
Aleppo	3879	3831	202322	212473	0	414792	850	0
Bassel Al-Assad	936	936	23198	24120	0	47318	0	0
Deir-ez-zor	0	0	0	0	0	0	0	0
Al- Kamishli	367	367	23316	23500	0	46816	0	0
Total	20350	20376	1951835	1922824	0	3874656	15949	15983

Source: Ref [9] statistical yearbook 2008

General establishment of civil aviation is responsible of five airports. Four airports are international in Damascus, Aleppo, Lattakia and Deir-ez-zor. The airport in Al-kamishli is for local service only.

Fig No.6 shows Number of passengers in the Syrian airports 2006-2007

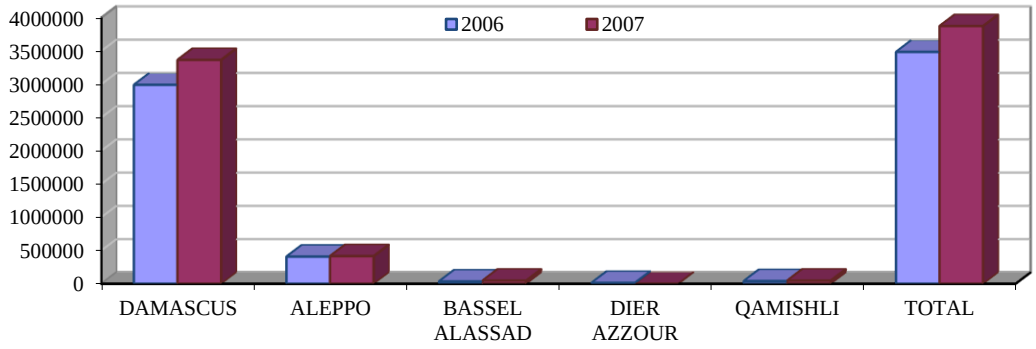


Fig.6. Number of Passengers in the Syrian Airports 2006-2007

1.6.Maritime Transport

Maritime transport is consisted of the next five authorities

1) General company of Lattakia port
2) General company of Tartous port
3) General establishment of maritime transport
4) Company of navigation agencies
5) General directory of ports

This sector is supervised by the directory of the maritime transport in the ministry of transport headquarters.

Table No.14 shows the activity of maritime transport through the Syrian ports in the period 2004-2007

Table 14. The activity of Maritime Transport through the Syrian Ports in the period 2004-2007

Ports	No. Of Ships		Goods (1000 T)		Passengers	
	Income	**Leaving**	**Unloading**	**Loading**	**Arrivals**	**Departure**
2004						
Lattakia	1357	1344	4778	833	7065	7051
Banias	0	0	0	0	0	0
Tartous	2209	2077	8320	0	0	0
Arwad	145	103	0	0	0	0
Total	3711	3524	13098	833	7065	7051
2005						
Lattakia	1615	1594	6325	963	14899	14426
Banias	0	0	0	0	0	0
Tartous	2639	2188	30704	1701	0	0
Arwad	143	145	0	0	0	0
Total	4397	3927	37029	2664	14899	14426
2006						
Lattakia	1785	1733	7178	918	9114	8671
Banias	0	0	0	0	0	0
Tartous	2627	2546	9708	2428	0	0
Arwad	82	83	0	0	0	0
Total	4494	4362	16886	3346	9114	8671
2007						
Lattakia	1381	1390	6402	1660	4480	4217
Banias	0	0	0	0	0	0
Tartous	2764	2640	9772	2965	0	0
Arwad	80	82	0	0	0	0
Total	4225	4112	16174	4625	4480	4217

Source: Ref [9] statistical yearbook 2008

Table No.15Number of tankers transporting petroleum and gas to the Syrian ports in the period 2004-2007

Table 15. Number of Tankers Transporting Petroleum and Gas to the Syrian Ports 2004-2007

Ports	Tankers Arriving	Tankers Departing	Total
2004			
Tartous	60	60	**120**
Banias	244	244	**488**
Total	304	304	**608**
2005			
Tartous	56	51	**107**
Banias	298	298	**596**
Total	354	349	**703**
2006			
Tartous	57	53	**110**
Banias	308	307	**615**
Total	365	360	**725**
2007			
Tartous	55	54	**109**
Banias	353	353	**706**
Total	408	407	815

Source: Ref [9] statistical yearbook 2008

Fig No.7 Transport of goods in the Syrian ports in the period 2004-2007

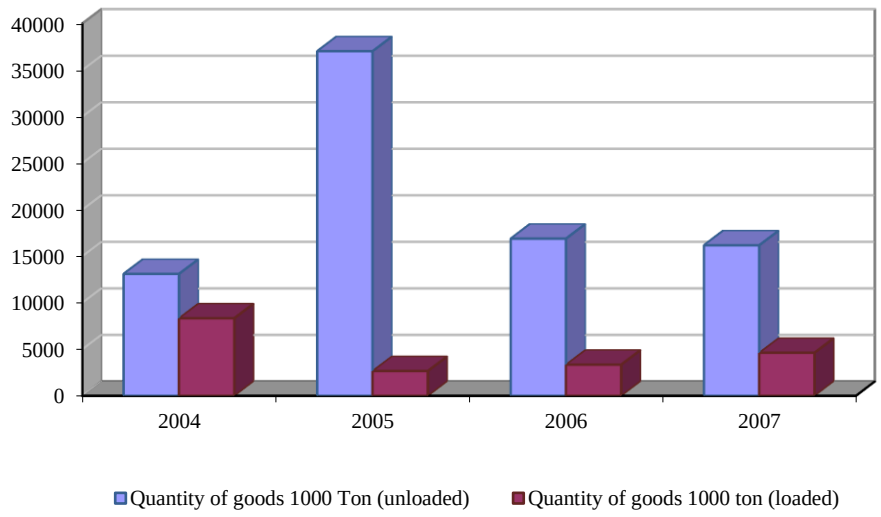


Fig.7. Transport of Goods in the Syrian Ports in the period 2004-2007

1.7.Pipelines

This sector is under supervision of the ministry of Petroleum and mineral resources.

There are three networks of pipelines:

1. Network of the company of petroleum products (SADCOP)
2. Network of the Syrian petroleum products (SPC)
3. Network for transporting gas

Table No.16 shows the main pipelines in Syria

Table 16. The Main Pipelines in Syria

Pipeline	Length (km)	Diameter (INCH)	Oil Products	Capacity
Tal Ads- Homs- Tartous	86+669	18/22	Oil	MM3/yr 14
Laward Pipeline	64	16	Oil	B/D 4800
Al-Taym Pipeline	92	20	Oil	B/D 10000
Omar Pipeline	90	24	Oil	B/D 124000
Homs- Trablous	105	24	Oil	
Homs- Banias	135	24	Oil	
Aljafrah Pipeline	80	16	Oil	B/D 30000
Tadmour Gas Pipeline	326	24	Gas	6 MM3/D
Omar Gas Pipeline	440	18	Gas	160 MF3/D
Almharda Gas Pipeline	206	18	Gas	160 MF3/D
Jpesae Gas Pipeline	520	16	Gas	2.5 MM3/D
Homs- Adra	167	6	Oil	
Homs- Adra	167	12	Diesel	
Homs- Aleppo	183	6	Gasoline	
Homs- Banias	124	6	Oil	
Banias- Homs	116	24	Diesel + Gasoline	
Banias- Lattakia	43	6	Diesel	

Source: Ref [13]

2. Fuel Consumption in the Transport Sector (TS)

2.1. The Energy Efficiency of the Different Means of Transport

It is necessary to take into consideration the energy efficiency and the amounts of GHG emissions when policies and planes for developing transport systems are determined.

Table No.17 shows energy efficiency (goe/tkm) for fright transport and (goe/pkm) for passenger transport

Table 17. Energy efficiency (goe/tkm) for Fright transport and (goe/pkm) for Passenger Transport

Freight transport Goe/tkm	Pipes	trains	River	sea	road	Urban distribution	Air
	8.5	18	25	32	75	660	690

Passengers transport Goe/pkm	trains	buses	Cycles	Cars	Air
	15	28	31	48	90

Source: Ref [16]

It is clear from the table that the sequence of freight transport from Low to high energy unit consumption: Pipelines, trains, river, sea, road, urban distribution, air.

For passenger transport the sequence is: trams, buses, cycles, cars, air

Fig No.8 demonstrate unit of energy consumption by mode

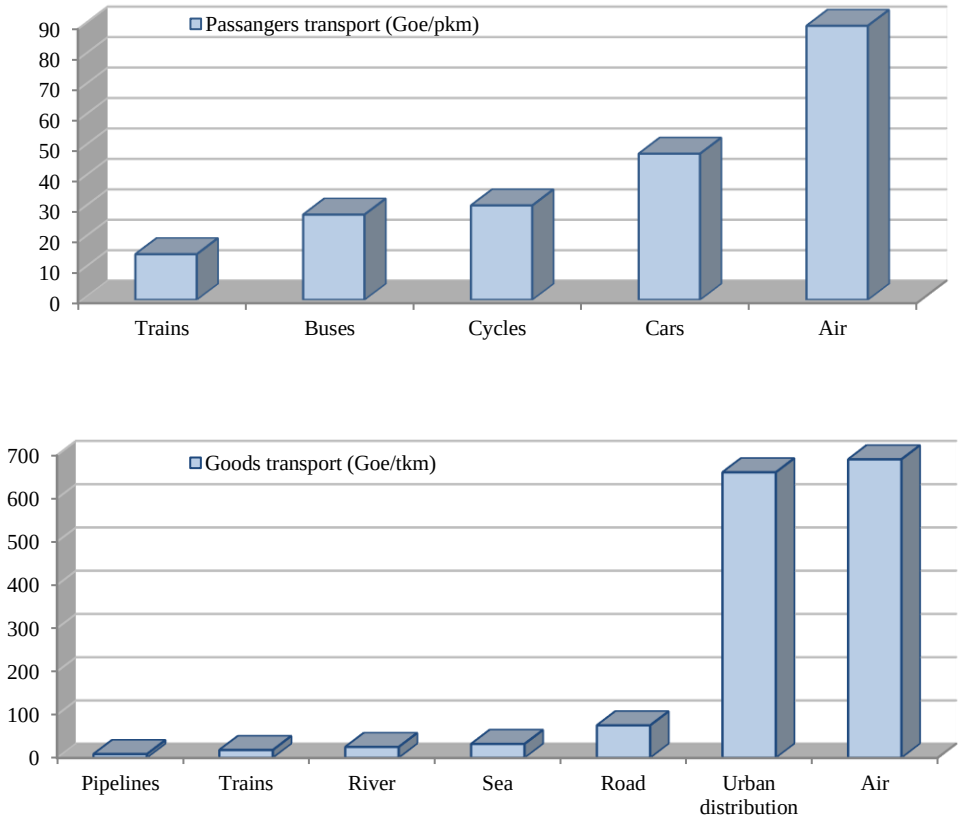


Fig.8. Unit of Energy Consumption by Mode

2.2. Effect of Speed on Fuel Consumption: Private Cars

Fuel consumption and the amount of GHG emissions depend on car speed which goes down to about 5 km/h during the rush hours. In this case fuel consumption and CO2 emissions are 3 times higher in comparison with the fluid urban speed 25 km/h.

Table No.18 shows the amount of CO2 emissions (g/km) for the three cases: urban, road, motorway, slow and fluid speeds

Table 18. CO2 emissions (g/km) for the three cases: Urban, Road, Motorway, Slow and Fluid speeds

Traffic type	Fuel consumption (g/km)	CO2 (g/km)	V (km/h)
Slow urban	182	425.5	5
Fluid urban	65	174	25
Slow road	54.5	148	40
Fluid road	51.5	140	70
Motorway	56	151	100
Motorway	60	162	120

Source: Ref: [16]

Fig No.9 shows the effect of traffic and congestion on CO2 emissions

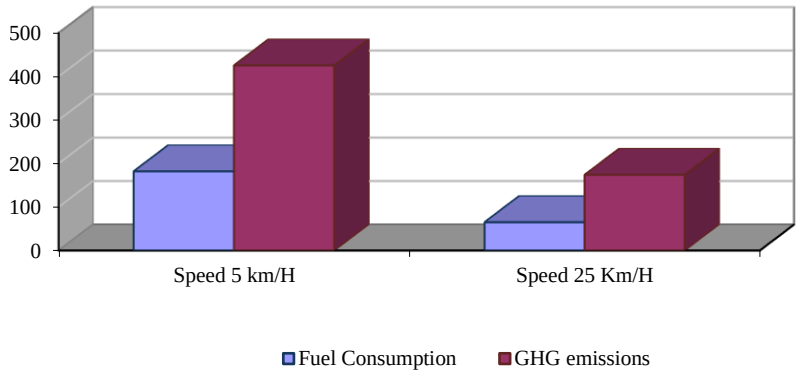


Fig.9. The Effect of Traffic and Congestion on CO2 Emissions

2.3. Estimation of Diesel Consumption in TS

Diesel consumption in TS does not appear separately in fuel consumption statistics. Therefore it is calculated from some indicators including number of vehicles by groups and type of plates, average amount of annual working days, average daily distance, average fuel consumption, Equation of calculation is:

Diesel Consumption= number of vehicles X number of working days X average daily distance(km/day) X average fuel consumption (L/100 km)

Table No.19 shows number of diesel vehicles and diesel consumption in diesel vehicles in 2005

Table 19. Number of Diesel Vehicles and Diesel Consumption in Diesel Vehicles in 2005

Vehicles Type	Number	Average Working day per year	Average Distance per day	Consumption Average	Total Yearly Consumption	
		day	K.m/day	LTR/100 K.m	1000 LTR	1000 MT
Automobiles and double Cabin	5305	200	50	10	5305	4.45
Buses	**3143**				**100608**	**84.31**
Private and temporary entrance	185	250	50	50	1156.25	0.97
Public	2100	300	250	50	78750	65.99
Governmental	858	250	40	50	4290	3.6
Urban transport					16412	13.75
Microbuses	**42154**				**741132**	**621.07**
Private and temporary entrance	735	300	40	15	1323	1.11
Public	38874	300	350	18	734718.6	615.69
Governmental	2545	250	40	20	5090	4.27
Trucks	**165098**				**2216677**	**1857.58**
Private and temporary entrance	116374	250	100	55	1600143	1340.919
Public	36657	225	100	55	453630.4	380.1423
Governmental	12067	225	100	60	162904.5	136.514
Cold storage Lorry	**1886**				**28077**	**23.53**
Private and temporary entrance	0	250	100	66	0	0
Public	1834	225	100	66	27234.9	22.8
Governmental	52	225	100	72	842.4	0.7
Small good vehicle	**7660**				**34647**	**29.03**
Private and temporary entrance	7042	300	100	15	31689	26.56
Public	474	330	100	15	2346.3	1.97
Governmental	144	250	100	17	612	0.51
Tankers Citterns	**5253**				**22895**	**19.19**
Private and temporary entrance	135	200	100	20	540	0.45
Public	3235	200	100	20	12940	10.48
Governmental	1883	200	100	25	9415	7.89
Three wheels pick up	**3**				**9**	**0.01**
Private and temporary entrance	0					0
Public	3	300	100	10	9	0.01
Governmental	0					0
Motorcycle	**225**				**267**	**0.22**
Private and temporary entrance	210	300	50	8	252	0.21
Governmental	15	250	50	8	15	0.01
Total	**230727**				**3149618**	**2639.38**

Source: Ref [13]

Table No.20 shows diesel consumption in tractors supposing 20 % of their activities are for transport purpose.

Table 20. Shows Diesel Consumption in Tractors for Transport Purpose.

Vehicles Types	Number	Percentage of tractors working in transport	Consumption Average	Average working days per year	Total Consumption Per year	
		%	LTR/Day	day	1000 LTR	1000 MT
Tractors	127992				39473.6	33.08
Agricultural vehicles temporary entrance	123355	20	8	200	39473.6	33.08

Source: Ref [13]

Table No.21 shows diesel consumption in General establishment of Syrian Railways in the period 2000-2008

Table 21. Diesel Consumption in General establishment of Syrian Railways 2000-2008

Year	No. of Trail	Consumption (LTR)
2000	111	29,482,027
2001	132	29,409,157
2002	127	33,051,610
2003	162	38,977,131
2004	177	41,718,077
2005	170	49,844,285
2006	178	51,516,943
2007	242	55,745,604
2008	226	50,237,998

Source: Ref [2]

Table No.22 shows diesel and fuel consumption in General establishment of Hedjaz railways in the period 2000-2008

Table 22. Diesel and Fuel Consumption in General Establishment of Hedjaz Railways in the period 2000-2008

Year	Consumption	
	Diesel (LTR)	Fuel (K.G)
2000	313208	518810
2001	174496	508318
2002	157699	298367
2003	188517	154400
2004	133937	165727
2005	159528	89805
2006	52425	131640
2007	298670	60090
2008	184519	106400

Source: Ref [2]

Table No.23 shows diesel consumption in urban bus transport companies in the period 2000-2009

Table 23. Diesel Consumption in Urban BusTransport Companies in the period 2000-2009

Year	Urban Public buses Transport			
	Damascus	Aleppo	Lattakia	Homs
2000	9264470	5317240	2269106	1643215
2001	9108960	5391360	2421995	1527270
2002	8921256	5835959	2473719	2093622
2003	8758380	6073291	2537290	1923100
2004	8816942	5150480	2373017	1755930
2005	5914805	3588979	1849860	1575540
2006	4993210	2708022	2017274	1502098
2007	4966961	2420281	1799137	1412665
2008	7922897	3593015	2389094	1781695
2009 till 30/09	7601252	2705414	120115	870000

Source: Ref [3]

Table No. 24 shows diesel consumption in maritime transport

Table 24. Diesel Consumption in Maritime Transport

Item	Total Consumption in 2005	
	1000 LTR	1000 T
Total Maritime transport	8480	7.11
Public maritime Transport	4292	3.6
Private maritime Transport	4188	3.51

Source: Ref [13]

The quantity of diesel consumption for oil and gas transportation by pipelines =4000 T*.

* Ref Energy balance

Table No. 25 shows total diesel consumption in TS in 2005

Table 25. Total Diesel Consumption in TS in 2005

Item	Total Consumption in 2005	
	1000 LTR	1000 MT
Roads transport	3149618	2639.38
Transport by Tractors	39473.6	33.08
Railways	54574	45.73
Maritime transport	8480	7.11
Pipelines Transport	4773	4
Total	3256919	2729.3

Source: Ref [13]

The total diesel consumption in road transport, transport by tractors, railways, maritime transport, and Pipes was 3256,919 m liters (2.7293 mt). It represents 38.71% of total diesel consumption in Syria in the year 2005 which was 8413486 liters (table. 26)

2.4. Gasoline Consumption in TS

Table No. 26 shows fuel consumption by products in the period 2000-2008. Gasoline consumption in 2008 was 2071912 ton. Gasoline is mainly consumed in cars, pickups, Cycles

Fig No.10 shows diesel, gasoline and kerosene consumption in 2005 and 2008

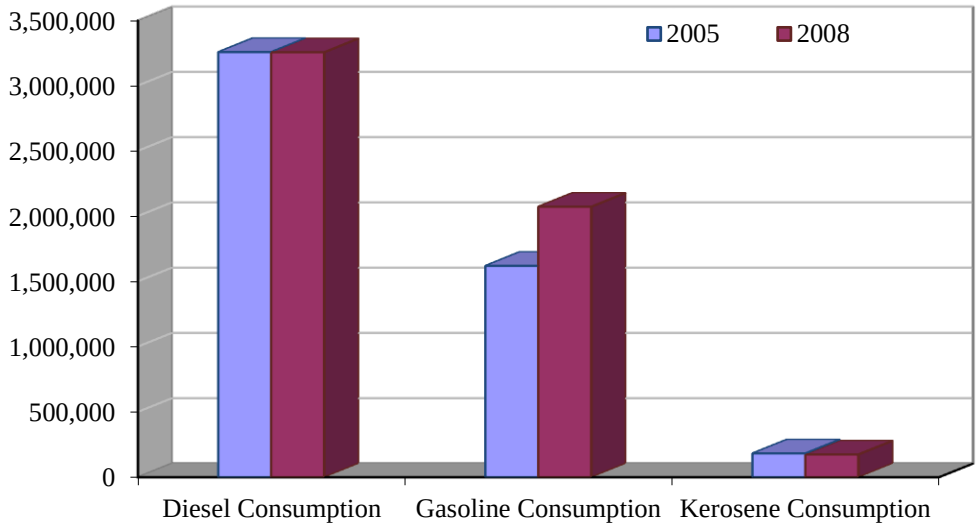


Fig.10. Diesel, Gasoline and Kerosene Consumption in 2005 and 2008

In Ref. [13] report implies final energy consumption in TS according to the program (MAED-d) transport sector is divided into subsectors:

- ✓ Intercity transport
- ✓ Urban transport
- ✓ Freight transport
- ✓ Other transport

In the report: ref [13] mobility is considered as the main indicator in transport calculations. It is measured in the units (p km) for passenger transport and (tkm) for freight transport.

This indicator is calculated separately for different groups of vehicles

Table No.26 shows fuel consumption by products in the period 2000-2008

Table 26. Fuel Consumption by Products in the period 2000-2008

Year	SQM						MT			MT	
	Disel	Household Kerosene	Kerosene R.T	Kerosene for planes	Gasoline Super	Gasoline ordinary	Lubricants			Fuel	LPG
							local	imported	Total		
2000	6412261	75872	63631	128786	1056206	105630	52114	1675	53789	4058	586
2001	6402116	73596	60863	141713	1137607	115289	55769	1841	57610	4031	636
2002	6548665	60675	83919	141427	1209640	113578	56564	2471	59035	3932	666
2003	7147725	18928	67278	140713	1213231	105750	56658	1860	58518	3717	687
2004	7716018	3469	63610	170483	1300780	98237	51684	1609	53293	4109	722
2005	8413486	2631	57885	182319	1518228	101053	61274	1305	62579	5330	767
2006	8925712	3593	52122	180199	1737265	88583	55780	1057	56837	5515	811
2007	9658041	3892	47278	178316	1929317	86699	60163	1171	61334	6253	847
2008	8409061	4702	60558	174055	1992999	78913	53640	862	54502	6862	824

Source: Ref [13]

2.5. Energy Consumption in Passenger Transport

Table No.27 shows total fuel consumption in intercity transport in 2005

Table 27. Total Fuel Consumption in Intercity Transport in 2005

Items	Total Consumption	Average passenger No.	Average consumption	Mobility
	1000 LTR	(P/vehicle)	LTR/100 Km	(Million pas/K.m)
Automobiles	**303062**	**3**	**11-8**	**10419**
Buses	**72774**			**6372**
Private and temporary entrance	1041	30	45.5	69
Public	70875	40	45.5	6237
Government	858	35	45.5	66
Urban transport	0	40	45.5	0
Microbuses	**369039**			**34678**
Private and temporary entrance	662	24	19.5	81
Public	367359	22	23.4	34538
Government	1018	15	26	59
Railways	**3341**			**622**
General establishment of Syrian railways	3258	150	80.58	622.1
General establishment of Hidjaz railway	84	150	80.58	15.57
Aviation	**6686.22**			**115.7**
The Syrian establishment of airways	6686.22			115.7
Total	754902			52207

Source: Ref [13]

Table No.28 shows fuel consumption in urban transport in 2005

Table 28. Fuel Consumption in Urban Transport in 2005

Items	Total Consumption	Average passenger No.	Average consumption	Mobility
	1000 LTR	(P/vehicle)	LTR/100 Km	(Million pas/ K.M)
Automobiles	**1100537**	**1.75**	**15-12**	**15151**
Buses	**27834.63**			**1991**
Private and temporary entrance	115.6	30	55	6
Public	7875	40	55	573
Government	3432	35	55	218
Urban transport	16412	40	55	1194
Microbuses	**372093**			**25036**
Private and temporary entrance	662	15	14	73
Public	367360	11	16	24695
Government	4072	12	18	269
Total	1500464			42178

Source: Ref [13]

Table No.29 shows the sum of intercity passengers transport and urban transport in 2005

Table 29. The Sum of Intercity Passengers Transport and Urban Transport in 2005

Items	Total Consumption	Intercity Transport	Urban Transport
	1000 LTR	1000 LTR	1000 LTR
Automobiles	**1403599**	**1100537**	**303062**
Buses	**100608**	**27834.6**	**72773.6**
Private and temporary entrance	1156	116	1041
Public	78750	7875	70875
Government	4290	3422	858
Urban transport	16412	16412	0
Microbuses	**741132**	**372093**	**369039**
Private and temporary entrance	1323	662	662
Public	734719	367359	367359
Railways	**3341**	**0**	**3341**
General establishment of Syrian railways	3258	0	3258
General establishment of Hidjaz railway	84	0	84
Aviation	**6686**	**0**	**6686**
The Syrian establishment of airways	6686	0	6686
Total	2255366	1500464	754902

Source: Ref [13]

2.6. Fuel Consumption in Freight Transport

Table 30 shows fuel consumption in freight transport in Syria in 2005

Table 30. Fuel Consumption in Freight Transport in Syria in 2005

Items	Yearly Consumption in freight transport	Average Loading	Mobility
	1000 LTR	MT/ Vehicle	1000 MT/K.m
Trucks	**1805923**		**39105762**
Private and temporary entrance	1280114	12	27929760
Public	362904	12	7917912
Governmental	162904	12	3258090
Cold storage Lorry	**3566**		**63558**
Private and temporary entrance	0	12	0
Public	2723	12	49518
Governmental	842	12	14040
Small good vehicle	**17324**		**345753**
Private and temporary entrance	15844	3	316890
Public	1173	3	23463
Governmental	306	3	5400
Gaz. Pickup	**154966**	**0.25**	**465653**
Tankers Citterns	**22895**		**1050600**
Private and temporary entrance	540	10	27000
Public	12940	10	647000
Governmental	6415	10	376600
Tractors	**39474**		**197368**
Agricultural Vehicles temporary entrance	39474	2	197368
Governmental			0
Railways	**51232**		**2264447**
General establishment of Syrian railways	51037		2255825
General establishment of Hidjaz railway	195		8622
Pipelines	**28334**		**19526293**
Pipelines	28334		17826293
Electrical Pipelines			1700000
Total	1968748		63019433

Source: REF [13]

Table No.31 shows fuel consumption in other different transport (outside the country) in 2005

Table 31. Fuel Consumption in other Different Transport (outside the country) in 2005

Vehicles	Yearly Consumption for different Transport Sectors / 1000 MT
Trucks	**344.2**
Private and temporary entrance	268.2
Public	76
Governmental	0
Cold storage Lorry	**20.5**
Private and temporary entrance	0
Public	20.5
Governmental	0
Aviation	**7.11**
Others	**202.8**
Total	574.7

Source: REF [13]

2.7. Total Fuel Consumption in TS in 2005

Table No.32 shows total fuel consumption and mobility in TS in 2005

Table 32. Total Fuel Consumption and Mobility in TS in 2005

Vehicles	**Automobile**	**Buses and Microbuses**	**Railways**	**Planes**	**Total**
Intercity passenger transport					
Mobility (M.PAS-K.m)	10419	41050	622	116	52207
Fuel consumption (Ktoe)	238.8	377.6	2.9	5.6	624.9
Urban passenger transport					
Mobility (M.PAS-K.m)	15151	27027	-	_	42178
Fuel consumption (Ktoe)	866.8	341.8	-	_	1208.7
Freight transport					
Means of transport	Inside city tracks	Outside city tracks	railways	Pipelines	Total
Mobility (M.PAS-K.m)	8935	32294	2264	19526	63019
Fuel consumption (Ktoe)	481.1	1255.6	43.8	25	1805.8
International Transport					
Fuel consumption (Ktoe)	574.7				

Source: REF [13]

Table No.33 shows total fuel consumption in Syria in 2005

Table 33. Total Fuel Consumption in Syria in 2005

Type of transport	**Intercity passenger transport**	**Urban passenger transport**	**Freight transport**	**International Transport**	**Total**
Consumption	624.9	1208.7	1805.8	574.7	4214.1

Source: REF [13]

Notice: the small differences in the figures of fuel consumption and emissions in the TS in the section 3 and 4 are related as I think to using different assumptions and methods in calculations of different references.

3. GHG Emissions from the Transport Sector (TS)

Transport Sector in Syria depends mostly on road transport.

The increase of the number of vehicles in the period 1994-2008 is very big as it is shown in the table No.3 in the 2nd section. The number of vehicles in 1994 was 440976, in 2005 were 1067529, and in 2008 were 1537206 vehicles.

3.1. The Amounts of Emissions in TS

Table No.34 shows fuel consumption and GHG emissions from the TS in the period 1994-2005 (Mtoe, MtCO2eq)

Table 34. Fuel Consumption and GHG Emissions from the TS in the period 1994-2005 (Mtoe, MtCO2eq)

Year	1994	1995	1996	1998	1999	2005
Fuel Consumption in TS MtCO2eq	2.58	2.59	2.46	2.55	2.64	4.44
GHG emissions from the TS MtCO2eq	7.26	7.27	6.92	7.18	7.44	12.54

Resource: Ref [14]

Fig No. 11 shows fuel consumption and GHG emissions in TS in the period 1994 -2005

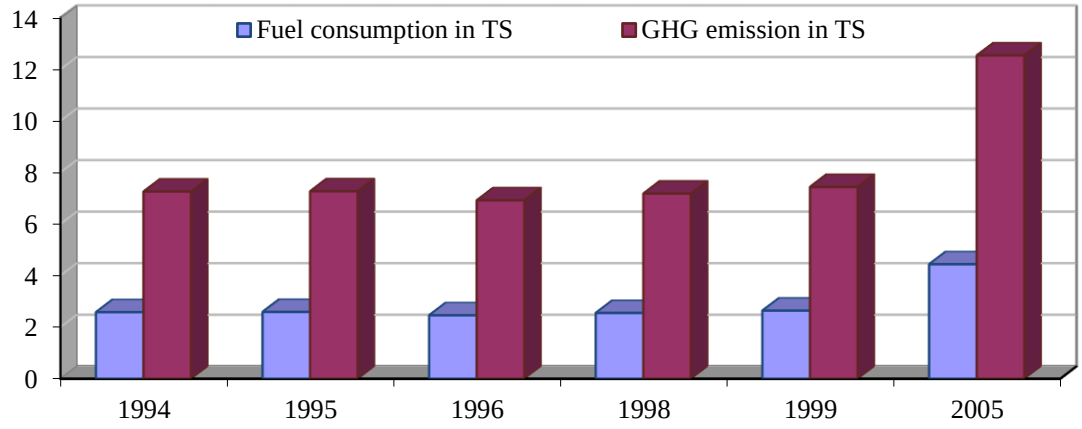


Fig.11. Fuel Consumption and GHG Emissions in TS in the period 1994 -2005

Table No.35 shows GHG emissions (MtCO2eq) in TS in the period 1990-2010

Table 35. GHG Emissions (MtCO2eq) in TS in the period 1990-2010

Year	1990	1994	2000	2005	2010
Transport Sector	5.3	7.5	10	12.5	15.5

Resource: Ref [11]

Table No.36 shows GHG emissions in subsectors of TS in 2005

Table 36. GHG Emissions in Subsectors of TS in 2005

GHG emissions (Ktoe)	CO2	CH4	N2O
Transport Sector	12457	1.7225	0.1386
Aviation	383.52	0.006	0.024
Road Transport	11917.29	0	0
Railway	133.22	1.695	0.112
Maritime	11.33	0.020	0.002
Pipeline	11.6	0.0015	0.0002

Resource: Ref [13]

Quantity of CO2 (QCO2) is calculated by the equation:

QCO2= QF X EF X OF

QF: Quantity of fuel (GJ)

EF: Emission factor (kg/GJ)

OF: oxidization factor %

OF: 0.99 for oil and oil products

OF: 0.995 for NG

Table No.37 shows yearly GHG emissions from TS in the period 1994-2005

Table 37. Yearly GHG Emissions from TS in the period 1994-2005

Year	1994	1995	1996	1998	1999	2005
CO2 (Mt)	7.218	7.23	6.88	7.14	7.40	12.46
CH4 (Kt)	1.01	1.016	1.009	1.043	1.045	1.722
N2o (kt)	0.08	0.080	0.077	0.075	0.080	0.139
Mt CO2 eq	7.26	7.27	6.92	7.18	7.44	12.54

Resource: Ref [14]

The final energy consumption in Syria in 2005 was 15.25 Mtoe.

The consumption by sectors was%: Transport 27, HH 23, Ind.19, Ag.11, Cons.7, Min. 7, and Serv.6

The Consumption by the type of fuel was%: Oil products 72, Natural gas 10, electricity 15 and other 3.

The total CO2 emissions according to the ref. scenarios in 2005 were 55.58 Mt.

Table No.38 shows emissions by type of fuel

Table 38. Emissions by Type of Fuel

Diesel	Fuel	NG	Gasoline	LPG	Pet. Coal	Gas of burning	Kerosene
34	29	24	6	4	1	1	1

Resource: Ref [14]

GHG emissions are composed of 95% CO2, 4.4% CH4, 0.6% N2O. TS produces 22% CO2, 10.2 CH4, 15.4 N2O emissions.

Table No.39 shows some indicators of energy sector in Syria and the world 2005

Table 39. Some Indicators of Energy Sector in Syria and the World 2005

	Primary energy (toe/ capita)	Final electricity consumption (Kwh/ capita)	CO2 emission (t CO2/ toe)	CO2 emission (t CO2/ capita)
Syria	0.99	1367	2.59	2.57
Arab World	1.4	2881	2.47	6.51
Asia	0.63	617	1.94	1.22
Africa	0.67	547	1.39	0.93
World	1.77	2516	2.37	2.57

Resource: Ref [14]

Table No.40 shows estimation of energy final demand in TS and all sectors (Mtoe) in the period 2003-2030

Table 40. Estimation of Energy Final Demand in TS and all Sectors (Mtoe) in the period 2003-2030

Year	2003	2004	2005	2007	2010	2015	2020	2025	2030
Transport Sector	4.212	4.372	4.538	4.979	5.723	7.337	9.493	12.286	15.870
Total Sectors	13.233	13.825	14.446	15.853	18.235	23.237	29.714	37.918	48.359

Resource: Ref [11] P.20

Fig No. 12 shows energy estimation of energy final demand in TS and all sectors (Mtoe) in the period 2003-2030

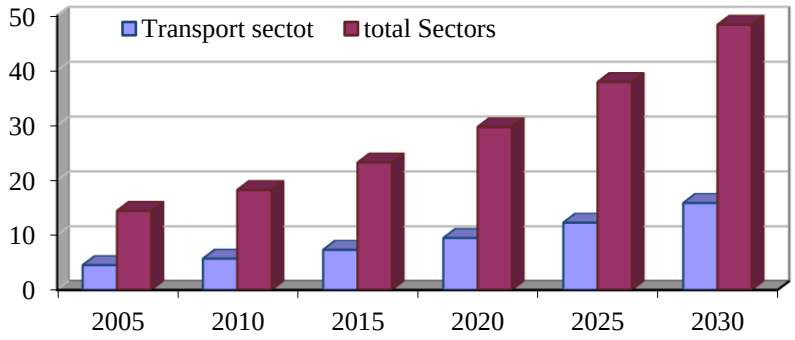


Fig. 12. Energy Estimation of Energy Final Demand in TS and all Sectors (Mtoe) in the period 2003-2030

Table No. 41 shows energy consumption and emissions in TS in 2005

Table 41. Energy Consumption and Emissions in TS in 2005

Fuel Consumption and GHG emissions	Consumed energy (Mtoe)	CO2 emissions (Mt)	CO2 per 1 toe (t)	CH4 (Kton)	N2O (Kton)
Transport Sector	4.53	12.35	2.7	1.72	0.13
Total Sectors	**21.33**	**58.98**	–	**12.25**	**0.491**

Resource: Ref [11] P.15

3.2. Study of Scientific Research Center 3rd Stage 1999 on climate change in Syria

The study contains 2 options for reduction CO2 emission from the TS.

3.2.1. Renewal of Taxi Gasoline Fleet

The ratio of old cars before 1980 is 60%. It consumes fuel 20-30% more.

Table No.42 shows reduction of CO2 emissions resulting from renewal of taxi fleet in the years 2005 and 2010

Table 42. Reduction of CO2 Emissions resulting from Renewal of Taxis Fleet in the years 2005 and 2010

Year	2000	2005	2010
Total CO2 emissions (Mt)	42	51	63
CO2 emissions from transport means (Mt)	8.4	10.2	12.7
The amount of CO2 reduction (Mt)	0.7	0.9	1.8
Reduction Ratio (%)	1.6	1.7	2.8

Resource: Ref [10]

The table shows that CO2 emissions could be reduced 2.8% in the year 2010. The renewal of taxi fleet needs 16 mil dollars. For the 1st half and

30 mil dollars for the 2nd half in 2010

3.2.2. Replacing Microbuses by Big Buses

Table No.43 shows the amount of CO2 reduction (m.t) resulting from replacing microbuses by buses

Table 43. The Amount of CO2 Reduction (m.t) Resulting from Replacing Microbuses by Buses

Year	2000	2005	2010
CO2 emissions from transport means (Mt)	8.4	10.2	12.7
CO2 emissions from Microbuses (Mt)		3.2	4.3
CO2 emissions from Buses (Mt)		0.45	1.2
The amount of CO2 reduction (Mt)	0.7	0.9	1.8

Source: Ref [10]

30 % of microbuses are replaced by buses in 2005 and 70% in 2010 the cost is 100 mil dollars.

The reduction of CO2 emissions is 14% of total emission from TS.

4. Suggestion of main Transport Policies, Projects, Measures and Calculations of mitigation GHG emissions in each suggested measure for the period 2020,2030

The ratio of fuel consumption in TS on the world level in 1971 was 33%, in 2005 47%, expected to increase in 2030 to 54%. Although that some countries are encouraging the utilization of natural gas and bio fuels, the ratio of oil consumption in TS is expected to continue increasing till 2030 to the level of 95% of the whole consumed energy.

The increase of oil demand in the Middle East and North Africa (MENA) is attributed to the policy of subsidization of oil products implemented by the governments of the countries in this area. The amount of subsidization related to the TS is 31%. It is considered that the policy of subsidization of oil products is one of the factors that hinder improving of energy efficiency.

In the year 2003 the European manufacturers were producing the least polluting vehicles, with 163 grams of CO2 emitted on average every test cycle kilometer (g/km). by comparison, cars from Japanese automakers emitted on average of 172 g/km, and Korean cars 179 g/km (European commission, 2005)

European, Japanese and Korean car makers have all committed to reducing CO2 emissions from passenger cars to 120 g/km by 2012. This would represent a 25% reduction in fuel demand against current levels in new cars

The IEA's World Energy outlook Alternative Policy Scenario depicts energy in which countries around the global demand for oil in transport is 12% lower in this Alternative Scenario than in the reference Scenario in 2030.

4.1. Efficiency Technology Options

Five main types of approach can be singled out that improve fuel efficiency.

1. Improvements in existing engines
2. Switching from gasoline to diesel
3. Hybrid vehicles
4. Fuel cell vehicles
5. Other technologies

Improvement in Existing Engines

- ✓ Gasoline direct injection is already widely applied
- ✓ Engine downsizing, using turbo engines and compressors, this can reduce fuel consumption by up to 25 %
- ✓ Continuously variable control of valve timing
- ✓ Variable compression ratio
- ✓ Advance transmissions can enhance drive system efficiency.
- ✓ An " idle stop" feature can reduce fuel consumption in Urban Cycles by about 10%

Switching from Gasoline to Diesel

In 2003 the average European petrol gasoline vehicles emitted 171 g CO2/km. The average diesel car emitted 157 g CO2/km, which is 8% less.

The share of diesel cars in Europe doubled from 22.2% in 1995 to 44.4% in 2003. This is much higher proportion than in North America or Japan. During this period there was an 11.8% decline in CO2 emissions from new passenger cars sold in the former 15 European Union countries

(EU-15). Concerns regarding local air pollution, it can address through improved technology for treating exhaust gas.

Hybrid Electric Vehicles (HEVs)

HEVs are widely regarded as a promising solution for TS efficiency for the coming decades. The concept was pioneered successfully by Toyota, whose first Prius entered the Japanese market in December1997. The car was released in Europe in September 2000. Half a million second-generation Pruis cars have been sold since the beginning of 2004. Other car producers are now licensing Toyota technology, or developing their own hybrid technology. But saled of HEVs currently amount to less than 1% of global car sales.

Table No.1 shows comparison between the hybrid and non hybrid models of one specific vehicle from the same car manufacturer. All the components in the respective models are identical except the engine. The hybrid car is one third more expensive than the equivalent ICE car. But the HEV boasts higher efficiency, especially for city driving. At current gasoline prices in US ($ 0.7/L), it takes more than 20 years to reach breakeven, assuming use of the car for 20000 km/year.

Obviously technology learning can reduce the additional cost and therefore future reduces the payback time.

Table No.44 show fuel efficiency and cost characteristics of a similar conventional ICE vehicle and hybrid vehicle

Table 44. Fuel Efficiency and Cost Characteristics of a Similar Conventional ICE Vehicle and Hybrid Vehicle

Vehicles Type	**Honda Civic Hybrid**	**Honda Civic**
Fuel Type	Regular Gasoline	Regular Gasoline
Manufacturer Suggested Retail Price (US$)	20900	15360
Efficiency Liters per100 km (city) Liters per 100km (highway) Liters per 100km (comb)	 4.8 4.6 4.7	 7.4 5.7 6.4
Period to breakeven(at 0.7 US$ /1,2000km/year)	23	
Period to breakeven(at 0.7 US$ /1,3000km/year)	15	
Period to breakeven(at 1.4 US$ /1,3000km/year)	8	

Source: Ref [17]

HEV technology is still improving. While the first-generation Pruis emitted about 120 g CO2/km, the second generation emits only 104 g CO2/km. Its hybrid efficiency gains are

highly dependent, nevertheless, on driving cycle characteristics. Benefits are especially important in urban stop-and-go traffic. But a diesel engine may be more fuel efficient than a gasoline hybrid under highway conditions.

While hybrid technology is embraced in Japan and the United States, European producers have been reluctant to apply this technology. One reason is the strong position of diesel engines, which can achieve similar efficiencies and CO2 emissions reductions. This situation seems to be changing through as hybrid technology improves. Moreover, a hybrid diesel engine would result in yet greater fuel efficiency.

Studies estimate that annual global hybrid production could reach one million units by 2010, or about 2% of the market as whole.

Fuel Cell Vehicles (FCVs)

Fuel cell vehicles (FCVs) offer tank-to-wheel efficiency twice to three times as high as conventional gasoline cars. But this calculation does not take into account significantly higher efficiency losses in the actual production of hydrogen and fuel. Globally, US$ one billion are spent every year on hydrogen and fuel cell development. But producing fuel cell vehicle drive systems still costs between 10 and 50 times too much to make them be comparative. Cost reductions, along with improved performance and reliability, will call for further development of the technologies for fuel cells themselves, for onboard storage systems and for refueling infrastructures. Because a new supply infrastructure will be needed, large-scale introduction of hydrogen FCVS will take decades.

For hydrogen production, decentralized from natural gas and electrolysis will be the initial technologies.

Centralized production from natural gas and coal seem the least-cost supply options in the medium term, possibly followed by nuclear and renewable energy on the long term.

IEA analysis suggests that up to 30% of the global car and light truck fleet could be hydrogen- fueled by 2050.

Other Technologies

The so-called fuel efficiency "shortfall" concerns the considerable gap between test-cycle efficiency and real-life, on road fuel efficiency. This

Shortfall can be attributed to a range of factors such as air-conditioning, insufficient maintenance or bad driving habits. In Europe the shortfall is about 18%. Because technologies that reduce the shortfall do not generate efficiency improvements in fuel-cycle tests, they have been somewhat neglected by car makers. Their combined total efficiency potential is in the range of 10% to 15 % at law cost (ECMT/ IEA, 2005). This includes options such as fuel- efficient tires and better lightning systems.

4.2. Alternative fuels

Biofuels merit special focus. They can contribute to both supply security and CO2 reduction while demanding no substantial adjustments in car technology. Rising oil prices have again heightened interest in bio fuels for the transportation sector. This follows an ongoing trend over the past three decades that swelled the share of bio fuels in total transportation sector energy use to 0.8% (0.6 exajoules [EJ]) in 2003. Further rapid increases are likely. Currently, two forms of bio fuel dominate: ethanol and biodiesel.

Ethanol production worldwide is estimated to have reached 46 billion liters (bl) at end-2005, with 80% (0.78EJ) for fuel use. 40% of current production takes place in the United States, 40% in Brazil and 7% in Europe. Production of biodiesel is smaller, at some 3 billion liters (0.1 EJ), and concentrated largely in Europe, which accounts for some 2 billion liters.

While ethanol production from sugar cane is already cost-effective in countries such as Brazil and India, this is not the case elsewhere.

Currently the ethanol production process involves between 60% and 90% less CO2 emissions than production of gasoline.

At a feedstock price of US$3/GJ, the cost of producing cellulosic bioethanol is roughly US$62 cents per liter (US$ 24/GJ). The current oil price spike of US$ 60/barrel translates into a similar level of US$ 55-60 cents per liter of gasoline. However the energy content of a liter of ethanol is only two-thirds that of gasoline.

Table No.45 shows options and % of CO2 reduction

Table 45. Options and % of CO2 Reduction

Technology	**%Ratio**
Improving engines	12 – 25
HEVs	10 – 30
FCVs	75 – 100
Additional technical improvements	8
Diesel vs. Gasoline	14
Biodiesel	100
Ethanol	100
Elastic Ethanol (Mix. Ethanol and Gasoline)	0 – 10

Source: Ref [author]

4.2.1. Estimations of emissions reduction amounts in the year 2020-2030.

From report [11] energy sector and climate change we find:

Table No.46 shows GHG emissions in the period 1990-2010

Table 46. GHG Emissions in the period 1990-2010

Year	**1990**	**1994**	**2000**	**2005**	**2010**
Electricity	8.4	10.5	14	18	**22.6**
Manufacturing	4.1	4.9	6.5	8.1	**10.6**
Transport	5.1	7.5	10	12.5	**15.5**
House Hold	5.6	6	8.5	10.6	**12.4**
Agriculture	1.9	1.9	1.9	1.9	**1.9**
Total	**25.3**	**30.8**	**40.9**	**51.1**	**63**

Source: Ref[11]

From the table we find that the amount of emissions increase in the TS in the period 2000-2010 is 5.5 (m.t). We suppose that the same amount of emissions increase will take place in the period 2010-2020 and the period 2020-2030. Then the amount of emissions will be 21 mt in the year 2020 and 26.5 (m.t) in the year 2030.

- ✓ The table No.49 shows that emissions in cities is 30% of total and the other70% represent emissions outside cities
- ✓ In the table No.36 it is clear that the emissions from road transport represent 96% of total emissions from TS
- ✓ According to the above mentioned figures we find:

Table No.47 Estimation of emissions in cities and outside cities and from road transport in the year 2020 and 2030

Table 47. Estimation of Emissions in Cities and Outside Cities and from Road Transport in the year 2020 and 2030

Item	**2020 Mt CO2**	**2030 Mt CO2**
Total GHG emissions	21	26.5
Intercity	6.3	7.95
Road transport	6.05	7.63
Outside cities	14.07	18.55
Road transport	14.11	17.8

Resource: Ref [author]

We calculate the amount of emission mitigation in the table No. 48 using the equation:

Emission mitigation= Ratio of using in vehicles X ratio of reducing emissions X amount of emissions from road transport inside cities, supposing that suggested measures in this table mostly related to cities.

Table No.48 shows the percentage of mitigation CO2 emissions according to technology and type of fuel

Table 48. The Percentage of Mitigation CO2 Emissions according to the Technology and Type of Fuel

Technology	**Ratio of utilization in vehicles %**		**Ratio of emissions reduction %**		**Emissions reduction amount s**	
	2020	2030	2020	2030	2020 KtCO2eq	2030 KtCO2eq
Improving engines	20	40	3.2	6.4	193.6	488
HEVs	20	40	3	6	181.5	457.9
FCVs	5	10	4	8	242	610.6
Additional technical improvements	20	40	1.6	3.2	96.8	244
Diesel vs. Gasoline	10	20	1.4	2.8	84.7	213.7
Biodiesel	10	20	10	20	605	1526
Ethanol	10	20	10	20	605	1526
Elastic Ethanol (Mix. Ethanol and Gasoline)	20	40	1	2	60.5	152.6
Total			**34.2**	**68.4**	**2069**	**5220**

Source: Ref [17]

4.3. Directions of improvement road transport efficiency

- ✓ Improvement of road transport indicators (reducing time and cost, fuel consumption of transportation)
- ✓ Renewal of old fleet of trucks and buses. This action needs the support of the government to the fleet owners by eliminating the customs taxes related to this process.
- ✓ Renewal of road transport legislations
- ✓ Encouraging replacement of individual form of investment and operation by companies including stock market companies.
- ✓ Annulment of transport bureaus ruling the road transport activities
- ✓ Activation of the role of new established union of transport companies.
- ✓ Encouraging the establishment of multimodal transport companies.
- ✓ Liberalization of transportation between Arab countries and annulment of all kinds of taxes and charges.
- ✓ Introducing the utilization of the developed communication systems in transportation.
- ✓ Participating in all international transport conventions and agreements.
- ✓ Simplifying the procedure in the crossing border centers, the organization of convoys.
- ✓ Controlling the axel loads of trucks to maintain the roads
- ✓ Improvement of roads and traffic efficiency, permanent maintenance of roads.

Estimation of the Amounts of Mitigation Emissions from Intercity Road Transport in 2020 and 2030

Referring to table No.2 in the 2nd section we compose table No.49

Table No.49 numbers of vehicles outside cities in equivalent and absolute units in 2008

Table 49. Numbers of Vehicles Outside Cities in Equivalent and Absolute Units in 2008

Vehicles type	Transfer Coefficient	Number of vehicles	Equivalent No. of vehicles	Ratio of intercity vehicles	No. of intercity vehicles	Equivalent No. of vehicles
Automobiles	1	555475	555475	10	56000	56000
Buses	5	6258	31290	–	4032	20160
Microbuses	2	49017	97034	20	40000	80000
Trucks	5	215689	1078445	93	200000	1000000
Cold storage Lorry	5	1853	9265	100	1853	9265
Tankers citterns	5	5718	28590	100	5718	28590
Small good vehicles	1	322652	322652	50	160000	160000
3W pickups	1	13063	13063	100	13063	13063
Motorcycle	3/1	205518	68506	50	100000	33000
Agricultural Vehicles	4	144439	120000	20	30000	120000
Building machines	–	4950	–	–	–	–

Transport and rider	1	7504	7504	–	–	–
Special use Vehicles	4	5070	20280	20	1000	4000
Army and police vehicles	4	300000	1200000	80	240000	960000
Total		**1717206**	**3553104**		**851666**	**2484078**

Source: Ref [6] + author

From table No. 49 we find that the ratio of intercity vehicles to the total in equivalent units is 70%

From table No.36 Ref:[13] in the 4th section we find that the amount of emissions from road transport in 2005 is 11,917 MtCO2eq. This figure represents 96% of the total emissions from TS. It is divided in two parts 30% inside cities=3.575 MtCO2eq, and 70% outside cities are 8.342 MtCO2eq.

The above mentioned measures of improvement of the road transport efficiency can be divided in two categories: technical measures: renewal of fleet+ maintenance of roads and administerial, planning organizatory measures which play an important indirect role in reducing emissions.

Table No.50 shows the suggested measures and the amount of reduced emissions

Table 50. the Suggested Measures and the Amount of Reduced Emissions

Suggested measures	**Emissions reduction ratio%**		**Emissions reduction amounts (KtCO2eq)**	
	2020	2030	2020	2030
Fleet renewal	10	15	1411	2670
Administrative, planning, organizatory measures	10	15	1411	2670
maintenance of roads	10	15	1411	2670
Total	**30**	**45**	**4233**	**8010**

Source: Ref [Author]

4.5. Measures of improvement efficiency of urban transport

- ✓ Developing structural organization of the sector
- ✓ Developing urban transport systems
- ✓ Developing traffic systems
- ✓ Measures of reducing transport demand
- ✓ Controlling the technical readiness of vehicles
- ✓ Improving the quality of fuels

4.6. Developing structural organization of the sector

- ✓ Putting limits to urban development in Damascus and other old cities. Development of new small and medium cities taking into consideration the criteria of international urban planning.

- ✓ Transport and traffic planning should be an essential part of the master plan of all cities.
- ✓ Public transport is a vital necessity in all cities.
- ✓ Renewal of urban transport legislations.
- ✓ Attracting public opinion to participate in the definition and implementation of improval measures.
- ✓ Supplying the financial needs to this sector.
- ✓ Replacement the individual form of ownership and operation of transport means by modern companies.
- ✓ Coordination and cooperation among public, private and mutual sectors in the development of urban transport.
- ✓ Establishment of faculty of transport and traffic engineering and economics with three departments.
  - Construction department (roads, bridges, tunnels, railways, airports, ports and pipelines)
  - Operation department of transport modes (urban transport, road transport, railway transport, aviation maritime transport, pipeline transport).
  - Department of transport economics.
- ✓ Renewal of transport fleet
- ✓ Reviewing the prevention of utilization diesel fuel in cars and pickups taking into consideration the needs for emissions mitigations.
- ✓ Reviewing the subsidization policy of fuel products
- ✓ Separating diesel of vehicles from diesel for heating

1. Developing urban transport system

- ✓ Implementation of utilization CNG in buses and cars.
- ✓ Implementation of electric modes of transport (metro, monorail, tramways) in Damascus and other cities.
- ✓ Construction of new train station in the northern part of Damascus.
- ✓ Supplying new buses to all Syrian cities
- ✓ Improvement of bus and microbus networks.
- ✓ Establishment of database and information system for urban transport.
- ✓ Utilization of wireless communication for managing the activity of taxis.
- ✓ Encouraging bikes and walking
- ✓ Encouraging the utilization of HEVs and FCVs

2. Developing traffic system

- ✓ Separation the motion of pedestrians at traffic flows, construction of upper or under passages
- ✓ Establishment central traffic control unit
- ✓ Separation of traffic flows intersecting in round central squares, development of other road junctions.
- ✓ Solving the problem of cars using streets as garages
- ✓ Implementation measures for improving organization of traffic flows: specialized lanes for buses and microbuses, preventing motion of vehicles in some areas, implementing green wave of signals.
- ✓ Improvement of the quality and maintenance of roads and all facilities and networks connected with roads.
- ✓ Construction garages under parks and squares and in the passenger terminals.
- ✓ Completion of circular roads in Damascus
- ✓ Renewal the traffic study done by JICA.

3. Measures of reducing transport demand and smoothing rush hours

- ✓ Simplifying system of paying different charges or taxes including annual charges for vehicles enabling people to pay them in the living area or through banks
- ✓ The movement of start time of work in different ministries establishments, companies, etc.
- ✓ Simplifying measures ruling the organization of services to people.

4. Controlling the technical readiness of vehicles

- ✓ Equipping and putting into operation vehicles inspection centers in all transport directorates
- ✓ Participating the private sector in establishing vehicles inspection and maintenance centers.
- ✓ The vehicles running in streets to be checked by specialized personnel.
- ✓ Training drivers on principles and methods of energy efficient driving.

5. Improving the quality of fuels

- ✓ Using unloaded gasoline in all gasoline vehicles
- ✓ Reducing the amount of lead added to gasoline
- ✓ Reducing sulffer in diesel fuel
- ✓ Experimenting the possibility of introducing biofueles in the country
- ✓ To prevent using the old refined oils in vehicles.

Estimation of expected emissions mitigation in urban transport in the years 2020 and 2030

The ratio of vehicles inside cities in equivalent units is 30%. The same ratio 30% of the total emissions from road transport is considered to be inside cities.

We calculate the amount of emissions reduction by the equation:

The amount of emissions reduction = ratio of reduction X amount of emissions

Table No.51 shows the suggested measures and the resulting emissions reduction (ktCO2)

Table 51. The Suggested Measures and the Resulting Emissions Reduction (ktCO2)

Suggested measures	**Reduction Amount (ktCO2eq)**		**Reduction ratio%**	
	2030	2020	2030	2020
Developing structural organization of the sector	1145	605	15	10
Developing urban transport systems	1145	605	15	10
Developing traffic systems	763	303	10	5
Measures of reducing transport demand	763	303	10	5
Controlling the technical readiness of vehicles	356	181	5	3
Improving the quality of fuels	356	181	5	3
Total	**4579**	**2178**	**60**	**36**

Source: Ref [authors]

4.5. Railways transport

During the recent history of transport and all over the world, the railway transport was the 1st, because it consumes less fuel for (tkm) and (pkm).

Aiming to achieve full coordination between railways and other modes of transport, already railways have modified their equipment. Since the end of the 20th century all loads, except that which need specialized equipment (corn, raw materials, wood), are transported by multimodal containers which can be used in all modes of transport within a unified transportation process between origin to destination.

The establishment of Syrian railways is expecting to increase its ratio in freight transport to 17% in 2010 and to 26% in the period 2015-2025.

Table No.52 shows the planned activities till 2025 and the estimated costs.

Table 52. The Cost of Rehabilitation Plan in the Establishment of Syrian Railways till 2025

Items	**Cost 1000 mil sp**
1.Rehabiliation of railways	37
2.Construction newlines (1006 km)	68
3.Rehabilitation of locomotives (56 locomotives)	6.55
4.Rehabilition of passengers vehicles and goods wagon	0.0278
5.Import of new means of transport	60.003
5-1 New trainsets :quantity (10)	3.250
5-2 New locomotives (3000-4000), quantity 144	50.4
5-3 New locomotives (2500-3000), quantity 10	1.82

5-4 New phosphate wagons, quantity 160	0.884
5-5 New fuel wagons, quantity 250	1.465
5-6 Sand wagons, quantity 180	0.936
5-7 Dump wagons, quantity 80	0.416
5-8 Flat wagons for containers, quantity 160	0.832
Total	**172**

Source: Ref [5]

It is mentioned that electrification is implied in the plan, but there is no timetable for that.

Table No.53 shows expected mobility in Syria in the railways establishment in the period 2010-2025

Table 53. The Volume of Freight Transport in Syria and Railways Establishment in the period 2010-2025

Item	year	Intercity Ts T1000	Import 1000 T	Export 1000 T	Transit 1000 T	Total 1000 T
Volume of total transport	2010	25844	22200	19847	7067	74958
	2015	28757	26606	21821	7184	84368
	2020	36358	33630	27580	9090	106650
	2025	35969	40623	27622	15507	119721
Volume of Transport in Syrian railway establishment(SRE)	2010	8105	1050	2820	750	12725
	2015	10830	2000	6000	3500	22330
	2020	10830	2250	9650	5000	27730
	2025	14770	2500	10000	6000	30730
The share of SRE in total transport	2010	31.3	4.7	14.2	10.6	17
	2015	38	8	27	48	26
	2020	30	7	35	55	26
	2025	41	6	36	39	26

Source: Ref [5]

Table No.54 shows the amounts of GHG emissions reduction in railways in the period 2020-2030

The volume of freight transport by railways is now 10%. It is expected to rise to 20% in 2020 and 26% in 2030.This increase will take place at the expense of road transport and we suppose it will reduce emissions from road transport 5% in2020 and 3% in 2030.

From table 36 we find that railway emissions in 2005 are 133.22kton. It is estimated that this figure will be 400 kton in 2020 and 520 kton in 2030.

Table 54. Suggested Measures and the Amounts of Emission Reduction in 2020 and 2030.

Suggested measures	Reduction emissions ratio %		Reduction Amount (ktCO2eq)	
	2020	2030	2020	2030
The increase of railways share in transport to 26%	5	3	705	423
Electrification of some lines	5	10	20	52
Rehabilitation of network and locomotives	5	5	20	26
Import of new locomotives	5	5	20	26

Administrative, planning, organizatory measures	5	5	20	26
Total	**20**	**25**	**785**	**553**

Source: Ref [5]

4.6. Air transport

Some activities were opened to the private sector. The expected development in air transport is summarized as follows: Fleet renewal, renewal of airports equipments and communication system, improval of management, planning and operation systems. The expected reduction of emissions related to these measures is 30%.

4.7. Sea transport

Some activities were also opened to the private sector. The improvements are the same and emissions reduction is estimated to be 30% also.

5. Economic, Environmental and Climatic Effects of the Suggested Measures

The measures of improvement efficiency of transport systems till 2030 were mentioned in the section 5 and were classified as follows:

- ✓ Efficiency technology options
- ✓ Alternative fuels
- ✓ Improvement of road transport efficiency
- ✓ Improvement of roads
- ✓ Development of urban transport systems
- ✓ Development of railways
- ✓ Improvement the efficiency of air and maritime transport

These measures can be divided into technical measures having a direct effect on GHG mitigation, and managing organizational and planning measures having important but indirect effect on reducing of GHG emissions.

In order to put these measures into implementation, they should be approved as a part of the governmental strategy and plans. In the last years Syrian government tried to attract the private sector to increase its role in implementing the national developing plans. Therefore private sector could participate in financing and execution of these measures. For example 2 highways north-south from Turkish to Jordanian borders, and west-east from Tartous to Iraqi borders are under study to be constructed on BOT base.

- ✓ The permanent maintenance of roads and related to them facilities needs much more money than what is assigned now.
- ✓ The need is more than 10 billion Syrian pounds annually.
- ✓ Renewal of the fleet of vehicles should be encouraged and supported by the state by mean of nullifying custom charges.
- ✓ Encouraging the import of HEVs and in future FCVs. Encouraging the use of alternative fuels: ethanol and biodiesel
- ✓ Implementing CNG in cars and buses.
- ✓ Scheduling the construction of electric modes (Metro, monorail, trams) in big cities.
- ✓ Replacement of micro buses by new CNG buses different capacity in all cities.
- ✓ Construction of upper or under pedestrian passages, construction of tunnels and bridges to separate traffic flows, construction of garages for cars.
- ✓ Railways development plan in the G.E. of railways needs more than 172 billion Syrian bounds.
- ✓ Scheduling the construction of railway station in the northern entrance of Damascus.

All these projects need plenty of money and the private sector may participate in this investment.

There is plenty of managing, organizational and planning measures which do not need a lot of money but have a large effect on the efficiency of the transport system. They are mentioned in the 5th section including the issue of reducing the transport demand through simplifying governmental services.

These measures need to be understood and approved by the civil society to support them.

As it is expected these measures and projects can find support and help from the international organizations working globally to solve the problems of climate change.

Otherwise the positive results of these measures are: reducing fuel consumption, mitigation of GHG emissions.

Table No.55 summaries the results of calculations of the amounts of GHG mitigation according to the suggested measures.

Table 55. Ratio and the Amounts of GHG Emissions in 2020 and 2030

Suggested measures	**Ratio of GHG mitigation %**		**The amount of GHG emissions (ktonCO2eq)**	
	2020	2030	2020	2030
Efficiency technology options and alternative fuels	34.2	68.4	2069	5220
Renewal of the fleet of vehicles, maintenance of roads, managing, organizational and planning measures	30	45	4233	8010
Development of urban transport systems	36	60	2178	4579
Development of railways	30	35	785	553
Total			**9265**	**18362**

Source: Ref [author]

Fig No.13 shows Ratio and the amounts of GHG emissions (KtonCO2eq) in 2020 and 2030

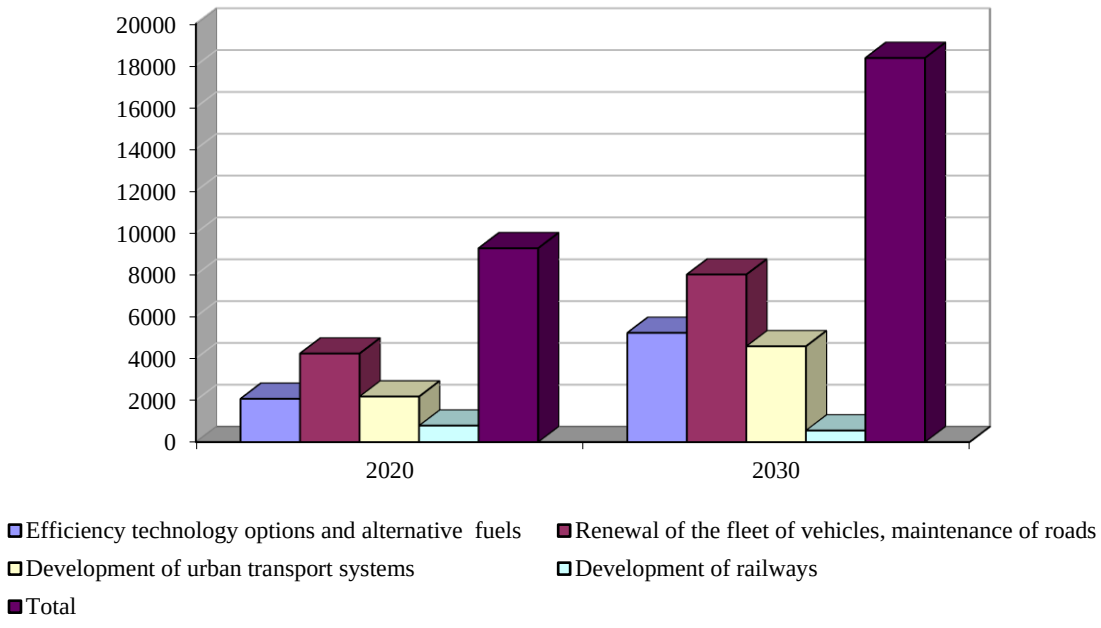


Fig.13. Ratio and the Amounts of GHG Emissions (KtonCO2eq) in 2020 and 2030

The implementation of the suggested measures and projects will result in reducing GHG emissions by 9265 KtonCO2eq (44%) in 2020 and 18362 KtonCO2eq (69.29%) in 2030.

It is expected that these reductions of GHG emissions in the TS and reductions in other sectors will have an important effect on climate change in Syria.

6. Obstacles, Difficulties facing GHG Emissions Mitigation in the TS.

The emissions of road transport and urban transport represent about 95% of GHG emissions. Therefore we concentrate on them.

The main obstacles are:

- ✓ The absence of data base for fuel consumption in road transport and urban transport. This imposes the need to activate the role of transport companies union.
- ✓ Old legislations ruling the two sectors. Decree No. 112 of year 1953 ruling urban transport and passenger road transport – Decree No.66 of the year 1964 ruling freight road transport.
- ✓ Old classification of vehicles statistics. Statistics are not available for the vehicles of the army and police.
- ✓ Only few experts, engineers in the field of transportation are available. This specialty does not exist in universities and research centers.
- ✓ The main form of investment and ownership in the two sectors is individual. This is a big obstacle, referring that some small and medium transport companies were formed in the last years
- ✓ The fleet of vehicles is old. It 's renewal should be encouraged by the state by means of nullifying custom charges
- ✓ Very little amounts of money are assigned to develop urban transport. The absence of permanent specialized authorities working on developing urban transport.
- ✓ Urban planning does not take into consideration the needs of developed transport and traffic systems.
- ✓ Maintenance of vehicles is very week and it is not under sufficient control.
- ✓ Weak maintenance of roads and facilities related to them.
- ✓ The lack of money assigned to develop railways which consume much less fuel for tkm and pkm.
- ✓ Paying taxes and different charges, other governmental services still need to go personally to the related departments, using means of transport. Simplifying the forms of payment and other governmental services may ensure the reducing of transport demand, reducing fuel consumption and GHG emissions.

7. Conclusions and Suggestions

- ✓ The development of TS is going on according to the market economy towards which Syrian economy was transferring since 2005.
- ✓ Number of cars was quickly increasing due to the reducing of custom charges. It was increased 4 times in the period 1994-2008, 2 times in the period 2004-2008.It is now 28 cars per 1000 inhabitants.
- ✓ Road transport is playing the main role. It is share in transportation is about 90%. It is still ruled by old legislations, individual form of ownership and operation.
- ✓ It is planned to enlarge the network of highways on BOT basis, the maintenance of roads network is weak because of the lack of the assigned money. The possibility to enlarge roads network inside cities is very limited.
- ✓ Microbuses still play the main role in urban transport. UT is ruled by the old decree 112 of the year 1953, the form of ownership and operation is individual. It is proved all over the world the need to establish a comprehensive modern public transport system in every city including electric modes in big cities.
- ✓ Nearly one half of the people are living in cities, therefore it is necessary to develop the structure of urban transport by renewal of its' legislations.
- ✓ The huge increase of individual cars in cities has produced many problems for which very difficult to find solutions. Cars are standing along the two sides of roads using the space as a garage. The capacity of roads has been weakened sharply and the rush hours are now longer. The speed of traffic flows during the rush hours goes down in some areas to become equal to speed of the pedestrians. This also proves the need to establish a comprehensive modern public transport system in all cities.
- ✓ The GE of Syrian railways is aiming to increase its share in transportation from 10% now to 26% in 2030, and to connect the Syrian railways with the neighbor networks. This plan faces the problem of lack of financing. The railways sector is completely a state sector.
- ✓ Fuel consumption is 4 times less per tkm, and 2 times less per pkm when comparing railways with road trucks and buses
- ✓ The air transport is transferring. It is opened now to the private sector. The airplanes of Syrian Air are old and many of them are out of services.
- ✓ Sea transport is opened also to the private sector. It is necessary to modernize the fleet of ships.
- ✓ Fuel consumption in cars and GHG emissions from them during the rush hours in cities (the speed is about 5 km/h) is 3 times more than in the normal situation when the speed is about 25 km/h.
- ✓ Diesel consumption in the transport sector in 2005 was 2.7293 Mt or 38.71% of total consumption in Syria.
- ✓ Gasoline consumption in Syria in 2005 was 1518228 m3 supper and 101053 m3 ordinary. Most of them is consumed in transport sector.
- ✓ The total fuel consumption in the TS in 2005 was 4.538 mtoe. It is expected that this figure will rise to 9.493 in the year 2020 and 15.87 in the year 2030.

- ✓ The GHG emissions in the TS in 2005 were 12.5 mtCO2eq. It is expected that this figure will rise to 15.5 in 2010, 21 in 2020 and 26.5 in 2030 supposing that the situation will develop as it is now.
- ✓ The estimations and calculations of the author demonstrate that the suggested measures and projects aiming to improve the efficiency of different transport systems will reduce the amounts of GHG emissions as follows:

Table No.55 Ratio and amounts of reduction GHG emissions in the period 2020-2030

Table 56. Ratio and the Amounts of Reduction GHG Emissions in 2020 and 2030

Suggested measures	**Ratio of GHG mitigation %**		**The amount of GHG emissions (ktonCO2eq)**	
	2020	2030	2020	2030
Efficiency technology options and alternative fuels	34.2	68.4	2069	5220
Renewal of the fleet of vehicles, maintenance of roads, managing, organizational and planning measures	30	45	4233	8010
Development of urban transport systems	36	60	2178	4579
Development of railways	30	35	785	553
Total			**9265**	**18362**

Source: Ref [author]

It is clear from table No.55 that reduction of GHG emissions is 44% in 2020 and 69.29% in 2030. It is expected that the mitigation of GHG emissions in TS and other sectors, will have an important effect on climate change which took place in the country in the last years.

In general reduction of fuel consumption and GHG emissions mitigation in the TS can be achieved through improving the efficiency of transport systems according to the content of the section No.5, through international experience and the help of international organizations. This need:

- ✓ Joint financing public and private
- ✓ To make available specialists, experts, specialized administrations
- ✓ Plans and programs depending upon national and international experience.
- ✓ Attracting the civil society to participate in implementing the mentioned plans and activities.

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