

Fuel Consumption and Energy use in Tunisia's Public Road Transport: A Descriptive Study

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Abstract:

This paper presents a descriptive analysis of fuel consumption and energy use in Tunisia's public road transport sector during the period 2008–2014. The study covers 13 regional transport companies and the National Interurban Transport Company (SNTRI). Based on data on passenger numbers, kilometers traveled, vehicle fleet characteristics, and fuel consumption, the analysis highlights the main determinants of energy demand and compares energy efficiency across companies. The results show that while fuel consumption remained relatively stable, fuel expenditures increased over time. Significant disparities in energy performance persist among transport operators, and improvements in energy efficiency remain limited, pointing to the need for better energy management in the sector.

Keywords: Public road transport; Fuel consumption; Energy efficiency; Descriptive analysis; Tunisia

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1. Introduction

Urban public transport is one of the pillars of the process of sustainable economic and social development. It is considered one of the most indispensable public services for the daily mobility of citizens in all regions of the country, enabling social activities outside the place of usual residence, namely: working, studying, shopping, etc. From an economic point of view, transport occupies a significant share of international trade, generates wealth, and constitutes a key driver of national economic growth (the transport sector in Tunisia accounted for 7.3% of GDP in 2013 and recorded a growth rate of about 7.1%). From an environmental perspective (noise, pollution, safety), it is necessary to identify the main pollutants caused by traffic (generally suspended particles and lead) and to mobilize technical, financial, and practical management tools to limit fuel consumption.

In Tunisia, public transport is considered a public service. Indeed, the State is the main organizer of passenger public transport, primarily through public enterprises. These modes of transport belong to two major categories: road transport and rail transport.

The impact of greenhouse gas emissions on the environment, together with the burden of fuel subsidies on public finances, compels us to change our transport habits. From this perspective, Tunisia must regularly renew its vision regarding energy use in order to ensure not merely development, but rather sustainable development—one that is accompanied by inclusive and sustained economic growth, energy security, and respect for the environment.

The State is therefore required to regularly provide answers to certain questions:

- What is the current state of energy consumption?
- What are the determining factors of fuel consumption?

To answer these questions, the preparation of an energy balance is very important in order to assess fuel consumption in volume (thousands of liters) as well as fuel expenditures for each regional transport company. This is the objective of this study, which covers the entire road-based collective transport sector, consisting of 13 regional transport companies and the interurban transport company (SNTRI).

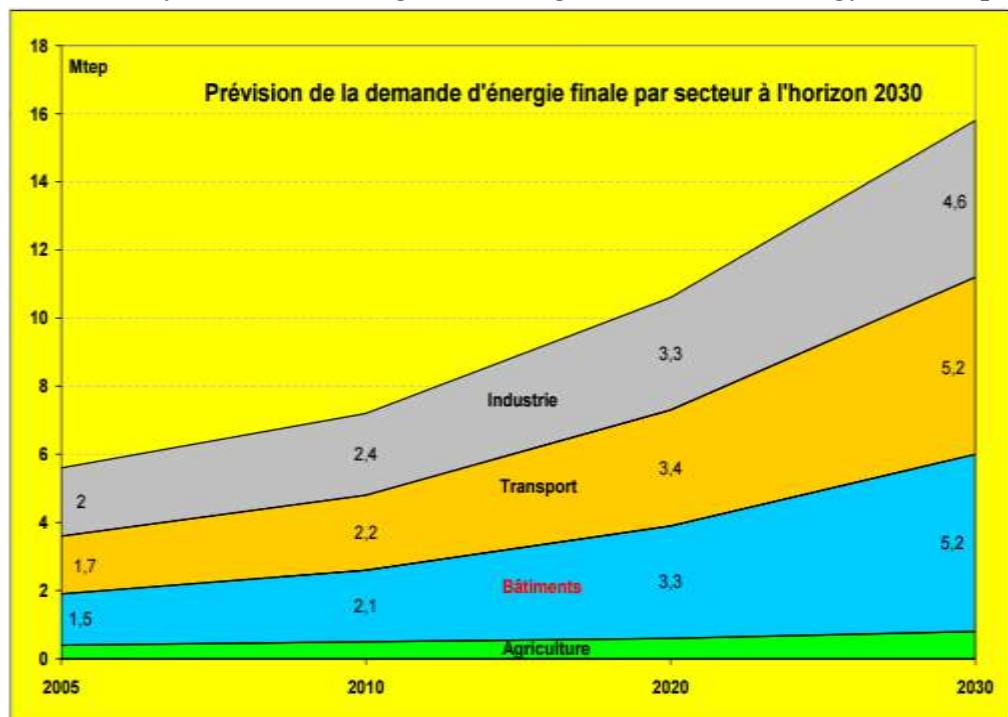
2. National Context

Tunisian transport services are provided at nearly 70% by the public sector under the supervision of the Ministry of Transport. The latter's main mission is to plan and ensure the proper functioning of a national transport system, making it a factor of sustainable development.

The classified road network is distributed as follows:

- National roads: 3,938 km
- Regional roads: 5,117 km
- Local roads: 2,453 km
- Roads under classification: 1,242 km

Transport, the second most energy-intensive sector after industry, consumes approximately 2 million toe (tons of oil equivalent) and could reach 5 million toe by 2030, becoming the leading sector in final energy consumption.



*Figure 1:
Forecast of final energy demand (Source: ANME)*

Road transport is the most widely used mode. It is also the most energy-intensive among transport modes, followed by rail transport.

Within its energy policy, the State grants significant subsidies to petroleum products and transport (for example, student transport). This burden on the State budget is very large: about 49% of energy subsidies, representing 4.7% of GDP in 2013, which is equivalent to the public deficit of 5.1% of GDP.

3. Energy Balance

In Tunisia, collective public transport is provided by the National Transport Company (SNT), the National Railway Company (SNCFT), the National Interurban Transport Company (SNTRI), as well as regional transport companies.

These companies develop a supply that is intended, in principle, to meet users' needs according to a "**public service**" approach.

4. Determinants of Fuel Demand

Fuel consumption in the transport sector is influenced by many factors, which can be grouped into three categories:

- Mobility demand measured by the number of passengers
- Transport supply quantified by the number of kilometers traveled
- Capital used, represented here by the vehicle fleet. The average age of the fleet affects energy consumption, especially in the absence of proper maintenance of rolling stock.

4.1 Evolution of the Number of Passengers

The number of passengers is an indicator of the intensity of passenger traffic. It measures the degree of demand for public transport.

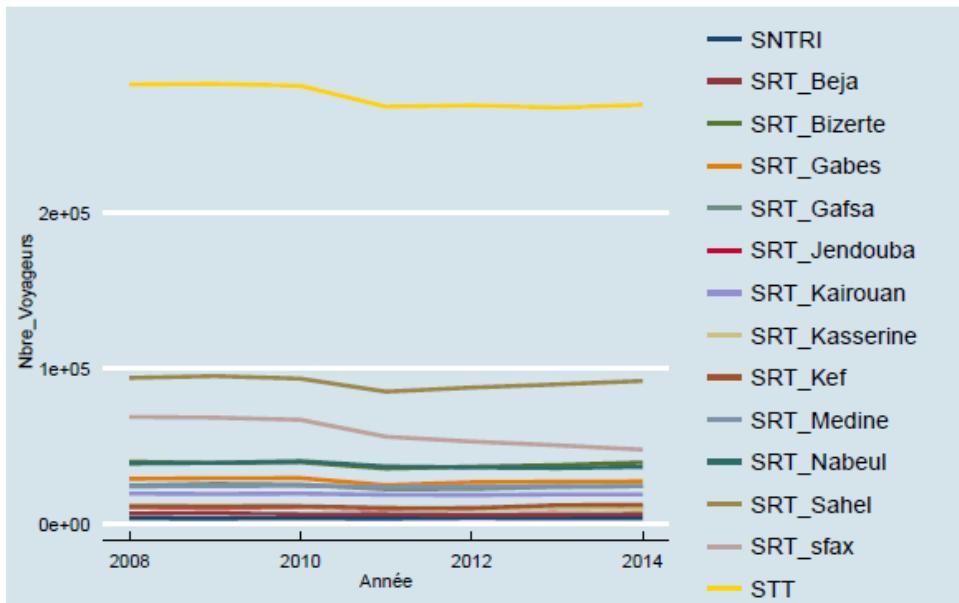


Figure 2: Evolution and distribution of passengers (thousands of passengers)

The number of passengers declined in 2011 due to the poor socio-economic situation triggered by the revolution. Repeated strikes, slowdowns in school and academic activities, and other factors affected passenger traffic. Growth rates of transport demand remained almost zero, with a slight recovery in 2010, except for the Sfax company, which has recorded a considerable decrease in passenger flows since 2010. Companies in coastal regions (North and Center-East) have higher passenger flows than those in the South and Center-West. This difference mainly stems from disparities in economic activity intensity and population density across regions.

Année	2008	2009	2010	2011	2012	2013	2014
Total (milliers) :	663228	665522	665612	700022	616302	620026	584600
Taux de croissance :	0,003	0,000	0,051	-0,119	0,006	-0,057	
Moyenne :	47373,	47537	47543	50001	44021	44287	41757
Ecarterpe :	72265,2	72382,3	71793,7	68833,5	68490,8	68035,5	58570,4
Min :	3700	3650	3758	3600	4000	3800	3700
Max :	282436	282820	281495	268115	269000	267500	229300

Table 1: Descriptive statistics of the number of passengers

Traffic growth is almost zero. Disparities persist over time, with a very large gap between the minimum and maximum values. STT accounts for more than 40% of total passengers. While the average remains almost unchanged, disparities decrease over time, as indicated by a declining standard deviation. The minimum number of passengers corresponds to STRI.

4.2 Evolution of the Number of Kilometers Traveled

Kilometers traveled reflect the level of activity of transport companies. This indicator provides information on the intensity of transport service supply.

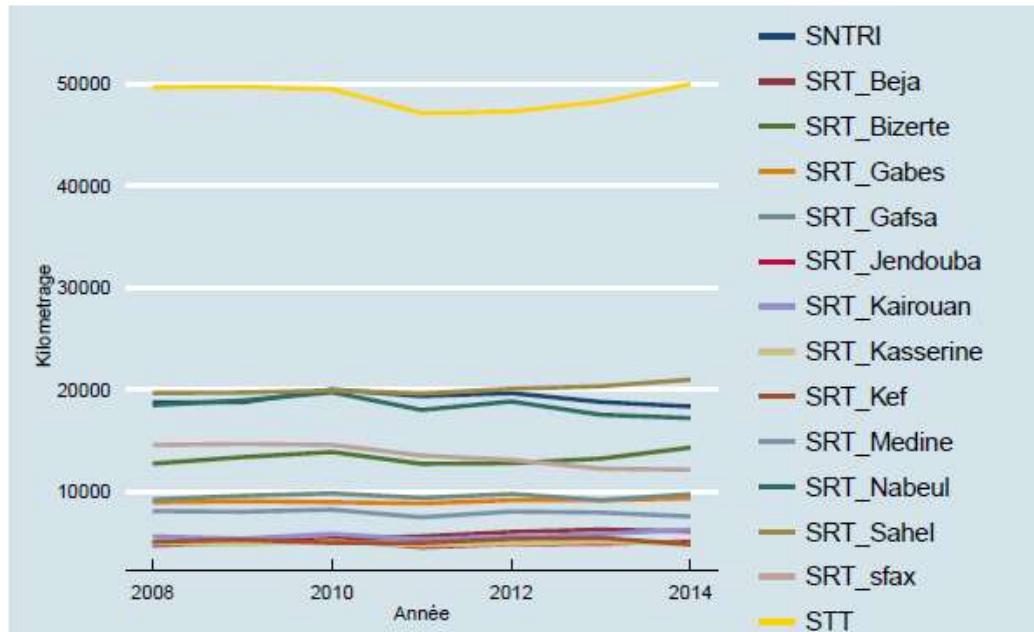


Figure 3: Evolution and distribution of kilometers traveled (thousands of km)

STT tops the ranking of transport companies in terms of kilometers traveled per year, with more than 45 million km, representing on average 26% of total mileage. Other transport companies are divided into two groups:

- SNTRI, Nabeul, Bizerte, Sfax, and Sahel, which operate routes between 10 and 20 million km, i.e., 5% to 10% of the total.
- The remaining companies operate less than 10 million km per year, representing less than 5%.

Année	2008	2009	2010	2011	2012	2013	2014
Total(milliers) :	185801	188085	191006	181449	185314	184252	186737
Taux de croissance :	0,012	0,015	-0,05	0,021	-0,005	0,013	
Moyenne :	13271	13434	13643	12960	13236	13160	13338
Min :	4742	5041	4665	4569	4564	4900	4600
Max :	49657	49724	49491	47139	47294	48249	49997
Écartype :	11832,7	11824,2	11843,1	11280,2	11275,4	11398,0	11849,4683

Table 2: Descriptive statistics of kilometers traveled (thousands of km)

Disparities are also pronounced, with a very high standard deviation. The minimum distance traveled is far from the maximum. The number of kilometers traveled and the overall average remained almost unchanged over time.

4.3Evolution and Evaluation of the Vehicle Fleet

The vehicle fleet defines the capital made available to companies to produce the services they offer.

Société	Moyenne	Pourcentage	Age moyen
SNTRI :	174,5	4,17	81
SRT_Beja :	112,5	3,00	90
SRT_Bizerte :	213,1	5,363	81
SRT_Gabes :	208,8	5,88	105
SRT_Gafsa :	204,4	5,33	106
SRT_Jendouba :	125,5	3,25	108
SRT_Kairouan :	125,7	3,40	114
SRT_Kasserine :	130,4	3,37	108
SRT_Kef :	124,28	3,02	111
SRT_Medine :	197,2	5,14	114
SRT_Nabeul :	257,5	6,70	109
SRT_Sahel :	344,5	8,93	93
SRT_sfax :	389,2	11,42	97
STT :	1203	30,96	93
Ecartype :	280,66		11.26

Table 3: Descriptive statistics of the fleet

Despite disparities in the number of buses in service, the average age of the fleet is almost similar across all companies. As shown in the figure, the distribution of the average age of buses is relatively flat. The condition of the fleet does not differ significantly across companies, with a low standard deviation of 11.26. Fleet renewal is similar (in proportion) across regions. The Bizerte company has the youngest buses, while the Kairouan fleet is the oldest.

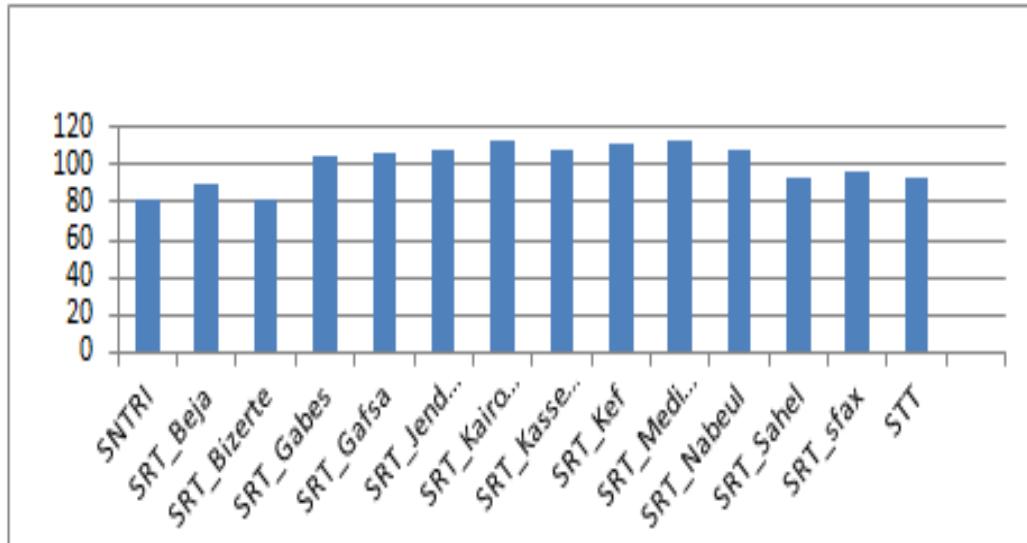


Figure 4: Average age of buses

4.4 Fuel Consumption (Thousands of Liters)

Since companies differ in service mode (intra- and/or interurban), in the size of the areas they cover (leading to different mileage), and in transport demand measured by passenger numbers and socio-economic activity intensity, the above values do not fully reveal inter-company differences. We therefore compare companies based on kilometers traveled per bus, consumption per kilometer, and consumption per bus.

4.5 Evolution and Distribution of Fuel Consumption Volume

Société	Moyenne	Part(%)	2009	2010	2011	2012	2013	2014
SNTRI :	6995	9,2	-0,015	0,017	-0,016	0,041	-0,058	-0,035
SRT_Bizerte :	4722	6,21	0,028	-0,013	-0,059	0,004	0,033	0,087
SRT_Gabes :	3518	4,62	0,009	0,009	-0,012	-0,091	0,09	-0,028
SRT_Gafsa :	3502	4,6	-0,013	-0,035	-0,121	0,043	-0,062	-0,066
SRT_Jendouba :	1730	2,27	0,048	-0,1	0,034	0,009	0,083	
SRT_Kairouan :	2159	2,84	-0,037	0,078	-0,089	0,058	0,053	0,06
SRT_Kasserine :	1824	2,4	-0,025	-0,037	-0,042	0,078	0,016	0,001
SRT_Kef :	1809	2,38	-0,018	0,026	-0,1	0,119	-0,07	0,021
SRT_Medine :	3053	4,01	-0,079	0,018	-0,002	0,063	-0,013	-0,035
SRT_Nabeul :	6873	9,04	0,03	0,041	-0,086	0,048	-0,03	0,03
SRT_Sahel :	9170	12,06	0,0013	-0,004	-0,047	0,003	0,02	0,036
SRT_sfax :	6428	8,45	-0,0087	-0,008	-0,118	-0,014	-0,042	0,016
SRT_Beja :	1904	2,5	0,069	0,063	0,074	0,057	0,038	-0,026
STT :	22302	29,35	0,001	-0,004	-0,004	0,003	0,02	0,0211

Table 4: Average consumption (thousands of liters) and growth rate

STT remains the largest fuel consumer, with an average well above 20 million liters since 2008, representing 29% of total public transport consumption. It is followed by the Sahel company with an average share of 12%. SNTRI, Sfax, and Nabeul have average consumption between 5 and 7.5 million liters, with respective shares of 9.2%, 8.45%, and 9%. Other transport companies each consume less than 5 million liters on average.

The companies of Jendouba, Kasserine, Kef, Beja, and Kairouan are the least energy-intensive, with average shares between 2% and 3%. Overall, the North and Center-East consume more energy than the Center-West and the South.

Aggregate consumption was affected by the revolution and fell by 4.7%. The revolution significantly reduced economic activity, leading to decreased transport flows, fewer passengers, and fewer kilometers traveled.

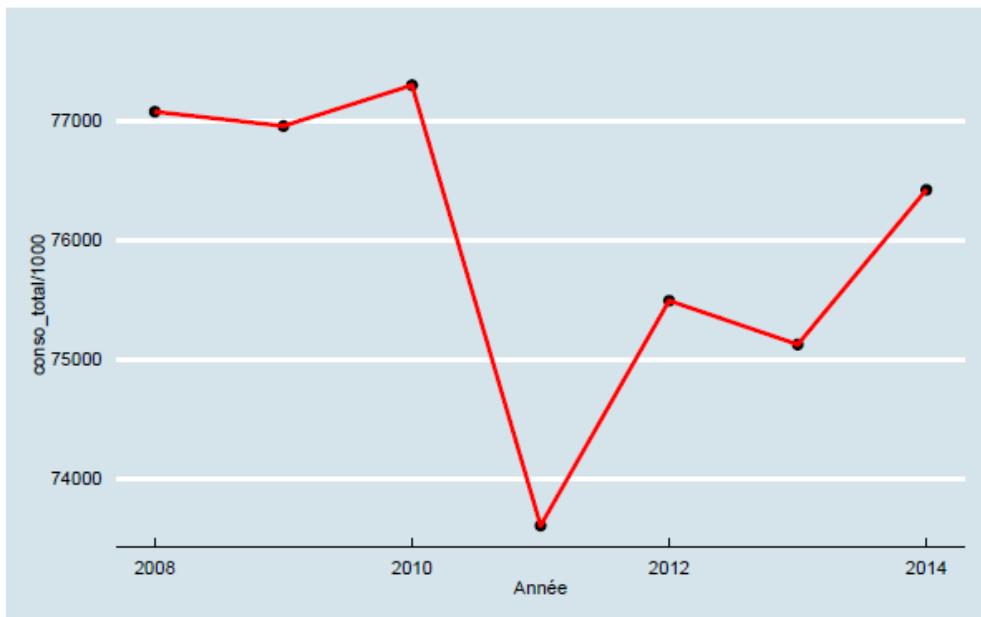


Figure 5: Evolution of total consumption (thousands of liters)

4.6 Fuel Consumption per Bus

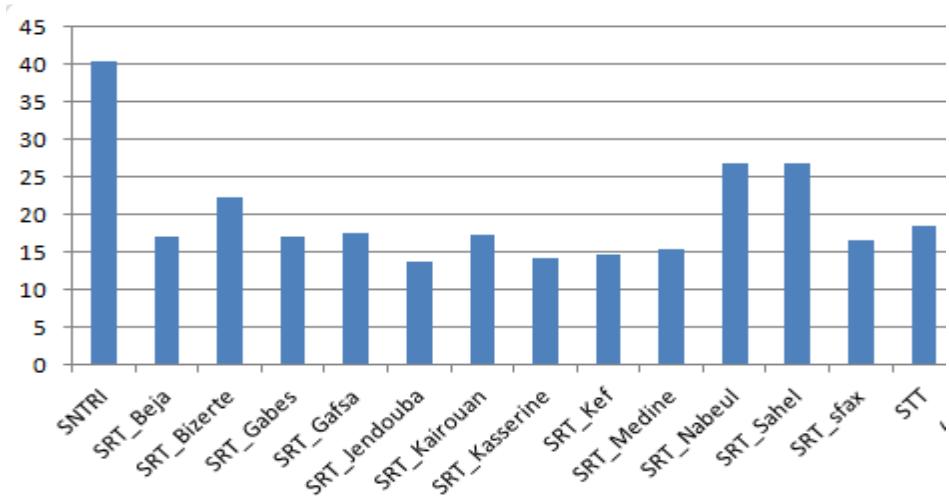


Figure 6: Fuel consumption per bus (thousands of liters)

Société	SNTRI	Beja	Bizerte	Gabes	Gafsa	Jendouba	Kairouan
Moyenne :	40	17	22	16	17	13	17
Société :	Kasserine	Kef	Medine	Nabeul	Sahel	Sfax	STT
Moyenne :	14	14	15	26	26	16	18

Table 5: Fuel consumption per bus (thousands of liters)

On average, a bus in the public collective transport sector consumes 19 thousand liters of diesel per year. The distribution of consumption per kilometer closely follows that of kilometers traveled per bus; both vary in the same direction.

SNTRI ranks first because its buses travel the longest distances, followed by the companies of Nabeul, Bizerte, and Sahel. The Tunis company ranks fourth

4.6 Fuel Consumption per 100 Kilometers

This indicator measures the energy efficiency of transport companies. It reflects the average fuel consumed by a bus traveling 100 km.

Société	SNTRI	Beja	Bizerte	Gabes	Gafsa	Jendouba	Kairouan
Moyenne :	36	34	35	39	37	35	38
Société :	Kasserine	Kef	Medine	Nabeul	Sahel	Sfax	STT
Moyenne :	39	35	38	37	46	47	46

Table 6: Consumption per 100 km (liters)

The average energy efficiency of the public transport sector is 38.7 liters per 100 km.

SNTRI consumes 36 liters per 100 km. Although it provides only interurban services, which allow buses to operate under relatively favorable conditions, this consumption level remains high, indicating that it is energy-intensive. Indeed, its buses travel on highways, allowing fewer stops due to congestion and operation at speeds that are theoretically energy-efficient.

Among regional companies, Beja is the most efficient, with buses consuming about 34 liters per 100 km. Sfax is the least efficient, with an average consumption of 47 liters per 100 km, followed by Tunis and Sahel with average

consumption of 45 liters per 100 km. Other regional companies record an average consumption of 37 liters per 100 km.

Within regional companies, trends of overconsumption and differences in energy efficiency are observed. These findings may stem from differences in urban layout and infrastructure, which affect traffic fluidity. This translates into congestion and a varying number of stops per bus depending on the region, which may explain why the companies of Sfax, Sahel, and Tunis exhibit poor energy performance.

Finally, this overconsumption trend may also be due to driver behavior. Unnecessary acceleration and braking increase instantaneous fuel consumption.

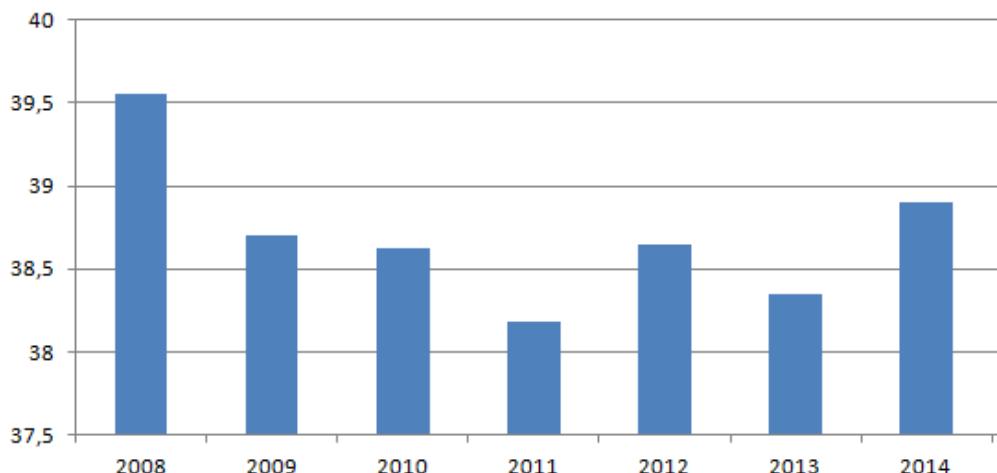


Figure 7: Evolution of fuel consumption per bus per km (liters)

Average energy efficiency improved from 2008 to 2011, with a continuous decline in consumption per 100 km. The situation deteriorated in 2012 with a 1.2% increase, followed by an improvement in 2013 with a 0.7% decrease. Consumption per km increased again in 2014 by 1.4% compared to 2013. On average over the 2008–2014 period, the improvement in energy efficiency is almost zero, with a change of -0.2%. Regional transport companies therefore need to intensify efforts toward better energy efficiency.

4.7 Fuel Expenditures by Regional Transport Company

Société	Moyenne	2009	2010	2011	2012	2013	2014
SNTRI :	6261	0,01	0,05	0,07	0,02	0,06	-0,01
SRT_Bizerte :	4304	0,03	0,08	-0,03	0,01	0,13	0,14
SRT_Gabes :	3448	0,07	-0,01	-0,03	0,25	0,01	0,06
SRT_Gafsa :	3410	-0,02	0,01	-0,07	0,07	0,05	-0,03
SRT_Jendouba :	1585	0,09	0,01	0,04	0,06	0,17	
SRT_Kairouan :	1916	-0,08	0,18	-0,03	0,21	0,05	0,10
SRT_Kasserine :	1668	-0,01	0,10	-0,14	0,13	0,14	0,03
SRT_Kef :	1599	0,01	0,02	0,02	0,04	0,08	0,05
SRT_Medine :	3130	-0,07	0,06	0,05	0,08	0,09	-0,003
SRT_Nabeul :	6139	0,01	0,11	0,01	0,03	0,07	0,04
SRT_Sahel :	7821	0,14	-0,06	0,06	0,00	0,10	0,12
SRT_sfax :	5788	-0,01	0,04	-0,07	0,01	0,09	0,22
SRT_Beja :	2123	0,11	0,43	0,7	0,13	0,011	0,036
STT :	19046	0,13	-0,059	0,10	-0,002	0,10	0,100

Table 7: Average fuel expenditures (thousands of dinars) and growth rate

Fuel expenditures increased over time, with a slowdown in 2011, except for STT, SNTRI, Jendouba, Médenine, Nabeul, and Sahel, which recorded higher fuel spending in 2011.

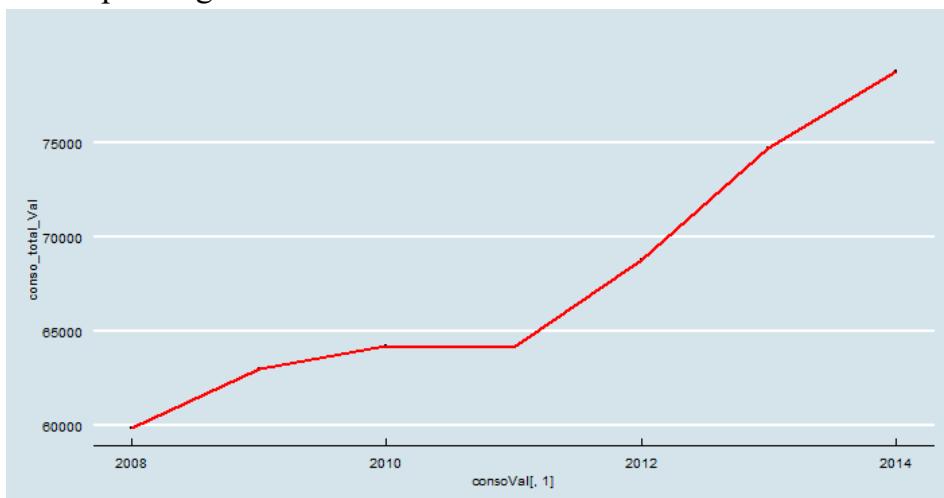


Figure 8: Fuel expenditures (thousands of dinars)

Despite stagnation in consumption volumes, fuel expenditures continue to rise over time.

5. Conclusion

The energy balance of the transport sector over the 2008–2014 period shows that fuel consumption and its main determinants evolved in a nearly stationary manner.

However, fuel expenditures increased over time, and disparities among transport companies are evident. SST dominates all other companies, accounting for more than 40% of passengers, 26% of kilometers traveled, 30% of the fleet, and 29% of total fuel consumption—far ahead of the South and West, which maintain low levels. The comparison among companies reveals that Beja is the most energy-efficient company, with the lowest fuel consumption per 100 km per bus.

Sfax, just behind Tunis and Sahel, is the least energy-efficient. Other regional companies behave in a fairly similar manner. Although energy efficiency in the sector has improved, it remains insufficient, with an average gain of only 0.2%.

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