

EXECUTIVE SUMMARY

2023 UPDATED COMPARISON OF ENERGY USE AND EMISSIONS FROM DIFFERENT TRANSPORTATION MODES USING THE LATEST AVAILABLE DATASETS

Background

Motorcoach buses are passenger-carrying vehicles that are generally used for long distance service which include touring, intercity travel, private charter service, and commuter transit. In general, motorcoaches have lower energy and emissions rates per passenger miles travelled than nearly all other similar and competing travel modes.

The American Bus Association Foundation (ABAF) sponsored Texas A&M Transportation Institute (TTI) to evaluate the environmental performance of motorcoach operations by comparing the energy use and pollutants emitted by motorcoaches to those of other transportation modes, utilizing the latest available information and emission rates.

This study serves as a continuation of the 2019 "*Updated Comparison of Energy Use & Emissions from Different Transportation Modes*" [report](#) (referred to here as the "2019 report").

TTI calculated and compared the pollutants emitted per passenger mile for select transportation modes^{1,2} against those emitted from motorcoaches, and quality assured/quality controlled (QA/QC) the data used and calculated emissions against the 2019 report.

Summary

Motorcoaches outperform all other transportation modes modeled in terms of passenger-miles (pass-mi) per diesel gallon equivalent (DGE)³, energy use per pass-mi, and carbon dioxide (CO₂) emitted per pass-mi (see Figures 1, 2, and 3):

- On average, motorcoaches achieved **195.3 pass-mi per DGE**, compared to vanpool's **97.4** (2nd best) and ferryboat **7.4** (2nd worst).

¹ The transportation modes featured in this study are the same ones from the 2019 report, which were AMTRAK, commercial air travel, commuter rail, demand response, ferryboat, passenger car (single driver, carpool, and TNC), heavy rail, light rail, motorcoach, transit bus, trolley bus, vanpool.

² Demand response is a transit mode (vans or small buses) that respond to calls from passengers (aka dial a ride, or on-demand transit) to pick up the passengers and transport them to their destinations.

³ A unit of measurement used to compare the energy content of alternative fuels to that of diesel fuel.

- In terms of energy use, motorcoaches consumed an average of **710** Btu per pass-mi, compared to vanpool's **1,425** and ferryboat' **18,794**.
- Motorcoaches only emit **53** grams of CO₂ per pass-mi compared to vanpool's **106** and ferryboat' **1,392**.
- Motorcoach ranked **5th**, **4th**, and **4th** for pollutants emitted per 1,000 pass-mi for nitrogen oxides (NO_x), particulate matter under 10 microns (PM₁₀), and under 2.5 microns (PM_{2.5}), respectively.
 - Motorcoaches emit **178** grams of NO_x per 1,000 pass-mi versus vanpool's **60** grams and ferryboat's **3,491** grams.
 - Motorcoaches emit **12** grams of PM₁₀ per 1,000 pass-mi versus vanpool's **8** grams and ferryboat's **84** grams.
 - Motorcoaches emit **7** grams of PM_{2.5} per 1,000 pass-mi versus vanpool's **2** grams and ferryboat's **81** grams.
- When considering the model year (MY) 2021 vehicles only, motorcoaches have the **lowest PM emission** rates among all on-road transportation modes, **5.9** grams of PM₁₀ per 1,000 pass-mi compared to vanpool's **7.6**, as well as **0.8** grams of PM_{2.5} per 1,000 pass-mi compared to vanpool's **1.3**.
 - In terms of NO_x, the only MY 2021 vehicles that were emitted less per 1,000 pass-mi were vanpool and the passenger car variants, which are gasoline-powered modes.
 - Pass-mi per DGE for most transportation modes dropped more than 30% from the 2019 report. Pass-mi dropped drastically due to COVID-19; however, the drop in fuel usage was comparatively smaller. This led to significant drops in overall Pass-mi per DGE.
 - Thus, motorcoach emissions will continue to lower as older vehicles get replaced by newer ones.

For More Information:

- The 2023 technical report contains a detailed description and discussion of the updated data sources, as well as the methodologies to calculate the emissions from each transportation mode. It also includes a detailed QA/QC report for all values shown in this executive summary.

- For further information, please contact Brandon Buchanan from the American Bus Association at bbuchanan@buses.org or (202) 218-7227.

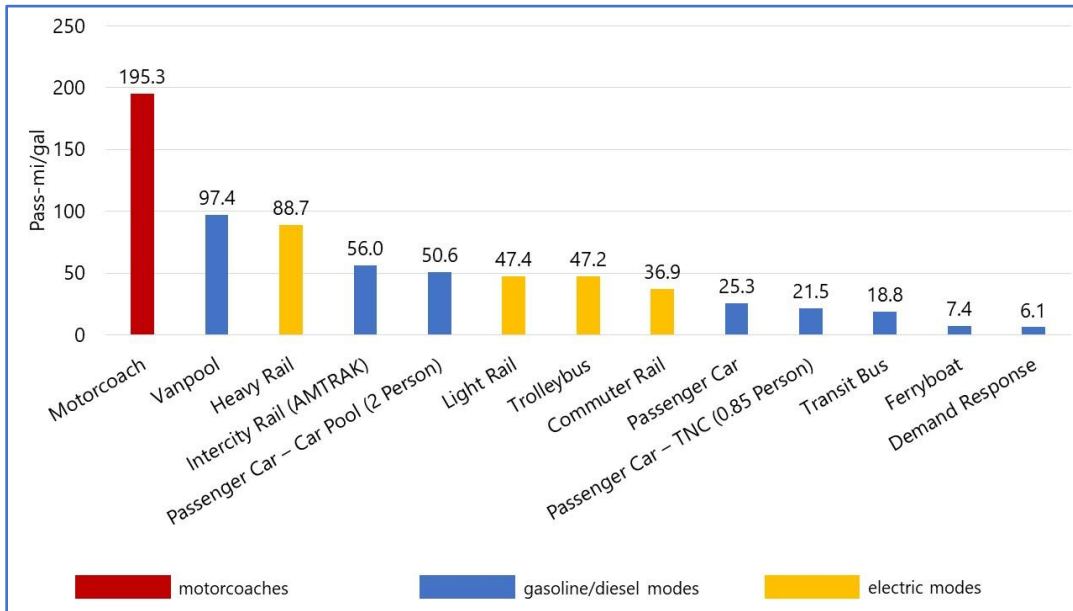


Figure 1. Passenger-Miles per DGE by Mode

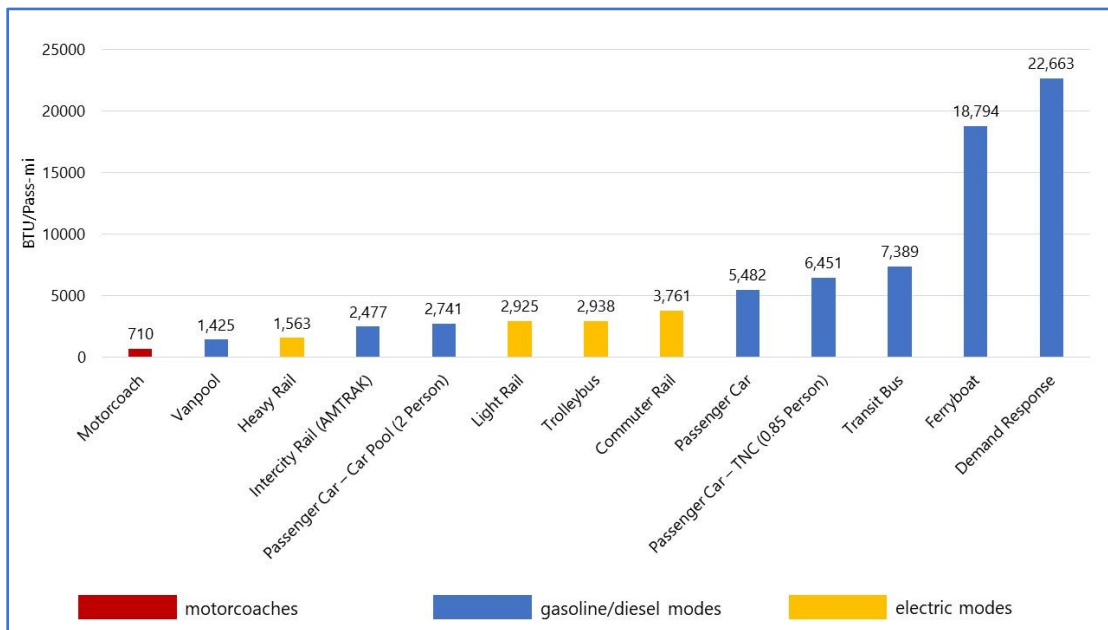


Figure 2 Energy Use (Btu) per Passenger-Mile by Mode.

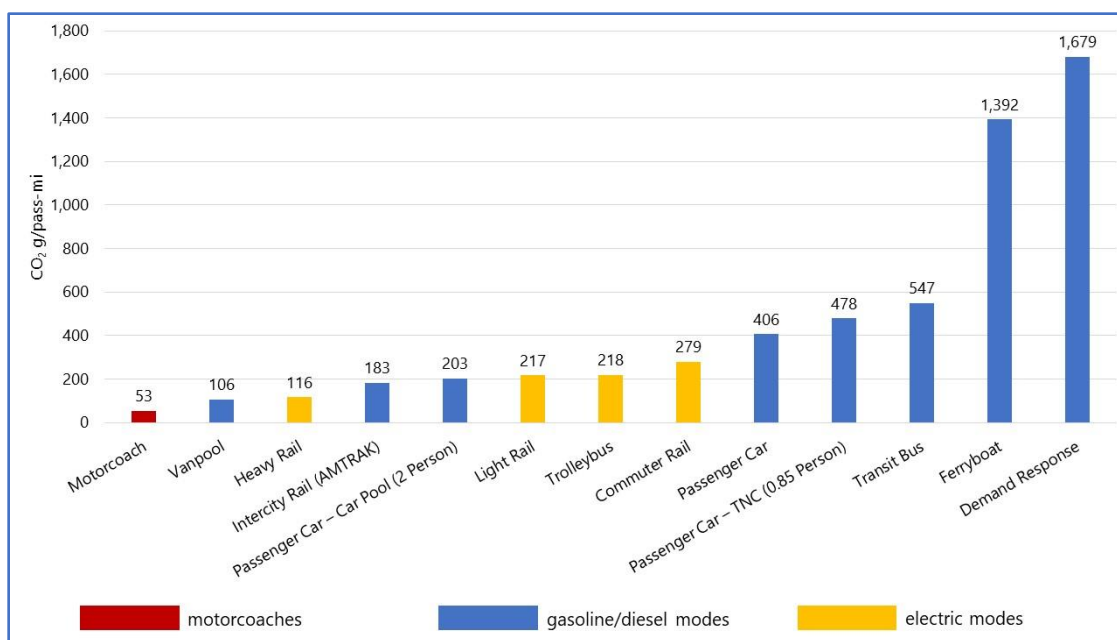


Figure 3. CO₂ Emissions (g) per Passenger-Mile by Mode

Table 1. Energy Use and CO₂ Emission (g/Passenger-Mile), by Mode

Transportation Mode	Passenger-Miles per DGE			Btu per Passenger-Mile			CO ₂ Emissions		
	Low	Average	High	Low	Average	High	Low	Average	High
Motorcoach	190.8	195.3	200.9	690.4	710.2	726.9	51.1	52.6	53.8
Passenger Car	24.4	25.3	62.1	2,233.5	5,482.2	5,684.4	165.4	406.1	421.0
Passenger Car—TNC (0.85-Person)	20.7	21.5	52.8	2,626.9	6,451.2	6,700.5	194.6	477.8	496.3
Passenger Car—Car Pool (2-Person)	48.8	50.6	124.2	1,116.7	2,741.1	2,842.2	82.7	203.0	210.5
Commuter Rail	6.4	36.88	80.0	1,733.8	3,760.8	21,671.9	128.4	278.6	1,605.2
Demand Response	0.5	6.12	29.3	4,733.8	22,663.4	277,400	350.6	1,678.7	20,547
Ferry Boat	1.1	7.38	18.0	7,705.6	18,794.0	126,091	570.8	1,392.1	9,339.6
Heavy Rail	7.1	88.72	150.9	919.2	1,563.3	19,535.2	68.1	115.8	1,447.0
Intercity Rail (Amtrak)		56.0 ²			2,476.8			183.5	
Light Rail	3.5	47.42	129.6	1,070.2	2,924.9	39,628.6	79.3	216.7	2,935.3
Transit Bus ¹	2.3	18.77	67.4	2,057.9	7,389.5	60,304.3	152.4	547.3	4,466.8
Trolley Bus	20.2	47.21	72.8	1,905.2	2,937.9	6,866.3	141.1	217.6	508.6
Vanpool	17.7	97.36	161.9	856.7	1,424.6	7,836.2	63.5	105.5	580.4

¹ For transit buses, Bus (Mode=MB) and Bus Rapid Transit (Mode=RB) were considered the same (i.e., the minimum passenger-miles per DGE was the minimum of the combined MB and RB modes).