



How to calculate the indicators for the transport sector

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Vehicle-kilometres, passenger-kilometres and consumption

Q1. Calculate vkm, pkm, and energy consumption of passenger cars, using the following data on passenger cars.

Activity data	2017	2018	2019
Vehicle stocks in use (billions)	0.02	0.02	0.02
Average distance travelled per vehicle (km)	12143	13485	14697
Average fuel efficiency per vehicle (MJ/km)	2.34	2.31	2.29
Average occupancy per vehicle (passenger)	1.42	1.37	1.29

Name	Prefix	Decimal	10 ⁿ
Quadrillion	Peta	1 000 000 000 000 000	10 ¹⁵
Billion	Giga	1 000 000 000	10 ⁹
Million	Mega	1 000 000	10 ⁶

Activity data (billions km)	2017	2018	2019
Vehicle-kilometres (vkm)			
Passenger cars	195.3	222.0	243.4
Passenger-kilometres (pkm)			
Passenger cars	277.3	304.1	314.0

Energy consumption data (PJ)	2017	2018	2019
Passenger transport			
Passenger cars	457.0	512.8	557.5

Vehicle-kilometres (vkm)	= stocks * average distance travelled
Passenger-kilometres (pkm)	= vkm * occupancy = (stocks * average distance travelled) * occupancy
Energy consumption	= vkm * avg. fuel efficiency = (stocks * average distance travelled) * avg. fuel effi.

Q2. Calculate energy intensities of the five transport modes, using the most relevant activity data.

Activity data (billions km)	2017	2018	2019
Passenger-kilometres (pkm)			
Passenger cars	277.3	304.1	314.0
Buses	46.9	46.6	44.7
Tonne-kilometres (tkm)			
Freight & Commercial road transport	269.2	269.2	269.2
Freight trains	334.9	336.2	338.9
Domestic freight ships	241.6	240.6	247.5

Name	Prefix	Decimal	10 ⁿ
Quadrillion	Peta	1 000 000 000 000 000	10 ¹⁵
Billion	Giga	1 000 000 000	10 ⁹
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Energy consumption data (PJ)	2017	2018	2019
Passenger transport			
Passenger cars	457.0	512.8	557.5
Buses	43.9	45.0	45.1
Freight transport			
Freight & Commercial road transport	725.4	740.2	738.5
Freight trains	71.4	72.8	74.1
Domestic freight ships	127.0	127.0	134.1

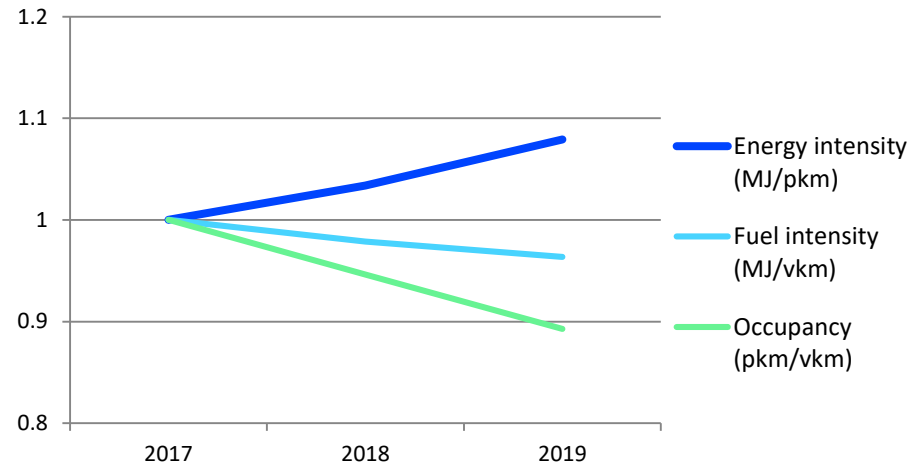
Energy intensity (MJ/pkm or tkm)	2017	2018	2019
Passenger transport			
Passenger cars	1.65	1.69	1.78
Buses	0.93	0.97	1.01
Freight transport			
Freight & Commercial road transport	2.69	2.75	2.74
Freight trains	0.21	0.22	0.22
Domestic freight ships	0.53	0.53	0.54

Passenger energy intensity (MJ/pkm)	= energy consumption / passenger-kilometres (pkm) = avg. fuel efficiency / occupancy
Freight energy intensity (MJ/tkm)	= energy consumption / tonne-kilometres (tkm) = avg. fuel efficiency / load

Q3. The energy intensity of bus transport worsened (increased) during the period. What can be the main reason for the trend, based on the data provided?

Energy consumption data (PJ)	2017	2018	2019
Passenger transport			
Passenger cars	457.0	512.8	557.5
Buses	43.9	45.0	45.1
Freight transport			
Freight & Commercial road transport	725.4	740.2	738.5
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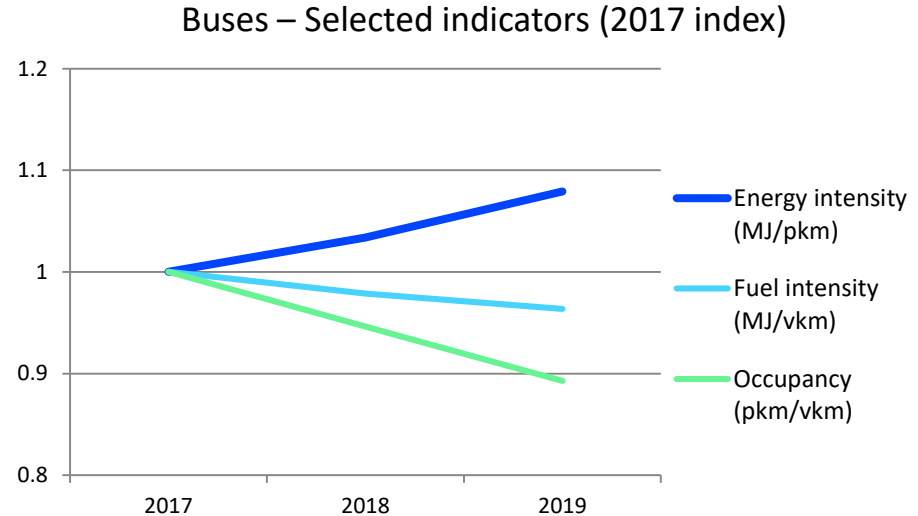
Buses – Selected indicators (2017 index)



Q3. The energy intensity of bus transport worsened (increased) during the period. What can be the main reason for the trend, based on the data provided?

$$\begin{aligned} \text{Energy intensity (MJ/pkm)} &= \frac{\text{Energy consumption (MJ)}}{\text{Passenger-kilometres (pkm)}} \\ &= \frac{\text{Fuel efficiency (MJ/km)}}{\text{Occupancy (pkm/vkm)}} \end{aligned}$$

- Fuel intensity (MJ/vkm) decreased (higher efficiency)
- Occupancy (pkm/vkm) decreased (lower efficiency)



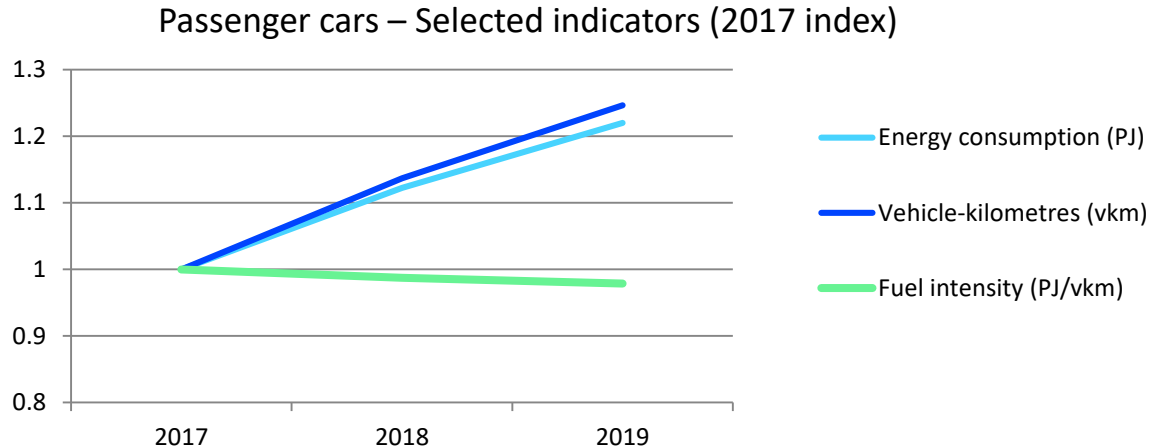
Answer: Decreased occupancy level is the main reason for increased energy intensity of bus transport.

Q4. Recently, the government implemented several regulations to improve fuel efficiency of passenger cars. Do the data indicate the policy was effective? Nevertheless, why did energy consumption in passenger cars increase? *Please do not include energy prices in the discussion.*

$$\text{Fuel intensity (MJ/vkm)} = \frac{\text{Energy consumption (MJ)}}{\text{Vehicle-kilometres (vkm)}}$$

Passenger cars	2017	2018	2019
Energy consumption (PJ)	457.0	512.8	557.5
Vehicle-kilometres (vkm)	195.3	222.0	243.4
Fuel Intensity (MJ/vkm)	2.34	2.31	2.29

Q4. Recently, the government implemented several regulations to improve fuel efficiency of passenger cars. Do the data indicate the policy was effective? Nevertheless, why did energy consumption in passenger cars increase?



Answer: Yes, fuel intensity (PJ/vkm) decreased, that is, improved.

However, activity (vkm) increased as well (people travelled more), possibly due to lower energy costs for driving (thanks to lower fuel intensity). To make the policy more effective, raising taxes on fuel can be considered.

Q5. What is the most efficient freight transport mode in this economy?

	Energy intensity (MJ/pkm or tkm)	2017	2018	2019
Passenger transport (MJ/pkm)	Passenger cars	1.65	1.69	1.78
	Buses	0.93	0.97	1.01
Freight transport (MJ/tkm)	Freight & Commercial road transport	2.69	2.75	2.74
	Freight trains	0.21	0.22	0.22
	Domestic freight ships	0.53	0.53	0.54

Answer: Freight train has the lowest energy intensity (0.22 MJ/tkm in 2019); it is the most efficiency mode.

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