Transportation in the world and in Turkey

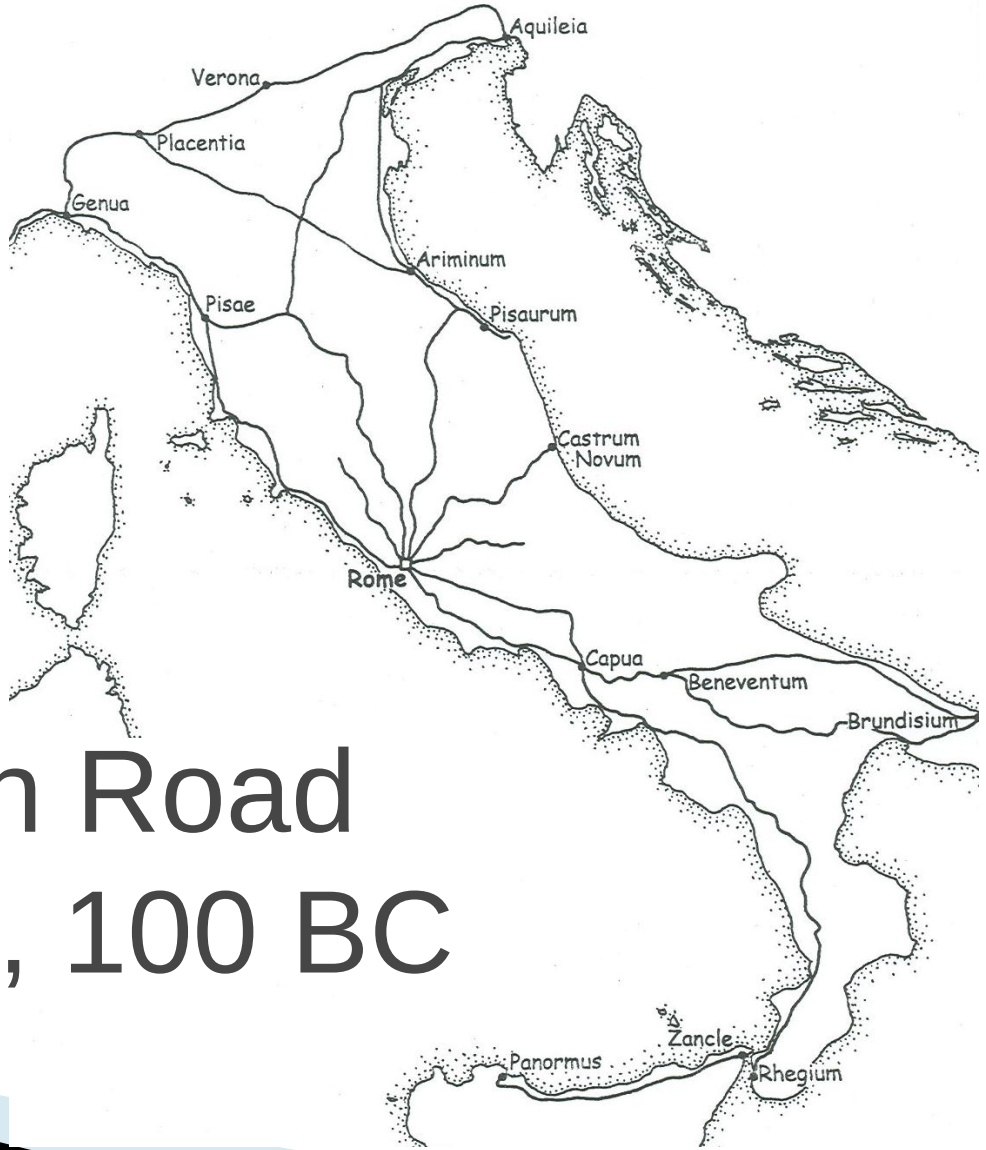
Early Road Transportation

- First traces of road structures were met in Egypt. According to the historians Heredot and Pilne roads were constructed in Egypt to carry stone blocks and other construction materials to the pyramids and similar movements.

- During the throne of Roman Empire roads called as “Roman Roads” had been constructed in Greece and Anatolia.

Roman Roads

- In Europe by Roman Empire
  - For military purposes
  - Great quality of road construction



Roman Road Network, 100 BC

Roman Roads – 200 AD

Early Road Transportation

- A French engineer, Tresaquet
  - introduced new approaches in the design, construction and maintenance of flexible roads by considering the weight of cars for thickness determination.

Early 1900s

- Two British engineers

(Mac Adam and Telford) and a French engineer Polonceau

  - new highway engineering techniques were developed

Early Road Transportation

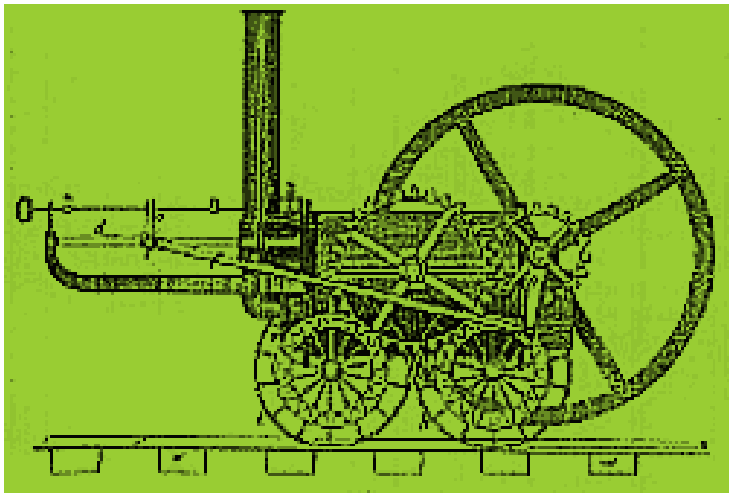
- Asphalt in pedestrian walk lanes and in roads was first seen in 1836 and 1838 in London and in Philedephia respectively.

Railway Era

- Thomas Savery (1698)
  - patented the first crude steam engine in
- Thomas Newcomen (1663-1729)
  - improved on this design.
- James Watt (1769) patent
  - improved on the steam engine in the second half of the 18th century
  - a truly viable piece of machinery that helped start the Industrial Revolution.
  - patent for a separate condenser connected to a cylinder by a valve.

History of Steam Power

- Samuel Homfray (1803)
  - funded the development of a steam-powered vehicle to replace the horse-drawn carts on the tramways.
- Richard Trevithick (1804)
  - built the first steam engine tramway locomotive for roads -not railroads in



- The locomotive hauled a load of 10 tons of iron, 70 men and five extra wagons the 9 miles between the ironworks at Pen-y-Darron in the town of Merthyr Tydfil, Wales to the bottom of the valley called Abercynnon. **It took about two hours. → speed 4.5 miles/hr =7,5 km/kr**

Railway Era

- In England,
  - In 1825, first steam engine in a locomotive pulling rail cars by George Stephenson
- In the USA ngland,
  - In 1830, Peter Cooper designed and built the first American-built steam locomotive,

- This resulted in the rise of “railways” in 19th century.

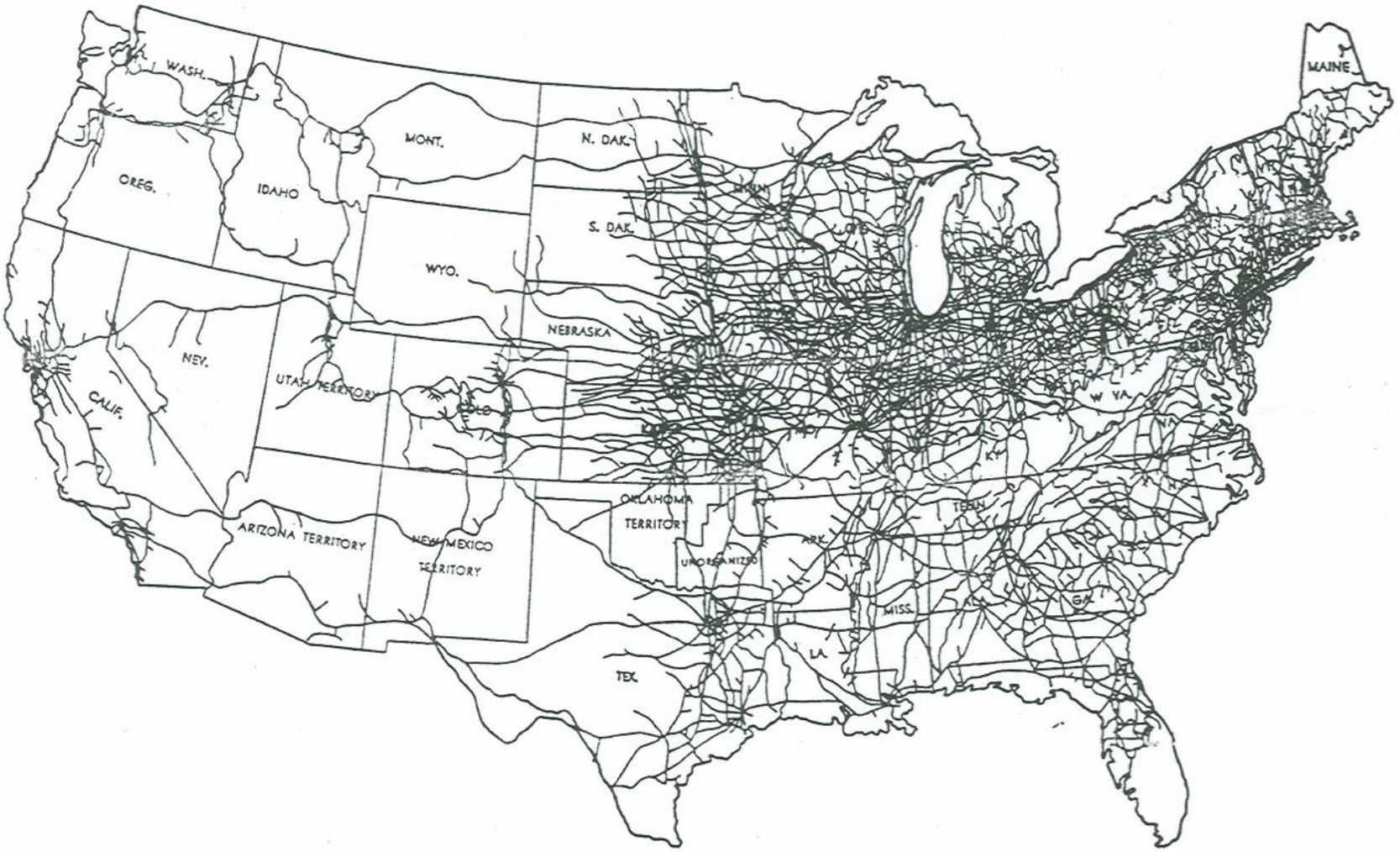


FIGURE 2.7. Railroad network of the United States, 1890.

US Railroad Network

(1890)

Railway Era –Turkey

- Parallel to this development, railways were constructed in different parts of the Ottoman Empire, but these railways were realized under the inspection of foreign companies.
  - Following lines were constructed between 1856 and 1922 in the territory of Ottoman Empire.

Rumelia Railways:	2383 km normal lines;
Anatolia - Baghdad Railways:	2424 km normal lines;
Izmir - Kasaba and its extensions	695 km normal lines;
Izmir -Aydin and its branches:	610 km normal lines;
Damascus - Hama & its extensions	498 km narrow& normal lines;
Jaffa - Jerusalem:	86 km normal lines;
Bursa - Mudanya and	42 km narrow lines;
Ankara - Yahsihan	80 km narrow lines.
Total:	**8.619 km**

Railway Era

- Post-Republic period (1923-1950),
  - there is a “railroad- intense” period when railways investments were focused on for transporting such mass cargos (iron, steel, coal, etc.) in the cheapest way.
  - For this reason, the railway lines were oriented towards motional resources and they became determining factors for establishing the locations during the process of national industrialization.

Highway Transportation

- At the beginning of 1900s, invention of personal vehicles (automobiles) that can operate with an engine is another milestone in the history of transportation.
- This changed the popularity of railways in the world and in Turkey.
- Very quickly, this personalized and “door-to-door” transportation system became popular and started an area of highway transportation,
  - became the predominant transportation system in almost everywhere today.

Highway Transportation

- After World War I, connection with the development in automotive industry, highway transportation and highway construction become wide-spreadable.
- At the early stages of highway construction,
  - asphalt was sprayed over the road surface to obtain a protective layer.
  - Later asphalt and aggregate mixtures were used to provide a stable and smooth layer for motor vehicles.
- Today asphalt mixtures are used extensively in flexible pavement structures successfully for a safe, rapid and economical highway transportation to sustain heavy axle loads.

Transportation Master Plans for Turkey

The aims of the 1983-1993 Transport Master plan of Turkey

- To **improve safety in transportation**
- To **increase accessibility of Turkish Transportation Network**
- To meet the future transport demands properly
- To minimize energy consumption and to decrease transport costs
- To minimize the dependency of transportation sector to a specific energy kind
- To decrease the adverse effect of transportation on environment
- To improve the efficiency of transportation network
- To increase the income obtained from transit transportation
- To **plan a transportation network for national security**

Transportation Master Plans for Turkey

- The latest strategy document for TMP of Turkey
  - has been published in 2005 (İTÜ).
- In this document, the main objective of **transportation** in Turkey is defines as

"to give the necessary, necessity being determined by the development and social aims of the country, service to the user at the most appropriate quality, with the conditions that it will be in conjunction with national security, it **will be safe and environment-friendly, cheap, technologically new, in harmony with international rules and EU policies.**"

2005 Strategy Document

Objectives:

- To give the users a safe, comfortable, fast and reliable service
- To help the necessary economic and social development
- **To get rid of the inequalities between regions**
- To be in conjunction with national security
- **To increase transportation safety**
- **To keep the negative environmental effects at the minimum**
- **To decrease energy inefficiency and decrease foreign dependence on energy**
- To decrease transportation costs
- To establish a balanced transportation system in which each transportation mode will give the service that is technically and economically effective; accordingly, to develop rail transport, air transport and marine transport.
- To support land use decisions
- **To develop a transportation network which is appropriate for the development of international relations and foreign trade.**

2005 Strategy Document

The principles

- To create justice between transport modes on facts like public service responsibilities, taxes, tariff applications etc.
- Internalization of external costs
- Coordination of different transport modes
- Promotion of public transport
- Development of transportation system according to plans, which are updated within a three-year period and which are flexible and dynamic
- Creation and updating of a data base for the plans and other decisions
- Resolution of financing problems in investment decisions

2005 Strategy Document

The policies

- Primarily, effective use of present transportation network and facilities and extension of the network with new investments
- Making arrangements for financing of investments
- Use of transportation revenues only for transport investments
- Development of transport-related industries
- Opening more international transit corridors over Turkey
- Better management and organization within transport institutions
- Replacement of current regulations that is present separately for each transport mode, with an integrated regulatory system that will be in harmony with international regulations
- Training of qualified staff on transportation
- Monitoring of the developments in logistics and evaluation of cooperation possibilities

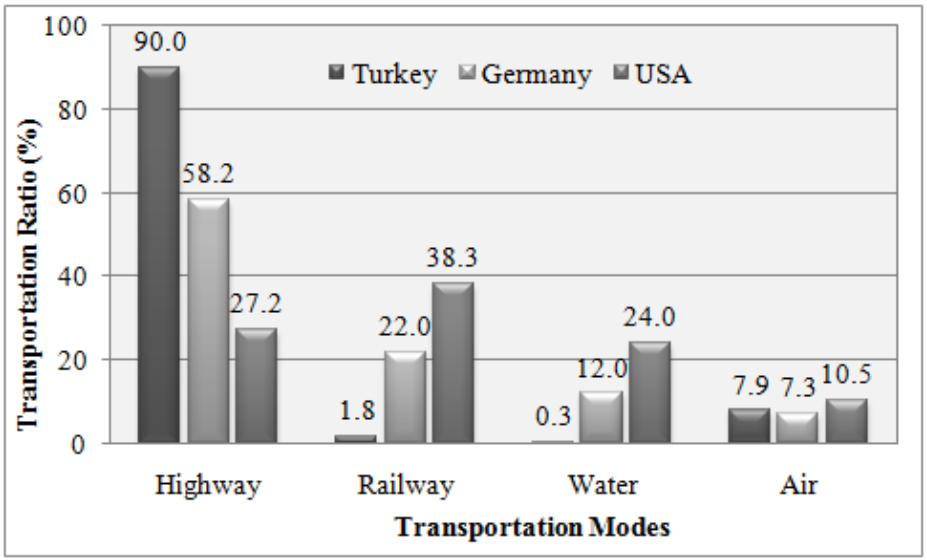
Current Status of Transportation Sector

- Highway has a market share of more than 90 % among all transportation systems for both passenger and freight.

Transportation of Passengers and Goods per Mode in Turkey (%) (TurkStat, 2008)

Current Status of Transportation Sector

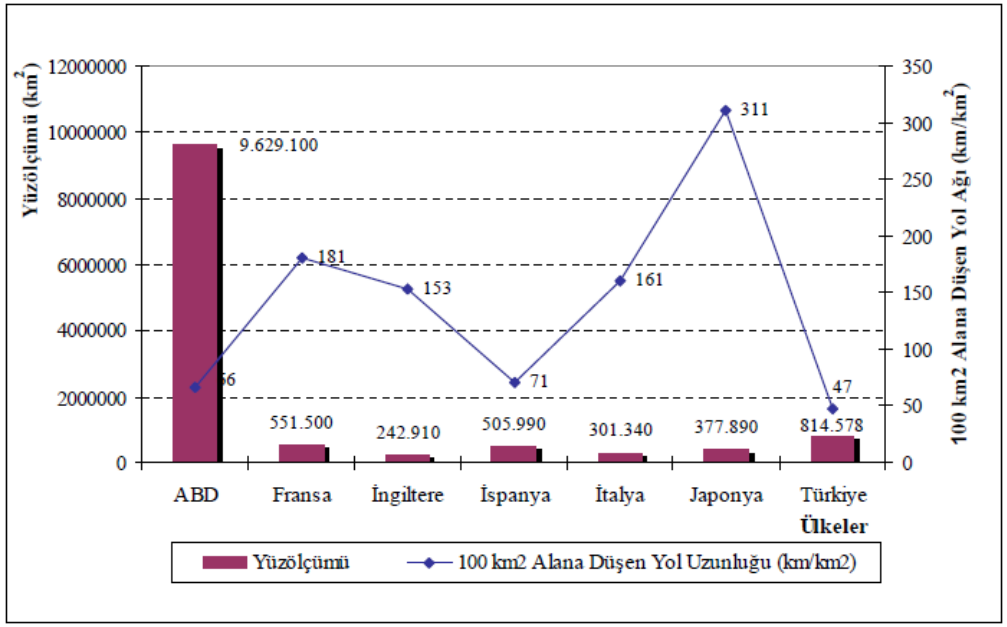
- Highway transportation system for passengers has around 90 % share, which is only 27 % in United States and 58 % in Germany.



Transportation of Passengers per Mode (%) in Turkey, United States and Germany (UNECE Transport Division, 2006)

Current Status of Transportation Sector

- However when road capacities are reviewed, it is seen that our country has much lower rates than developed countries.



Length of Total Road Network in Some Countries per 100 km²

Current Status of Transportation Sector

- Highest proportions of both passenger and freight transportation are realized by highways.

The distribution of passenger and freight transportation among each transportation subsystems (KGM, 2011; TurkStat, 2011)

Modes of Transportation	Passenger Transportation		Freight Transportation	
	passenger-km (10^6)		ton-km (10^6)	
	2000	**2009**	**2000**	**2009**
Waterways	30	1,642	7,900	11,458
Railways	5,833	5,374	9,895	10,326
Highways	185,681	212,464	161,552	176,455
Airways	3,555	*	310	*

- ***2009 air transportation values are not provided**

Current Status of Transportation Sector

Motorways, State roads and Provincial Roads in Turkey is given with emphasis on surface types, length of network

Road Network According to Surface Types in 2009

	Total	Bituminous surfacing	Stone black	Stone crushed and stabilized	Graded and ungraded	Unpaved roads
Motorways	2,036	2,036	-	-	-	-
State roads	31,271	30,770	66	137	53	245
Provincial roads	30,948	27,693	114	1,353	730	1,058
Village roads	298,405	124,439	-	136,885	30,309	6,772
Total	**362,660**	**184,938**	**180**	**138,375**	**31,092**	**8,075**

Current Status of Transportation Sector

- State roads has the highest share for both passenger and freight transportation.

Amount of Passenger-Km and Ton-Km Circulation on Turkish Highway Network (KGM, 2011)

	Motorways	State Highways	Provincial Roads	Total
passenger-km (10^6)	50,378 (22.2%)	158,072 (69.7%)	18,463 (8.1%)	226,913
ton-km (10^6)	42,941 (22.6%)	138,921 (73.0%)	8,503 (4.5%)	190,365

Current Status of Transportation Sector

- The number of vehicles is constantly increasing without much increase in the network capacity.

Lengths of Motorways, State Highways, Provincial Roads and Village Roads (SIT, 2005; KGM 2005)

	2000	2009	% increase (2000-2009)
Motorways (km)	1,773	2,036	14.8
State Roads (km)	31,397	31,271	-1.0
Provincial Roads (km)	29,693	30,948	1.0
Village Roads (km)	321,820	298,405	-9.0
Total	384,683	362,660	-9.4

Number of Vehicles

- Number of vehicles has increased from 8.8 million to 14.3 million with an increase of 38.6 % in the last decade. Almost half of the total vehicles are privately owned vehicles and also number of heavy goods vehicles is very high in 2009.

Year	Car	Minibus	Bus	Small Truck	Truck	Motorcycle	Special Use	Tractor	Total	Increase (*)
2000	4,855,421	289,422	129,924	789,524	593,361	984,592	21,822	1,131,626	**8,795,692**	
2001	4,975,733	293,697	133,944	877,563	598,481	1,011,160	22,939	1,148,391	**9,061,908**	**3.03%**
2002	5,080,555	303,803	137,964	924,342	604,050	1,032,011	23,666	1,168,389	**9,274,780**	**2.35%**
2003	5,124,254	309,545	141,987	1,045,776	616,940	1,096,777	24,468	1,178,929	**9,538,676**	**2.85%**
2004	5,400,440	318,954	152,712	1,259,867	647,420	1,218,677	28,004	1,210,283	**10,236,357**	**7.31%**
2005	5,772,745	338,539	163,390	1,475,057	676,929	1,441,066	30,333	1,247,767	**11,145,826**	**8.88%**
2006	6,140,992	357,523	175,949	1,695,624	709,535	1,822,831	34,260	1,290,679	**12,227,393**	**9.70%**
2007	6,472,156	372,601	189,128	1,890,459	729,202	2,003,492	38,573	1,327,334	**13,022,945**	**6.51%**
2008	6,796,629	383,548	199,934	2,066,007	744,217	2,181,383	35,100	1,358,577	**13,765,395**	**5.70%**
2009	7,093,964	384,053	201,033	2,204,951	727,302	2,303,261	34,104	1,368,032	**14,316,700**	**4.01%**

Fuel Consumption

- To assess the total impact of transportation on environment, we have to calculate the energy consumption required for transportation activities. One measure of this is the total fuel consumption.
- Gasoline consumption have continuously decreased but diesel and LPG and diesel consumption have increased over the last decade.

Fuel Consumption in Transportation Sector (PETDER, 2011)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Gasoline	10^6*ton	2.80	2.70	3.15	2.97	2.89	2.71	2.62	2.54	2.34	2.28
Diesel	10^6*ton	8.19	8.42	9.49	9.72	10.73	11.05	11.98	12.95	14.01	13.46
Gasoline + Diesel	10^6*ton	11.03	11.15	12.68	12.73	13.65	13.79	14.62	15.51	16.36	15.75
LPG	10^6*ton	1.28	1.23	1.14	1.15	1.64	1.75	1.55	2.01	2.11	2.30

Driver and Vehicle Statistics

- In the last ten years, number of drivers in Turkey increased 48.5% and rising from 13.8 million to 20.5 million drivers.

Year	Total Drivers	Increase (%)*	Male	(%)	Female	(%)
2000	13,859,449		11,988,154	86.5	1,871,295	13.5
2001	14,491,332	4.6	12,473,155	86.1	2,018,177	13.9
2002	14,994,960	3.5	12,851,459	85.7	2,143,501	14.3
2003	15,488,493	3.3	13,205,913	85.3	2,282,580	14.7
2004	16,151,623	4.3	13,704,551	84.8	2,447,072	15.2
2005	16,958,895	5.0	14,289,647	84.3	2,669,248	15.7
2006	17,586,179	3.7	14,770,114	84.0	2,816,065	16.0
2007	18,422,958	4.8	15,424,427	83.7	2,998,531	16.3
2008	19,377,790	5.2	16,073,831	82.9	3,303,959	17.1
2009	20,460,739	5.6	16,871,100	82.5	3,589,639	17.5

(*) increase rate from previous year

Number of Driver License Types

- With 2009 values, B Type (Car, Minibus or Small Truck), E Type (Bus) and C Type (Truck) driver license classes have the highest number of registered drivers, with approximately 14.8 million drivers, 3.5 million drivers, 1.4 million drivers, respectively.

Year	A1	A2	B	C	D	E	F	G	H	Total	Increase
2000	53,219	364,174	9,276,057	1,444,108	9,207	2,534,039	392,585	16,836	18,830	**14,109,116**	
2001	53,467	388,567	9,814,416	1,445,804	10,737	2,631,449	383,827	18,511	20,806	**14,767,694**	**4.67%**
2002	53,622	402,674	10,251,523	1,447,174	13,013	2,692,300	382,624	20,094	22,037	**15,285,187**	**3.50%**
2003	53,805	411,375	10,686,009	1,447,347	15,225	2,748,562	380,901	21,487	23,085	**15,787,933**	**3.29%**
2004	54,426	429,307	11,230,909	1,454,422	24,435	2,847,388	379,286	23,350	24,680	**16,468,317**	**4.31%**
2005	54,787	450,680	11,919,158	1,456,546	32,651	2,951,273	378,523	25,735	26,709	**17,296,216**	**5.03%**
2006	56,039	494,164	12,434,247	1,467,482	41,558	3,030,388	380,006	30,198	28,597	**17,962,895**	**3.85%**
2007	56,485	567,904	13,135,961	1,438,239	56,581	3,180,982	375,709	34,653	30,840	**18,877,354**	**5.09%**
2008	57,232	660,817	13,903,160	1,442,323	75,902	3,336,506	375,787	39,272	33,443	**19,924,442**	**5.55%**
2009	60,193	784,442	14,758,037	1,441,473	100,232	3,531,082	375,673	47,245	36,527	**21,134,904**	**6.08%**

A1:Moped; A2:Motorcycle; B:Car, Minibus or Small Truck; C:Truck; D:Towed Vehicle; E:Bus; F:Tractor; G:Construction Vehicle; H:Specially Designed for Disabled Persons

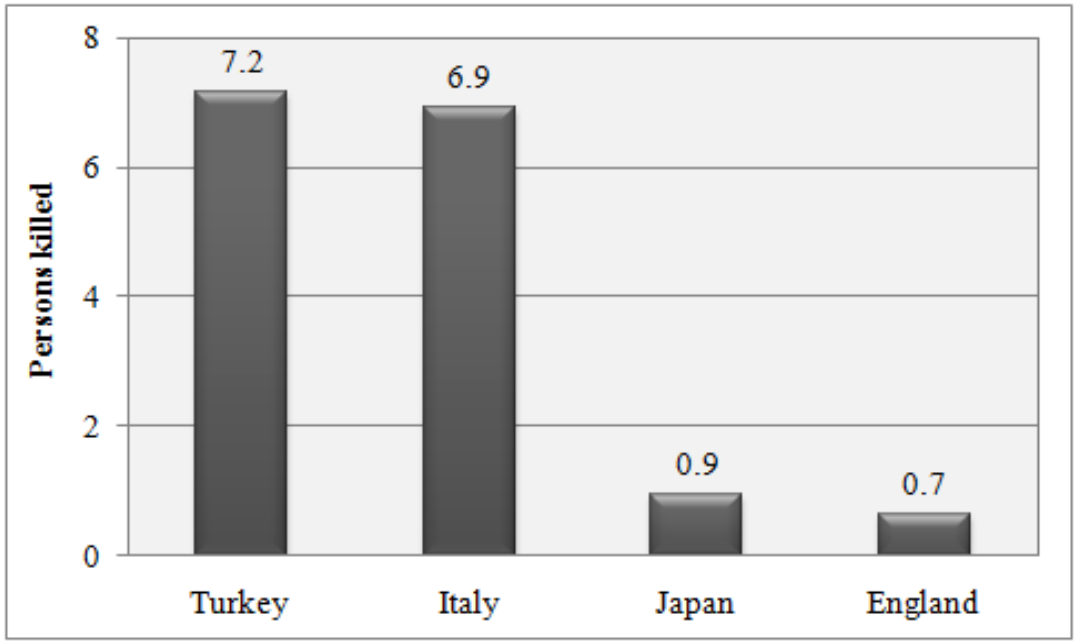
Traffic Safety

- Traffic accidents are the primary safety problem in highway transportation. In Turkey 4,300 people lost their lives and 200,405 people were injured in 1,034,435 total traffic accidents occurred in year 2009.

YEAR	ACCIDETS INVOLVING			PEOPLE	
	TOTAL	FATALITY	INJURY	KILLED	INJURED
2000	500,664	2,994	62,295	5,566	136,406
2001	442,960	2,312	52,848	4,386	116,202
2002	439,958	2,221	52,525	4,169	116,045
2003	455,637	2,120	53,983	3,959	117,551
2004	537,352	2,354	61,239	4,427	136,437
2005	620,789	2,535	69,659	4,505	154,086
2006	728,755	2,586	76,591	4,633	169,080
2007	825,561	2,671	84,295	5,007	189,057
2008	950,120	2,258	82,361	4,236	184,468
2009	1,034,435	2.310	89.204	4,300	200,405

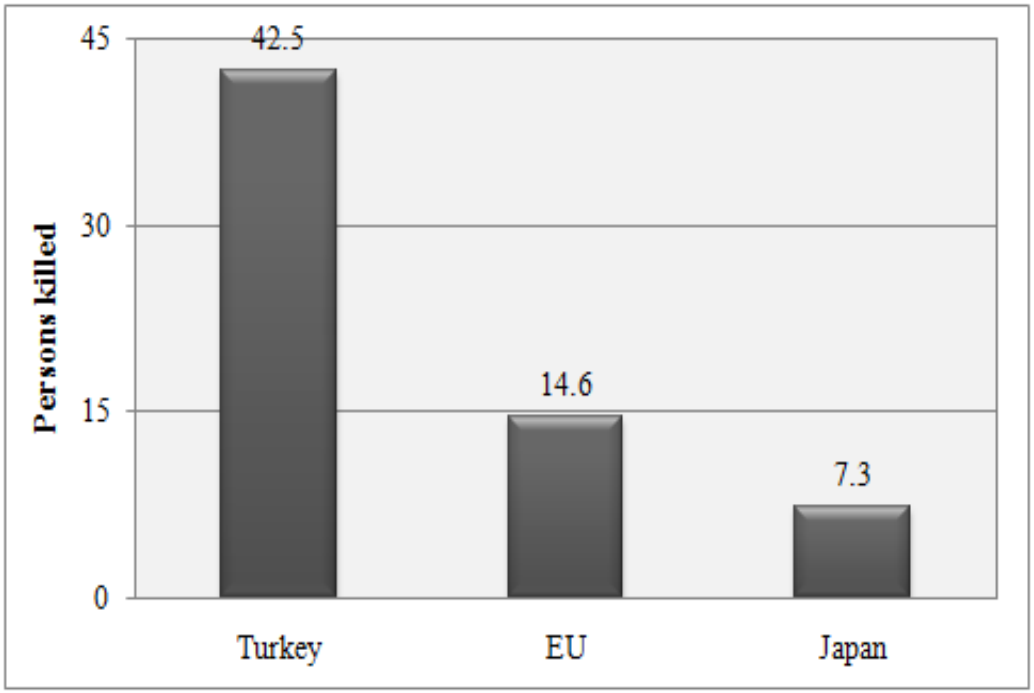
Traffic Safety

- Number of persons killed in road traffic accidents per 100 million vehicle-km in Turkey is 7.2, in Italy 6.9, in Japan 0.9, and in England 0.65.



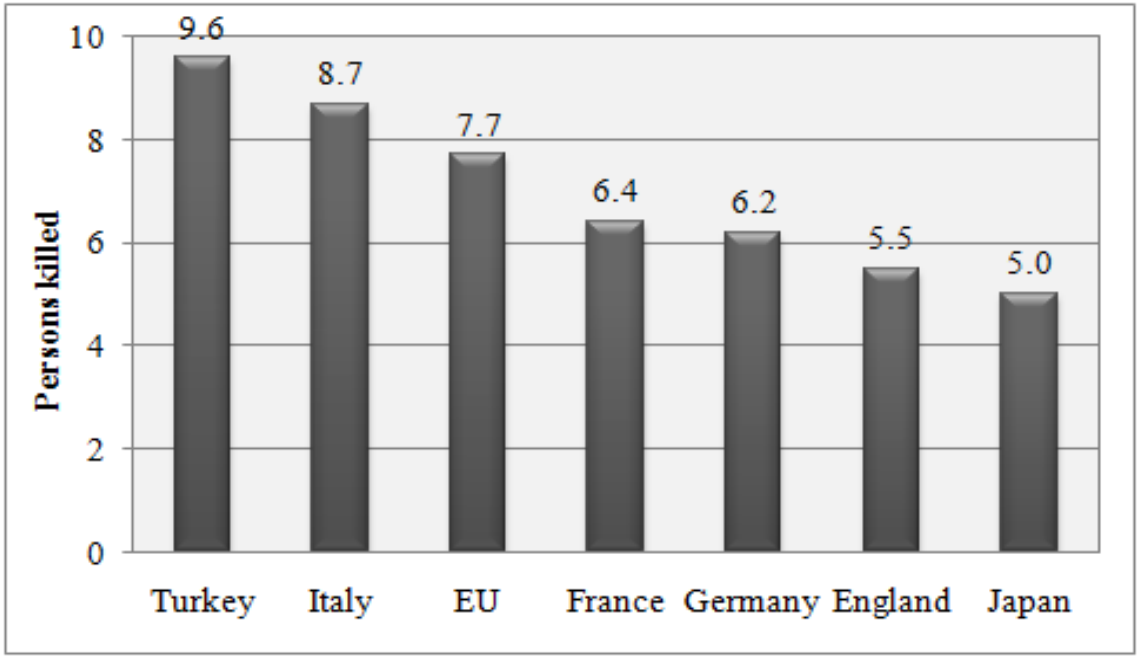
Traffic Safety

- Number of persons killed in road traffic accidents per 100 thousand vehicles in Turkey is 42.5, in EU Countries 14.6 and in Japan 7.3.



Traffic Safety

- Number of persons killed in road traffic accidents per 100 thousand population in Turkey is 9.6, in Italy 8.7, in EU Countries 7.7, in France 6.4, in Germany 6.2, in England 5.5 and in Japan 5.0.



Traffic Safety

Country	Surface Area (km^2)	Population (thousands)	Number of Road Traffic Accidents	Killed Persons			Injured Persons		
				Number of Killed Person	Ratio to Population (‰)	Ratio to Number of Road Traffic Accidents (‰)	Number of Injured Person	Ratio to Population (‰)	Ratio to Number of Road Traffic Accidents (‰)
Austria	83,858	8,207	42,657	878	0.11	21	55,857	6.81	1309
Belgium	30,528	10,446	48,670	1,163	0.11	24	62,992	6.03	1294
Bulgaria	110,994	7,761	7,612	943	0.12	124	9,308	1.20	1223
Cyprus	9,251	749	2,080	117	0.16	56	3,176	4.24	1527
Czech Republic	78,866	10,221	26,516	1,382	0.14	52	34,254	3.35	1292
Denmark	43,094	5,411	6,209	369	0.07	59	7,546	1.39	1215
Estonia	45,227	1,348	2,244	170	0.13	76	2,875	2.13	1281
Finland	338,145	5,237	6,767	375	0.07	55	8,791	1.68	1299
France	551,50	60,340	85,396	5,232	0.09	61	108,727	1.80	1273
Germany	357,022	82,501	339,310	5,842	0.07	17	440,126	5.33	1297
Greece	131,957	11,062	15,547	1,670	0.15	107	20,179	1.82	1298
Hungary	93,030	10,098	20,957	1,296	0.13	62	28,054	2.78	1339
Ireland	70,273	4,044	5,781	374	0.09	65	7,867	1.95	1361
Italy	301,318	58,462	224,553	5,625	0.10	25	316,630	5.42	1410
Latvia	64,589	2,306	5,081	516	0.22	102	6,416	2.78	1263
Lithuania	65,30	3,425	6,357	752	0.22	118	7,862	2.30	1237
Luxembourg	2,586	455	,692	49	0.11	71	1,079	2.37	1559
Malta	316	403	15,643	13	0.03	1	1,268	3.15	81
Netherlands	41,526	16,255	27,760	804	0.05	29	33,302	2.05	1200
Norway	323,758	4,577	8,425	257	0.06	31	12,121	2.65	1439
Poland	312,685	38,174	51,069	5,712	0.15	112	64,661	1.69	1266
Portugal	91,982	10,529	38,930	1,135	0.11	29	52,009	4.94	1336
Romania	238,391	21,70	6,860	2,418	0.11	352	5,594	0.26	815
Slovakia	49,036	5,385	8,443	603	0.11	71	11,190	2.08	1325
Slovenia	20,273	1,998	12,721	274	0.14	22	18,723	9.37	1472
Spain	505,992	43,198	94,009	4,741	0.11	50	138,383	3.20	1472
Sweden	449,964	9,011	18,029	480	0.05	27	26,582	2.95	1474
Turkey	**774,815**	**71,794**	**77,008**	**4,427**	**0.06**	**57**	**136,437**	**1.90**	**1772**
United Kingdom	242,90	59,834	207,410	3,221	0.05	16	277,619	4.64	1339

Traffic Safety

- 5E Approach
  - **Engineering**
  - Evaluation
  - Enforcement
  - Education
  - Encouragement

- You can desing transportation systems that will increase safety !!