Differences Between the 2002 VIUS and 2021 VIUS

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About This Report

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Abstract

This report lists and compares key analytical and methodological differences between the 2002 Vehicle Inventory and Use Survey (VIUS) and 2021 VIUS. Three key findings are discussed. First, differences in data fields and survey methodologies indicate trending between the two surveys should be limited to contextual and historical applications. Second, the 2021 VIUS included 31 new data fields. Finally, several methodological changes (e.g., survey instrument differences [paper versus online], weighting plan updates, geographic coverage, and response rate reductions impacting confidence intervals) may impact comparisons between the 2002 VIUS and 2021 VIUS.

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Introduction

The Bureau of Transportation Statistics (BTS), within the U.S. Department of Transportation (USDOT), is an objective supplier of statistically sound baseline, contextual, and trend information that shapes transportation policy and investment decisions across the United States. BTS is responsible for providing timely, accurate, and reliable information on U.S. passenger and freight transportation systems and their impacts on the economy, society, and the environment.

As part of its transportation statistics and analysis programs and activities, BTS conducts the Vehicle Inventory and Use Survey (VIUS) as a joint effort with the U.S. Census Bureau. VIUS collects data on the physical and operational characteristics of the truck population in the United States. The latest iteration of VIUS was conducted in 2021[1] and surveyed owners of vehicles with gross vehicle weight rating (GVWR) classes 1–8 that were classified by manufacturers as pickup trucks, straight trucks, truck tractors, minivans, light vans, or sport utility vehicles (SUVs).[2] For the 2021 VIUS, a total of 150,000 vehicles were sampled, and nearly 68,000 completed surveys were returned. Prior to 2021, the last VIUS was conducted in 2002. Additional details regarding the VIUS program can be found at https://www.bts.gov/vius [BTS 2025].

While the 2021 VIUS provides the most comprehensive data on the physical and operational characteristics of the trucks being driven on U.S. roadways, various aspects of the data are yet to be explored. The dataset remains a rich resource to inform decisions regarding investments in transportation infrastructure, vehicle technologies, safety, energy consumption, and more.

The purpose of this report is to list and compare key analytical and methodological differences between the 2002 VIUS and 2021 VIUS. Three key findings are discussed. First, differences in data fields and survey methodologies indicate trending between the two surveys should be limited to contextual and historical applications. Second, 31 new data fields and/or series were included in the 2021 VIUS. Their contents reflect logical follow-up questions from previous survey iterations, updates to accommodate new technologies, and administrative priorities. Additionally, 28 questions in the 2021 VIUS include nonresponse validation options (e.g., “none of the above” or similar), which may hinder trending with previous surveys given respondent behavior changes. Third, several methodological changes were implemented between the two surveys that may impact comparisons. These changes include survey instrument differences (e.g., paper versus online instrument), weighting plan updates, geographic coverage, and response rate reductions impacting confidence intervals (CIs). Further evaluation is needed to determine the impact these changes have on the ability to trend surveys.

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1 The 2021 VIUS was a joint product by BTS and U.S. Census Bureau with financial support from USDOT’s Federal Highway Administration and the U.S. Department of Energy.

2 Refer to https://www.census.gov/programs-surveys/vius/technical-documentation/methodology.html for more details about the GVWR classification scheme used in the 2021 VIUS [Census 2024].

1. Differences in Data: Analysis and Findings

Over time, VIUS captures comprehensive data on the usage of the United States' nongovernmental commercial and private truck fleet. Prior to the 2002 iteration, VIUS was fielded every 5 years, offering trending opportunities between surveys. After the 2002 VIUS, nearly 20 years passed until the next deployment in 2021. This hiatus introduced unique challenges and opportunities for survey improvement—both in survey methodology and survey questionnaire design—to allow for capturing information on the adoption of advanced vehicle technologies as well as vehicle evolution. This section covers updates to the 2021 VIUS in relation to the 2002 VIUS.

1.1. DETAILED LIST OF NEW FIELDS IN THE 2021 VIUS

The 2021 VIUS shares many similarities with the 2002 VIUS in terms of questionnaire design and response structure. Methodological and technological improvements, however, have led to the inclusion of new questions to help cover data gaps. These new fields are logical continuations of previous survey iterations (follow-up questions).

In total, 31 data fields and/or series are unique to the 2021 VIUS [Census 2021a, 2021b]. These changes include completely new questions (27 data fields), updated content (2 data fields), and direct-response asks of previously derived fields (2 data fields).[3] Most of the new data fields involve questions about onboard safety and navigation technology as well as fuel efficiency and mitigation features. Table 1 lists the 31 unique data fields and series.

Table 1. List of New Data Fields and Series in the 2021 VIUS

Data field/series	Form	2021 VIUS question	Action compared to 2002 VIUS
REPLACE	9502	Do you plan to replace this vehicle with a vehicle of a different weight class or axle load within the next 5 years?	New
REARAXLETIRES	9501/9502	How many tires were on the rear axle?	Derived in 2002
CABHEIGHT	9501/9502	What was the height of this vehicle's cabin (measured from the ground to the top of the roof)?	New
NUMGEARS	9502	How many gears did this vehicle have?	New
ST_ Series	9501/9502	In 2021, did this vehicle have any of the following standard features?	Additional categories added
DC_ Series	9501/9502	In 2021, did this vehicle have any of the following driving control assistance features?	New
CW_ Series	9501/9502	In 2021, did this vehicle have any of the following collision warning features?	New
CI_ Series	9501/9502	In 2021, did this vehicle have any of the following collision intervention features?	New

[3] The 2021 survey included two questions asking respondents for information directly. Those same two data fields were filled with derived information in the 2002 survey (and not asked of respondents). Table 1 shows these data fields, which are "REARAXLETIRES" (How many tires were on the rear axle?) and "Non Public**" (In 2021, when carrying a typical load, what was the average weight of goods, parcels, or any other products [including packaging] that were loaded for delivery or sale?).

Data field/series	Form	2021 VIUS question	Action compared to 2002 VIUS
PA_ Series	9501/9502	In 2021, did this vehicle have any of the following parking assistance features?	New
OD_ Series	9501/9502	In 2021, did this vehicle have any of the following other driver assistance systems features?	New
FE_ Series	9501/9502	In 2021, did this vehicle have any of the following fuel economy features?	New*
OF_ Series	9501/9502	In 2021, did this vehicle have any of the following other features?	Additional categories added*
TOWCAPACITY	9501/9502	What was this vehicle's towing capacity in pounds?	New
Non Public**	9501/9502	How was the annual mileage calculated?	New
Non Public**	9501/9502	How was miles-per-gallon (mpg) calculated?	New
Non Public**	9502	In 2021, what was the approximate number of hours that this vehicle was in operation (i.e., engine was running)?	New
Non Public**	9502	In 2021, what was the approximate percentage of this vehicle's operating time spent idling (stationary)?	New
Non Public**	9502	In 2021, what was the approximate percentage of this vehicle's operating time spent using an auxiliary power unit?	New
GM_COST	9501/9502	What was the total cost of all GENERAL maintenance in 2021? Round to the nearest whole dollar.	New
ER_COST	9501/9502	What was the total cost of all EXTENSIVE repairs in 2021?	New
ENGREBUILD	9501/9502	Has this vehicle's engine EVER been rebuilt or overhauled?	New
Non Public**	9501/9502	In what year was this vehicle's engine LAST rebuilt?	New
TE_ Series	9501/9502	Did the trailer have any of the following add-on equipment?	New
OWGTPMTANN	9502	In 2021, how many annual overweight permits did you purchase for this vehicle?	New
OWGTPMTSNG	9502	In 2021, how many trips were taken with this vehicle that required the purchase of single trip overweight permits?	New
Non Public**	9501/9502	What was the approximate percentage of this vehicle's 2021 mileage that this vehicle was filled to physical capacity (cubed out)?	New
WEIGHOUTPCT	9501/9502	What was the approximate percentage of this vehicle's 2021 mileage that this vehicle was filled to weight limit (weighed out)?	New
Non Public**	9501/9502	In 2021, when carrying a typical load, what was the average weight of goods, parcels, or any other products (including packaging) that were loaded for delivery or sale?	Could be derived
REPOSITIONPCT	9502	What was the approximate percentage of this vehicle's 2021 mileage driven to reposition the empty vehicle to a new location for the next load?	New
DEADHEADPCT	9502	What was the approximate percentage of this vehicle's 2021 mileage driven as a direct empty backhaul to home base?	New
LE_ Series	9502	In 2021, did you EVER take less efficient routes due to:	New

*Categorical response options differ between 9501 and 9502.
**Variable is not available in the 2021 VIUS Public Use File [Census 2025].
Source: Data from Census 2021a and 2021b.

1.2. ANALYSIS OF DIFFERENT DATA FIELDS BETWEEN THE SURVEYS

Though most the 2021 VIUS data fields are the same as the 2002 VIUS, updates to question design and expanded response options add new considerations. In total, BTS has identified 101 changes between the 2002 VIUS and 2021 VIUS [USDOT et al. 2024]. Changes include modified question wording and response categories being added or removed. Notably, 28 questions in the 2021 VIUS provided nonresponse validation options, including 15 fill-in questions that had an option to indicate that the response was "verified by records," and 13 multiple choice questions that had a "none of the above" option. These specific changes were implemented to improve response verification as, previously, it was not possible to determine the reasoning for nonresponse.

To illustrate the differences between the same questions in the 2002 VIUS and 2021 VIUS, consider the question concerning vehicle fuel type. The question asks, "During [survey year], what type of fuel or fuel combination was most often used in this vehicle?" [BTS 2019; Census 2021a, 2021b]. The response options, listed in Table 2, differ slightly between the surveys.

Table 2. Vehicle Fuel Type Options in the 2002 VIUS and 2021 VIUS

Fuel type	2002 VIUS	2021 VIUS
Alcohol fuels (ethanol or methanol)	Y	Y
CNG	N	Y
Diesel (including biodiesel)	Y	Y
Electricity	Y	Y
Gasoline (including gasohol)	Y	Y
LNG	N	Y
Natural gas (compressed or liquid)	Y	N
Other/combination	Y	Y
Propane	Y	Y

Y = yes, included as a response option; CNG= compressed natural gas; N = no, not included as a response option; LNG = liquified natural gas.
Source: Data from BTS 2019, Census 2021a and Census 2021b.

Cab type is another data field with small differences in the possible response options. Table 3 summarizes these differences.

Table 3. Cab Type Options in the 2002 VIUS and 2021 VIUS

Cab type	2002 VIUS	2021 VIUS
Cab beside engine	Y	N
Cab forward of engine	Y	Y
Cab over engine	Y	N
Conventional cab	Y	Y
Cutaway (no back wall, joined with van body)	N	Y
Low cab forward	N	Y
Not reported	Y	Y

Y = yes, included as a response option; N = no, not included as a response option.
Source: Data from BTS 2019, Census 2021a and Census 2021b.

As summarized in Table 4, some data fields have response options that differ more widely. Regarding body type, some choices are present in the 2002 VIUS and 2021 VIUS, some are present in only the 2002 VIUS, and some are present in only the 2021 VIUS.

Table 4. Vehicle Body Type Options in the 2002 VIUS and 2021 VIUS

Body type	2002 VIUS	2021 VIUS
Armored	Y	Y
Automobile carrier	Y	N
Beverage	Y	Y
Box truck	N	Y
Concrete mixer	Y	Y
Concrete pumper	Y	Y
Conveyor bed	N	Y
Crane	Y	Y
Curtainside	Y	N
Dump	Y	Y
Flatbed, stake, or platform	Y	Y
Hooklift/roll-off	N	Y
Livestock	Y	N
Low boy	Y	N
Minivan	Y	Y
Mobile home toter	Y	N
Open top	Y	N
Other	Y	Y
Other light vans	Y	Y
Pickup	Y	Y
Pole, logging, pulpwood, or pipe	Y	Y
Service, other	Y	Y
Service, utility	Y	Y
Sport utility	Y	Y
Street sweeper	Y	Y
Tank, dry bulk	Y	N
Tank, liquids or gases	Y	Y
Tow/wrecker	Y	Y
Trash, garbage, or recycling	Y	Y
Vacuum	Y	Y
Van, basic enclosed	Y	N
Van, drop-frame	Y	N
Van, insulated nonrefrigerated	Y	N
Van, insulated refrigerated	Y	N
Van, open top	Y	N
Van, other	Y	Y
Van, step, walk-in, or multistop	Y	Y
Wood chipper	N	Y

Y = yes, included as a response option; N = no, not included as a response option.
Source: Data from BTS 2019, Census 2021a and Census 2021b.

For some data fields, the response options are similar or collapsible to the same fields. Business- or commercial-related activity is an example of a field for which all responses can be collapsed across both surveys (Table 5).

Table 5. Vehicle Business or Commercial Activity Options in the 2002 VIUS and 2021 VIUS

Business activity	2002 VIUS	2021 VIUS
Personal use only	Y	Y
Some commercial activity	Y	Y
Vehicle not in use	Y	Y

Y = yes, included as a response option.
Source: Data from BTS 2019, Census 2021a and Census 2021b.

1.3. SOURCES OF STATISTICALLY SIGNIFICANT DIFFERENCES

Differences between the 2002 VIUS and 2021 VIUS that significantly affect statistical comparability between the two surveys can be grouped into the following two categories:

- Survey-design changes affecting statistical comparability:
  - Differences in the weighting approach applied to each survey could impact analysis. According to USDOT et al. [2024], the 2002 VIUS weight was the product of a sampling factor and a nonresponse adjustment factor, while the 2021 VIUS weight included those two factors plus a third factor that adjusted the data based on GVWR by sampling strata. This added adjustment factor could impact comparisons of GVWRs. Refer to Section 6 of USDOT et al. [2024] for more details.
  - While the sample sizes were similar for the 2002 VIUS and 2021 VIUS, the response rate was lower in 2021, which may lead to larger CIs for the 2021 VIUS, thus affecting comparison results to previous survey iterations.
  - The use of an online questionnaire for the 2021 VIUS as the primary mode of data collection (versus a paper questionnaire for the 2002 VIUS) provided real-time data flagging for respondents. This change could have decreased instances of missing or nonlogical responses and, therefore, slightly influenced respondent behavior and response rates. Using an online survey instrument could also introduce bias if there was a relationship between survey questions and if respondents did not have the internet or were not technically savvy enough to complete the online questionnaire.
- Questionnaire-design changes affecting statistical comparability:
  - Changes in question wording, including the addition of prompt notes, may have influenced respondent behavior. Caution should be taken to ensure these changes are accounted for during analysis.
  - Changes in response options, such as expanded choices, nonresponse options, or aggregated or disaggregated choices, could either influence respondent behavior or require additional analysis to appropriately crosswalk fields.

Users should be cautious when attempting to find statistically significant differences between 2002 and 2021 results. Consider the vehicle fuel type example. As shown in Table 2, in the 2002 VIUS, “natural gas (compressed or liquid)” was one survey response option, which combined the two natural gas fuel type categories (i.e., compressed natural gas [CNG] and liquified natural gas [LNG]) [BTS 2019]. In 2021, however, the survey response options for natural gas were divided into two separate categories: “compressed natural gas (CNG)” and “liquified natural gas (LNG)” [Census 2021a, 2021b]. It may seem natural to add the CNG and LNG numbers from 2021 to compare them to the 2002 results, but the 2021 LNG estimate has high sampling variability as indicated by a high (i.e., greater than 50 percent) coefficient of variation (CV). For information about CVs for the 2021 VIUS estimates, refer to the VIUS PUF Tabulation Tool [BTS n.d.]. If the 2021 survey responses for natural gas were combined, as in 2002, sampling variability may not have been high because the combined response would have had higher response quality. Whether changes to the natural gas response options affected nonresponse rates for this question is unclear.

Table 6 illustrates the vehicle fuel type options, the estimated numbers of vehicles, their 95-percent CIs, CVs, and the percentage of total estimated vehicles for the 2002 VIUS and 2021 VIUS.

Table 6. Estimates for Vehicle Fuel Type Options Based on the 2002 VIUS and 2021 VIUS Data

Survey year	Fuel type	Vehicles (thousands)	CI minimum	CI maximum	CV (%)	Percent of vehicles
2002	Gasoline	76,334.60	75,885.75	76,783.45	0.30	89.60
	Diesel	6,125.40	5,873.28	6,377.52	2.10	7.20
	Combination	379.20	287.78	470.62	12.30	0.40
	Alcohol fuels	141,100.00	108,466.39	173,733.61	11.80	0.20
	Natural gas[1]	74.80	42.40	107.20	22.10	0.10
	Propane	48.30	37.03	59.57	11.90	0.10
	Electricity	S	S	S	S	S
	LNG	—	—	—	—	—
	Not reported	93.30	43.74	142.86	27.10	0.10
	Not applicable	1,978.00	1,780.28	2,175.72	5.10	2.30
2021	Gasoline	151,269.20	149,905.36	152,633.04	0.46	84.10
	Diesel	12,127.95	11,652.53	12,603.36	1.96	6.70
	Combination	1,500.33	1,338.60	1,662.07	5.50	0.80
	Alcohol fuels	467.71	250.45	684.96	23.73	0.30
	Natural gas[1]	50.86	14.77	86.95	36.21	0.00
	Propane	11.73	6.12	17.34	24.40	0.00
	Electricity	530.53	191.54	869.52	32.63	0.30
	LNG	S	S	S	S	S
	Not reported	3,554.99	2,760.66	4,349.32	11.42	2.00
	Not applicable	10,301.99	9,554.89	11,049.09	3.66	5.70

[1]The estimate reported for 2021 Natural Gas is for CNG. The LNG estimate did not meet publication standards.
—Not available.
S = Estimate does not meet publication standards because of high sampling variability or poor response quality.

Examining one significant difference by fuel type, the estimated population of gasoline vehicles was 76,334,600 in 2002 and 151,269,200 in 2021. The overlap between CIs is sometimes used by analysts to judge the statistical significance of the differences between two point estimates; for instance, if the associated CIs do not overlap, the difference is deemed significant, and if there is overlap, the difference is not deemed significant [Schenker, Gentleman 2001]. Using CVs, 95-percent CIs can be constructed around 2002 and 2021 estimates. For example, Table 6 shows CIs and CVs for the number of estimated gasoline vehicles in both years. These estimates do not overlap, indicating that the difference in estimates for the number of gasoline vehicles in 2002 and 2021 may be statistically significant. However, caution should be exercised when using the CI overlap method for significance testing as further analysis and more formal significance testing may be needed to confirm the results produced by this method [Schenker, Gentleman 2001].

While the estimated number of gasoline vehicles is different between 2002 and 2021, how much of this difference is a result of survey-design changes, questionnaire-design changes, and/or a difference in the true population is unclear. While the 2021 estimate is 1.98 times larger than the 2002 estimate, whether the number of gasoline vehicles in 2021 is precisely 1.98 times larger than the number of gasoline vehicles in 2002 is not certain.

Users should also be cautious when examining subfields and specific subsets of data. For more unique vehicle characteristics or types, CV generally increases because of the smaller number of survey responses received. Even when differences in estimates are statistically significant, especially if they are different by a marginal amount, clearly determining whether the differences are caused by survey-design changes, questionnaire-design changes, and/or a difference in the true population is impossible.

Table 7 illustrates body type options for the 2002 VIUS and 2021 VIUS. The estimated number of SUVs in 2002 was 24,204,400 and 95,617,660 in 2021. While SUVs made up an estimated 53.17 percent of the 2021 U.S. truck fleet, SUVs made up an estimated 28.42 percent of the 2002 U.S. truck fleet.

Table 7. Estimates for Vehicle Body Types Based on the 2002 VIUS and 2021 VIUS Data

Survey year	Body type	Vehicles (thousands)	CI minimum	CI maximum	CV (%)	Percent of vehicles
2002	Armored	11.30	2.80	19.80	38.40	0.01
	Automobile carrier	12.80	10.34	15.26	9.80	0.02
	Beverage	75.20	64.74	85.66	7.10	0.09
	Box truck	—	—	—	—	—
	Concrete mixer	77.00	72.17	81.83	3.20	0.09
	Concrete pumper	5.90	4.42	7.38	12.80	0.01
	Conveyor bed	—	—	—	—	—
	Crane	17.60	14.32	20.88	9.50	0.02
	Curtainside	7.10	4.90	9.30	15.80	0.01
	Dump	856.20	831.03	881.37	1.50	1.01
	Flatbed, stake, or platform	1,141.60	1,108.04	1,175.16	1.50	1.34
	Hooklift/roll-off	—	—	—	—	—
	Livestock	15.30	12.69	17.91	8.70	0.02
	Low boy	61.30	38.95	83.65	18.60	0.07
	Minivan	12,207.30	11,728.77	12,685.83	2.00	14.33
	Mobile home toter	4.90	3.60	6.20	13.50	0.01
	Open top	64.00	59.99	68.01	3.20	0.08
	Other	2.40	0.84	3.96	33.10	0.00
	Other light vans	5,251.40	4,911.74	5,591.06	3.30	6.17
	Pickup	37,991.10	37,767.71	38,214.49	0.30	44.60
	Pole, logging, pulpwood, or pipe	39.80	34.73	44.87	6.50	0.05
	Service, other	221.80	208.32	235.28	3.10	0.26
	Service, utility	262.10	247.72	276.48	2.80	0.31
	Sport utility	24,204.40	23,682.55	24,726.25	1.10	28.42
	Street sweeper	6.40	4.39	8.41	16.00	0.01
	Tank, dry bulk	54.40	47.36	61.44	6.60	0.06
	Tank, liquids or gases	247.30	232.76	261.84	3.00	0.29
	Tow/wrecker	127.80	115.78	139.82	4.80	0.15
	Trash, garbage, or recycling	96.00	89.79	102.21	3.30	0.11
	Vacuum	14.70	12.14	17.26	8.90	0.02
	Van, basic enclosed	1,175.70	1,129.61	1,221.79	2.00	1.38
	Van, drop-frame	14.00	11.31	16.69	9.80	0.02
	Van, insulated nonrefrigerated	33.80	27.37	40.23	9.70	0.04
	Van, insulated refrigerated	206.70	187.25	226.15	4.80	0.24
	Van, open top	151.70	143.97	159.43	2.60	0.18
	Van, other	69.00	61.56	76.44	5.50	0.08
	Van, step, walk-in, or multistop	413.10	379.09	447.11	4.20	0.49
	Wood chipper	—	—	—	—	—
	Not reported	—	—	—	—	—
	Not applicable	33.70	28.61	38.79	7.70	0.04

Survey year	Body type	Vehicles (thousands)	CI minimum	CI maximum	CV (%)	Percent of vehicles
2021	Armored	10.30	7.91	12.69	11.84	0.01
	Automobile carrier	—	—	—	—	—
	Beverage	20.05	15.52	24.57	11.52	0.01
	Box truck	1,317.00	1,297.64	1,336.36	0.75	0.73
	Concrete mixer	86.65	81.79	91.51	2.86	0.05
	Concrete pumper	5.63	3.90	7.36	15.69	0.00
	Conveyor bed	8.82	6.90	10.74	11.11	0.00
	Crane	53.50	47.33	59.66	5.88	0.03
	Curtainside	—	—	—	—	—
	Dump	877.04	859.85	894.23	1.00	0.49
	Flatbed, stake, or platform	1,130.22	1,068.64	1,191.80	2.78	0.63
	Hooklift/roll-off	55.67	50.19	61.16	5.03	0.03
	Livestock	—	—	—	—	—
	Low boy	—	—	—	—	—
	Minivan	11,274.06	10,091.87	12,456.26	5.35	6.27
	Mobile home toter	—	—	—	—	—
	Open top	—	—	—	—	—
	Other	223.52	206.26	240.78	3.94	0.12
	Other light vans	6,706.71	6,299.21	7,114.21	3.10	3.73
	Pickup	57,309.21	56,365.67	58,252.75	0.84	31.87
	Pole, logging, pulpwood, or pipe	15.99	12.70	19.28	10.51	0.01
	Service, other	439.31	411.50	467.12	3.23	0.24
	Service, utility	372.65	338.03	407.27	4.74	0.21
	Sport utility	95,617.66	93,818.51	97,416.80	0.96	53.17
	Street sweeper	18.55	10.34	26.77	22.59	0.01
	Tank, dry bulk	—	—	—	—	—
	Tank, liquids or gases	192.40	179.88	204.92	3.32	0.11
	Tow/wrecker	126.10	110.83	141.38	6.18	0.07
	Trash, garbage, or recycling	98.82	84.74	112.90	7.27	0.05
	Vacuum	42.73	34.52	50.94	9.80	0.02
	Van, basic enclosed	—	—	—	—	—
	Van, drop-frame	—	—	—	—	—
	Van, insulated nonrefrigerated	—	—	—	—	—
	Van, insulated refrigerated	—	—	—	—	—
	Van, open top	—	—	—	—	—
	Van, other	336.26	301.53	371.00	5.27	0.19
	Van, step, walk-in, or multistop	274.56	223.44	325.68	9.50	0.15
	Wood chipper	13.61	9.34	17.88	16.01	0.01
	Not reported	292.43	273.00	311.86	3.39	0.16
	Not applicable	2,898.39	2,885.89	2,910.88	0.22	1.61

—Not available.

Examining one significant difference by cab type, Table 8 shows conventional cabs accounted for 5.73 percent of vehicles in 2002 (an estimated number of 4,878,700 based on the 2002 VIUS) and 2.50 percent of vehicles in 2021 (an estimated number of 4,500,230 based on the 2021 VIUS). Table 8 shows the CIs and CVs for the estimated number of vehicles with a conventional cab for both years. As seen from the table, the estimates for CIs do not overlap, indicating that the difference between estimates for the number of vehicles with a conventional cab in 2002 and 2021 may be statistically significant.[4]

[4] Caution should be exercised when using the CI overlap method for significance testing of differences between two point estimates as more formal significance testing may be required to confirm the results [Schenker, Gentleman 2001].

Table 8. Estimates for Cab Types Based on the 2002 VIUS and 2021 VIUS Data

Survey year	Cab type	Vehicles (thousands)	CI minimum	CI maximum	CV (%)	Percent of vehicles
2002	Cab beside engine	9.30	7.06	11.54	12.30	0.01
	Cab forward of engine	17.40	14.16	20.64	9.50	0.02
	Cab over engine	603.70	589.50	617.90	1.20	0.71
	Conventional cab	4,878.70	4,830.89	4,926.51	0.50	5.73
	Cutaway (no back wall, joined with van body)	—	—	—	—	—
	Low cab forward	—	—	—	—	—
	Not reported	11.40	3.76	19.04	34.20	0.01
	Not applicable	79,654.30	—	—	—	93.52
2021	Cab beside engine	—	—	—	—	—
	Cab forward of engine	255.71	245.09	266.34	2.12	0.14
	Cab over engine	—	—	—	—	—
	Conventional cab	4,500.23	4,459.65	4,540.80	0.46	2.50
	Cutaway (no back wall, joined with van body)	518.58	494.29	542.88	2.39	0.29
	Low cab forward	115.80	102.25	129.35	5.97	0.06
	Not reported	621.51	568.03	674.98	4.39	0.35
	Not applicable	173,806.03	172,715.91	174,896.14	0.32	96.66

—Not available.

Table 9 illustrates the vehicle use options in the 2002 VIUS and 2021 VIUS. As the table shows, 76.72 percent (estimated) of vehicles in 2002 and 75.28 percent (estimated) of vehicles in 2021 were for personal use only. Further, an estimated 19.43 percent of vehicles in 2002 and an estimated 16.54 percent of vehicles in 2021 were used for some commercial activity. Examining the number of vehicles used for commercial activity, the CIs between the 2002 VIUS and 2021 VIUS do not overlap, indicating a statistically significant increase in the number of vehicles used for some commercial activity may have occurred between 2002 and 2021.[5]

Table 9. Estimates for Vehicle Use Based on the 2002 VIUS and 2021 VIUS Data

Survey year	Business activity	Vehicles (thousands)	CI minimum	CI maximum	CV (%)	Percent of vehicles
2002	Not reported	1,308.20	1,138.97	1,477.43	6.60	1.54
	Personal use only	65,343.00	64,702.64	65,983.36	0.50	76.72
	Some commercial activity	16,545.60	13,853.96	19,237.24	8.30	19.43
	Vehicle not in use	1,978.00	1,718.25	2,237.75	6.70	2.32
2021	Not reported	4,402.64	3,896.10	4,909.17	5.87	2.45
	Personal use only	135,372.05	133,169.81	137,574.28	0.83	75.28
	Some commercial activity	29,741.18	27,601.84	31,880.52	3.67	16.54
	Vehicle not in use	10,301.99	9,562.97	11,041.02	3.66	5.73

[5] Refer to footnote 4.

1.4. IMPLICATIONS OF SIGNIFICANT DIFFERENCES

Given the length of time between the fielding of the 2002 VIUS and 2021 VIUS, significant changes were made to the VIUS design with facilitating trending and comparisons between the two surveys being of low priority. These changes clearly limit users' ability to reliably use the 2021 VIUS in conjunction with prior surveys. Coupled with this difficulty is the nearly 20 years between survey deployments. Economic and societal shifts have significantly altered to the point that the 2002 VIUS should be viewed as a historical context rather than a longitudinal dataset to enable examination of any statistically significant differences with the 2021 VIUS data.

Additionally, while most questions in the 2021 VIUS remained practically consistent with the 2002 VIUS, the response options and coverages of some questions vary enough to warrant additional analysis before verifiable conclusions can be made between surveys. Comparing the surveys' data dictionaries reveals only eight data fields retain the same variable names in both surveys.[6] This circumstance has positive and negative implications. Advantageously, it may limit the chances of users comparing findings between the two surveys easily, forcing determined users to understand the differences and limitations between the two surveys before comparing. It, however, may also introduce higher chances of misinterpretation and misrepresentation of VIUS data.

Overall, findings suggest that the 2021 VIUS should be viewed as a snapshot in time, with comparisons to previous survey iterations limited to contextual and historical applications. This recommendation includes the three major VIUS estimates—number of vehicles, vehicle miles traveled, and average miles per vehicle—due to changes in weighting design and sample coverage.

[6] The eight data fields with the same variable names in both surveys are ACQUIREYEAR, BRAKES, CAB, FUELWHERE, HBTYPE, LEASELENGTH, MPG, and TRIPOFFROAD.

2. Differences in Methodology: Survey and Sample Design

In addition to updated data fields, the 2021 VIUS experienced a limited methodology refinement. While the survey's scope and sampling frame remained the same, advancements in survey design and technology were integrated to modernize the 2021 VIUS. Given the length of time from its last deployment in 2002, these changes have greater impact and are less subtle than the changes recorded between the 2002 VIUS and 1997 VIUS. This chapter covers methodological differences between the 2002 VIUS and 2021 VIUS, including the following:

- Survey scope and frame
- Geographic coverage
- Sampling plan
- Survey instruments
- Recruitment method
- Weighting design

The following sections summarize the results of these comparisons.

2.1. COMPARING SURVEY SCOPE, DESIGN, QUESTIONNAIRES, AND ESTIMATION METHODS

Given the nearly 20 years between deployments, BTS and the Census Bureau made a reasonable number of changes to innovate VIUS between the 2002 and 2021 iterations. Of note are changes in scope, sampling, weighting, and deployment. Table 10 lists the differences between the two surveys with respect to these changes.

Table 10. Survey Methodological Differences Between the 2002 VIUS and 2021 VIUS

Metric	2002 VIUS	2021 VIUS
Sampling frame and geographic coverage	Nongovernmental personal and commercial trucking[1] All 50 states and Washington, DC	Nongovernmental personal and commercial trucking[1] 49 states and Washington, DC (New Hampshire data not included)
Sample size	140,000	150,000
Response rate	70.49% (98,682 responses)	45.30% (67,952 responses)
Sample strata design	Five strata per state and DC (total of 255 strata): • Pickups • Vans, minivans, SUVs • Straight trucks with GVWR ≤ 26,000 lb • Straight trucks with GVWR > 26,000 lb • Truck tractors	The strata of the 2002 VIUS were further separated into commercial and personal[2] for a total of 10 strata per state Washington, DC (total of 500 strata since New Hampshire was not sampled)
Recruitment[3]	Mail invitation to registered owner of sampled vehicle	Mail invitation to registered owner of sampled vehicle
Survey instrument	Paper	Push-to-web; paper option requestable
Weighting factors	Two factors: • Probability of selection post-stratified weighting (in 2021) • Nonresponse bias	Two factors: • Nonresponse bias adjustment • Post-stratified weighting by GVWR grouping per sampling stratum

[1]Specifically, "The VIUS sample excludes vehicles owned by federal, state, and local governments; ambulances; buses; motor homes; farm tractors; unpowered trailer units; and trucks reported to have been disposed of prior to January 1 of the survey year" [Census 2023a].
[2]This information is collected from administrative records and may not match responses.
[3]The recruitment method was the same for 2002 and 2021 and will probably remain unchanged as long as the same sampling frame is used.

2.2. DATA IMPROVEMENTS, LIMITATIONS, AND IMPLICATIONS OF DIFFERENT METHODOLOGIES BETWEEN SURVEYS

The 2021 VIUS marked notable improvements over its predecessor in terms of sampling, weighting, questionnaire design, and response options. These changes also introduce challenges in trending between survey years. While both surveys share scope and sampling frame, the differences in the sample size, weighting plan, geographic coverage, and survey instrument have the greatest implications in distinguishing between the 2002 VIUS and 2021 VIUS as described in the following list:

- **Sample size**—The sample size slightly increased (by roughly 7 percent) between survey years—from 140,000 in 2002 to 150,000 in 2021. The population of eligible vehicles per survey year in the United States saw an increase of 113 percent—from 89 million in 2002 to nearly 190 million in 2021. This difference results in small and negligible increases in the variance of the estimate, especially for the most granular data fields.
- **Geographic coverage**—For the 2021 VIUS, the state of New Hampshire was not included in the sample because the state declined to release motor vehicle registration records [Census 2023b]. As such, national-level estimates do not include New Hampshire for 2021 VIUS, while the 2002 VIUS does.

- **Survey instrument**—Respondents had the option to either complete their survey online or via a paper form for 2021, while the 2002 VIUS was only available via a paper form. This change not only reduces respondent burden and survey overhead but also allows for automatic data flagging to be implemented in real time. Consequently, this change could have influenced respondent behavior, but further analysis would be required to understand the full extent.
- **Weighting plan**—The 2021 VIUS weighting plan is a logical evolution of the 2002 weighting plan—further expanding the weighting factors via post-stratified weighting by GVWR grouping per sampling strata. This approach is an improvement over the 2002 weighting design and provides more robust estimates by preserving GVWR class distribution within a stratum. Comparisons of the 2021 VIUS to previous VIUS iterations would require further validation for class-level trending.

3. Summary

This report lists and compares key analytical and methodological differences between the 2002 VIUS and 2021 VIUS—particularly, with respect to data fields and survey methodologies. The main findings include the following:

- Compared to the 2002 VIUS, the 2021 VIUS included 31 new data fields and series. These new fields include logical follow-up questions as well as questions related to new technologies and administrative priorities. In addition, 28 questions in the 2021 VIUS included nonresponse validation options (e.g., “none of the above” or similar).
- Several methodological changes exist between the 2002 VIUS and 2021 VIUS that can impact statistical comparability between the two surveys. These changes include differences in the primary survey instrument (e.g., paper for the 2002 VIUS versus online tool for the 2021 VIUS), survey design, weighting plans, geographic coverage, and response rates.
- Considering the differences between the data fields and survey methodologies of the 2002 VIUS and 2021 VIUS, comparison between the two surveys should be limited to contextual and historical applications.

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List of Abbreviations, Acronyms, and Initialisms

BTS	Bureau of Transportation Statistics
CI	confidence interval
CNG	compressed natural gas
CV	coefficient of variation
GVWR	gross vehicle weight rating
LNG	liquified natural gas
SUV	sport utility vehicle
USDOT	U.S. Department of Transportation
VIUS	Vehicle Inventory and Use Survey