UMTRI-2013-40 NOVEMBER 2013

HAS MOTORIZATION IN THE U.S. PEAKED? PART 3: FUEL CONSUMED BY LIGHT-DUTY VEHICLES

MICHAEL SIVAK

UMTRI
UNIVERSITY OF MICHIGAN
TRANSPORTATION RESEARCH INSTITUTE

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PART 3: FUEL CONSUMED BY LIGHT-DUTY VEHICLES

Michael Sivak

The University of Michigan
Transportation Research Institute
Ann Arbor, Michigan 48109-2150
U.S.A.

Report No. UMTRI-2013-40
November 2013

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTRI-2013-40		

4. Title and Subtitle	5. Report Date
Has Motorization in the U.S. Peaked? Part 3: Fuel consumed by light-duty vehicles	November 2013
	6. Performing Organization Code 383818
7. Author(s) Michael Sivak	8. Performing Organization Report No. UMTRI-2013-40
9. Performing Organization Name and Address The University of Michigan Transportation Research Institute 2901 Baxter Road Ann Arbor, Michigan 48109-2150 U.S.A.	10. Work Unit no. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address The University of Michigan Sustainable Worldwide Transportation http://www.umich.edu/~umtriswt	13. Type of Report and Period Covered 14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This study examined recent trends in fuel consumption by light-duty vehicles (cars, pickup trucks, SUVs, and vans) in the U.S. fleet. The period examined was from 1984 through 2011. This is a follow-up study to Sivak (2013a; 2013b), in which I analyzed the corresponding trends in the number of registered light-duty vehicles and distance driven.

Although the report also presents trends in the total fuel consumption, of primary interest were the fuel-consumption rates per person, per licensed driver, per household, and per registered vehicle. All of these rates reached their maxima in 2003 or 2004—several years prior to the beginning of the current economic downturn—and decreased by 13% to 17% by 2011. These maxima coincide with the maxima in the distance-driven rates. However, the decreases in the fuel-consumption rates between the peaks and the 2011 values (13% to 17%) are greater than the corresponding decreases in the distance-driven rates (5% to 9%), reflecting the added contribution of the improved vehicle fuel economy.

Because the onsets of the reductions in the distance-driven rates were not the results of short-term, economic changes, and because of the expected continuation of the improvements in vehicle fuel economy, the 2004 maxima in the fuel-consumption rates have a good chance of being long-term peaks as well.

The combined evidence from this and the previous two studies indicates that—per person, per driver, and per household—we now have fewer light-duty vehicles, we drive each of them less, and we consume less fuel than in the past: The current fuel-consumption rates are lower than the corresponding rates in 1984—the first year of this analysis.

The best estimates of the current annual fuel-consumption rates are as follows: 398 gallons per person, 585 gallons per licensed driver, 1,033 gallons per household, and 530 gallons per registered vehicle.

17. Key Words	18. Distribution Statement
Motorization, fuel consumed, vehicles, licensed drivers, households	Unlimited

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
None	None	19	

Contents

Introduction

In two reports published earlier this year (Sivak, 2013a; 2013b), I examined recent trends in the numbers of registered light-duty vehicles (cars, pickup trucks, SUVs, and vans) in the U.S. fleet and in the corresponding distances driven. Both studies considered the total numbers and the rates per person, per licensed driver, per household, and (in the case of the distance-driven rate) per vehicle. The period examined was from 1984 through 2011.

The first study (Sivak, 2013a) found that the total number of light-duty vehicles reached a maximum in 2008 (see Figure 1). However, it is likely that this was only a temporary maximum and that the decline after 2008 was strongly influenced by the current economic downturn that started in 2008. Consequently, I argued that with the improving economy and the expected increase in the U.S. population, it is highly likely that (from a long-term perspective) the total number of vehicles has not yet peaked.

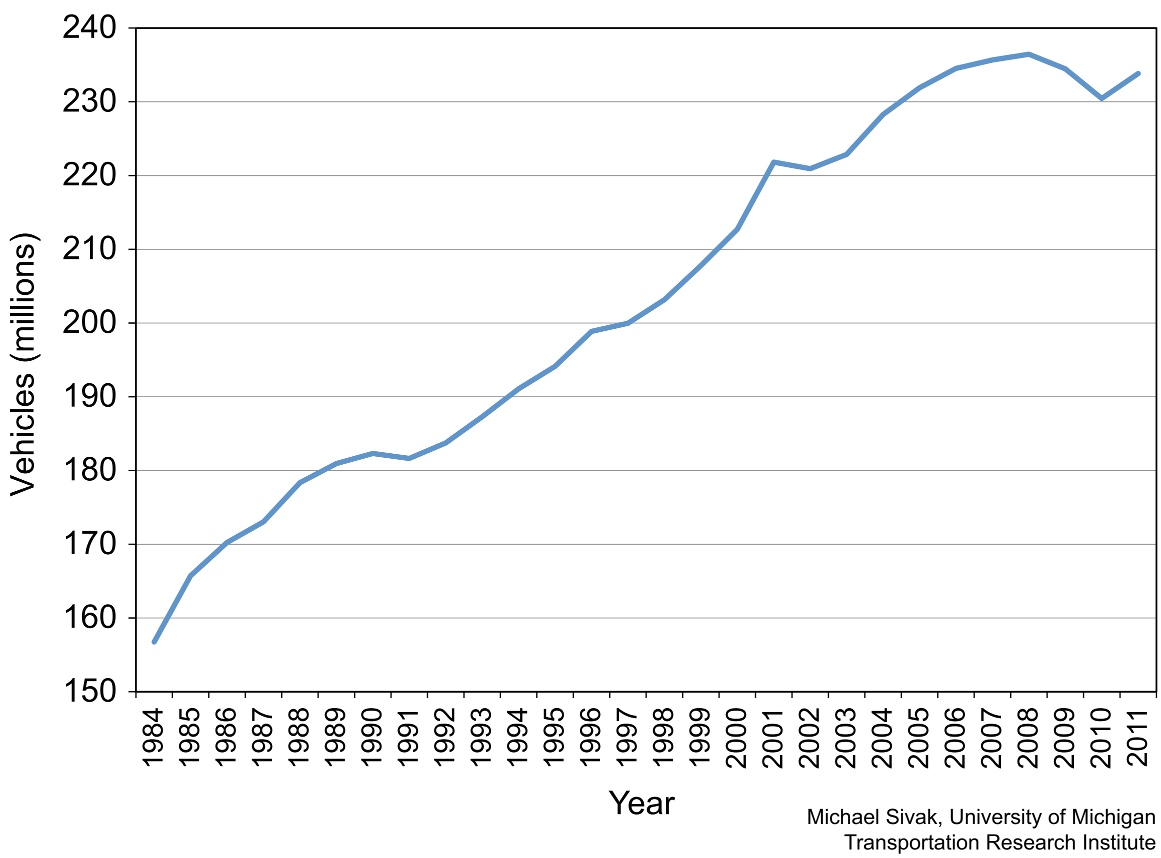

Figure 1. Total number of registered light-duty vehicles, 1984-2011 (Sivak, 2013a).

On the other hand, the same study showed that the rates of light-duty vehicles per person, per licensed driver, and per household reached their maxima between 2001 and 2006 (see Figure 2)—prior to the onset of the current economic downturn in 2008. Therefore, it is likely that the declines in these rates prior to 2008 reflect other societal changes that influence the need for vehicles (e.g., increased telecommuting, increased use of public transportation, and increased urbanization of the population). Therefore, the recent maxima in these rates have better chances of being long-term peaks as well. However, because the changes in the rates from 2008 on likely reflect both the relevant societal changes and the current economic downturn, whether the recent maxima in the rates will represent long-term peaks as well will be determined by the extent to which the relevant societal changes turn out to be permanent.

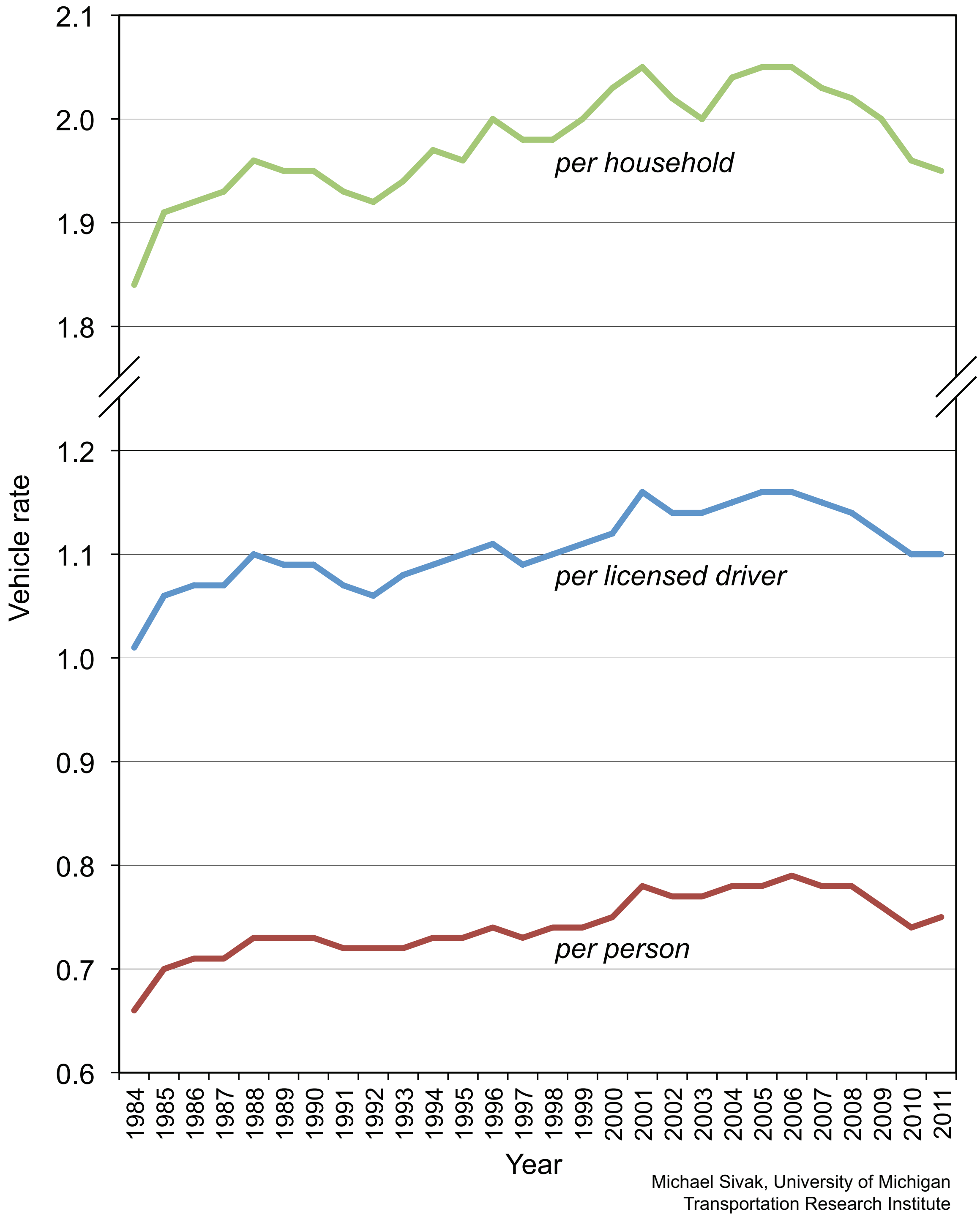

Figure 2. Registered light-duty vehicles per person, per licensed driver, and per household, 1984-2011 (Sivak, 2013a).

In the second study (Sivak, 2013b), I analyzed the recent trends in distances driven by light-duty vehicles. The total distance driven peaked in 2006 (see Figure 3). However, as was the case with the total number of vehicles, this was likely only a temporary peak. With the expected growth in the population (and the rebounding economy), the total distance driven will likely surpass the 2006 level in the near future.

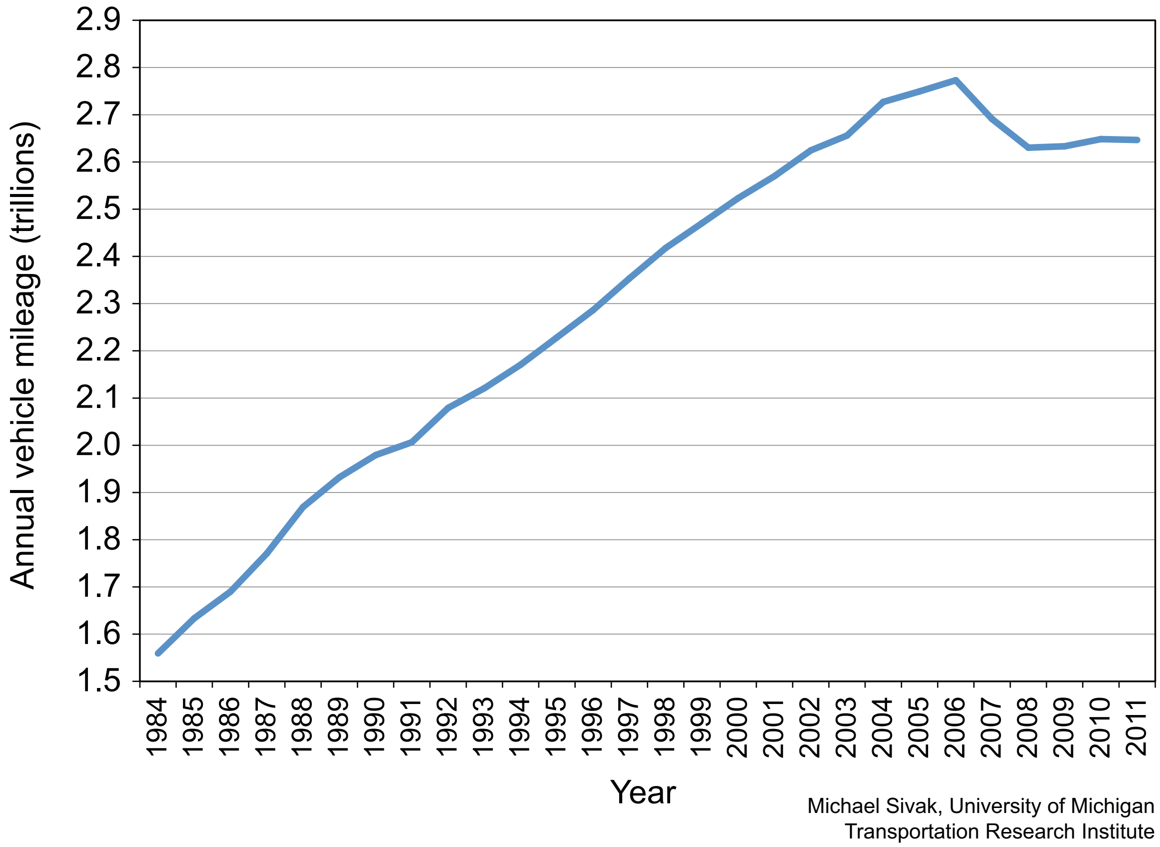

Figure 3. Total distance driven by all light-duty vehicles, 1984-2011 (Sivak, 2013b).

All examined distance-driven rates in Sivak (2013b)—per person, per driver, per household, and per vehicle—peaked in 2004, four years prior to the onset of the current economic downturn in 2008 (see Figure 4). Thus, as in the case of vehicle ownership rates, we must search for noneconomic factors as the explanations for the onset of this trend, such as increased telecommuting, increased use of public transportation, increased urbanization of the population, and changes in the age composition of drivers.

Although economic factors were unlikely to be responsible for the onset of the decrease in distance-driven rates, economic factors likely contributed to the post-2008 reduction in the rates. Among the relevant economic factors in the 2008 through 2011 time period were high unemployment rates, stagnating real income for a majority of the population, and the increased price of gasoline.

Because the onsets of the reductions in the driving rates were not the result of short-term, economic changes, the 2004 maxima in the distance-driven rates have a reasonable chance of being long-term peaks as well. An exception is the rate per vehicle. Should the number of vehicles per person, per driver, and per household continue to fall, it is possible that the distance driven per vehicle would start to increase and eventually surpass the 2004 value.

The present study examined the corresponding recent trends in fuel consumption by light-duty vehicles. The expectation was that, because of the recent reduction in distance driven, there would be a decline in the amount of fuel consumed as well. Furthermore, because vehicle fuel economy has been improving (Sivak and Schoettle, 2013), the decline in fuel consumption was predicted to be steeper than the decline in distance driven.

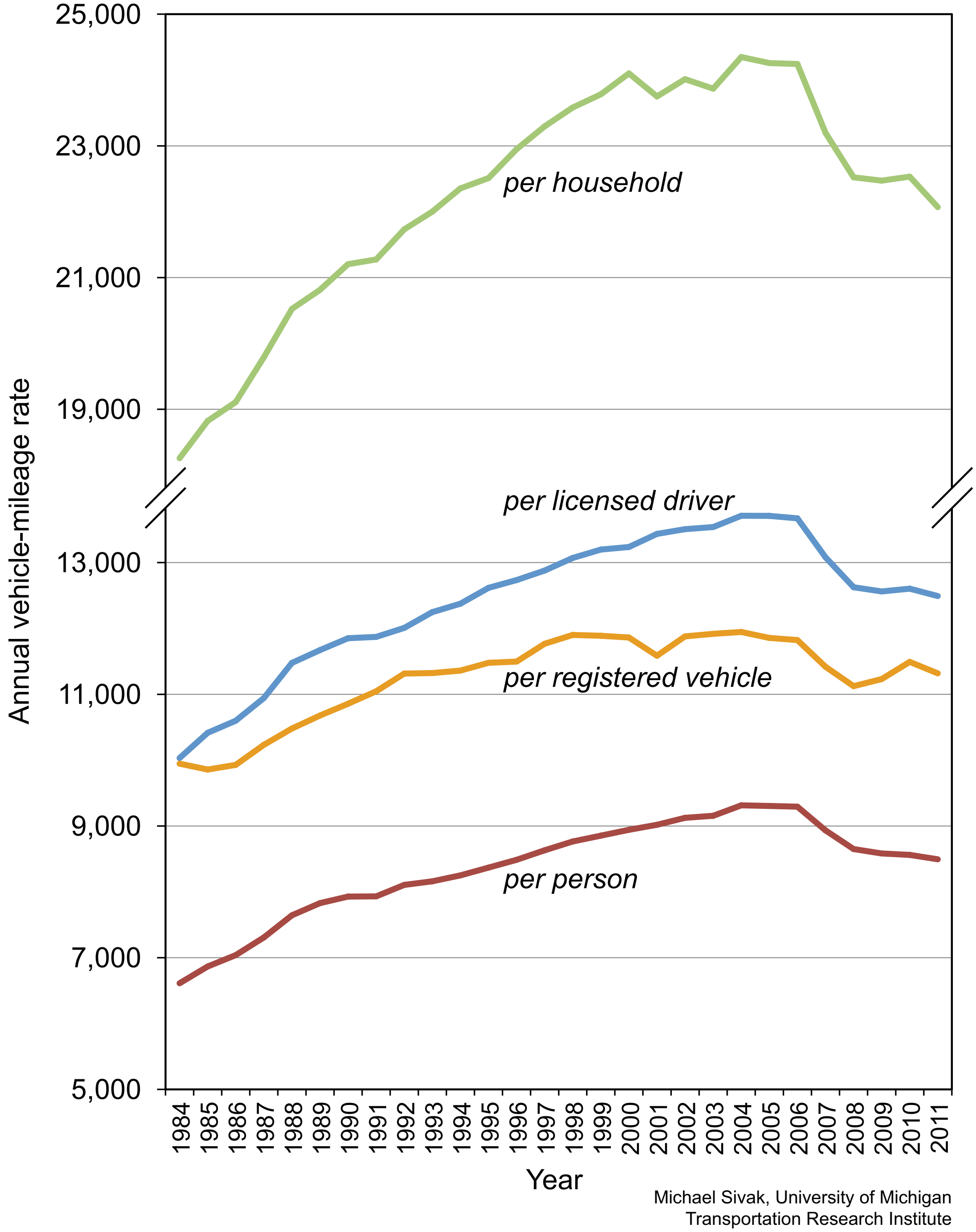

Figure 4. Distances driven per person, per licensed driver, per household, and per registered vehicle, 1984-2011 (Sivak, 2013b).

Method

The fuel consumed by all light-duty vehicles (cars, pickup trucks, SUVs, and vans) was examined, as well as the corresponding rates per person, per licensed driver, per household, and per registered vehicle. The data were analyzed for each year from 1984 through 2011.

The fuel consumed by light-duty vehicles for each year was obtained or calculated from the information in FHWA (2013). For 1984 though 2006, this number was the sum of the fuel consumed for cars and other two-axle, four-tire vehicles. For 2007 through 2011, this number was the sum of the fuel consumed for short-wheel-base and long-wheel-base light-duty vehicles.

The sources of other relevant data were as follows:

- resident population: ProQuest (2012)
- licensed drivers: FHWA (2013)
- households: U.S. Census Bureau (2012)
- registered light-duty vehicles: FHWA (2013)

Results

Total amount of fuel consumed

Figure 5 presents the total amount of fuel consumed by all light-duty vehicles from 1984 through 2011. These data are also listed in Table 1.

The amount of fuel consumed in 1984 was 94.4 billion gallons. The amount reached a maximum of 138.8 billion gallons in 2004. In 2011 (the latest year available), the number was 123.9 billion gallons (a reduction of about 11% from 2004). Prior to the peak in 2004, the last time this rate was below the 2011 level was in 1998 (see Table 1).

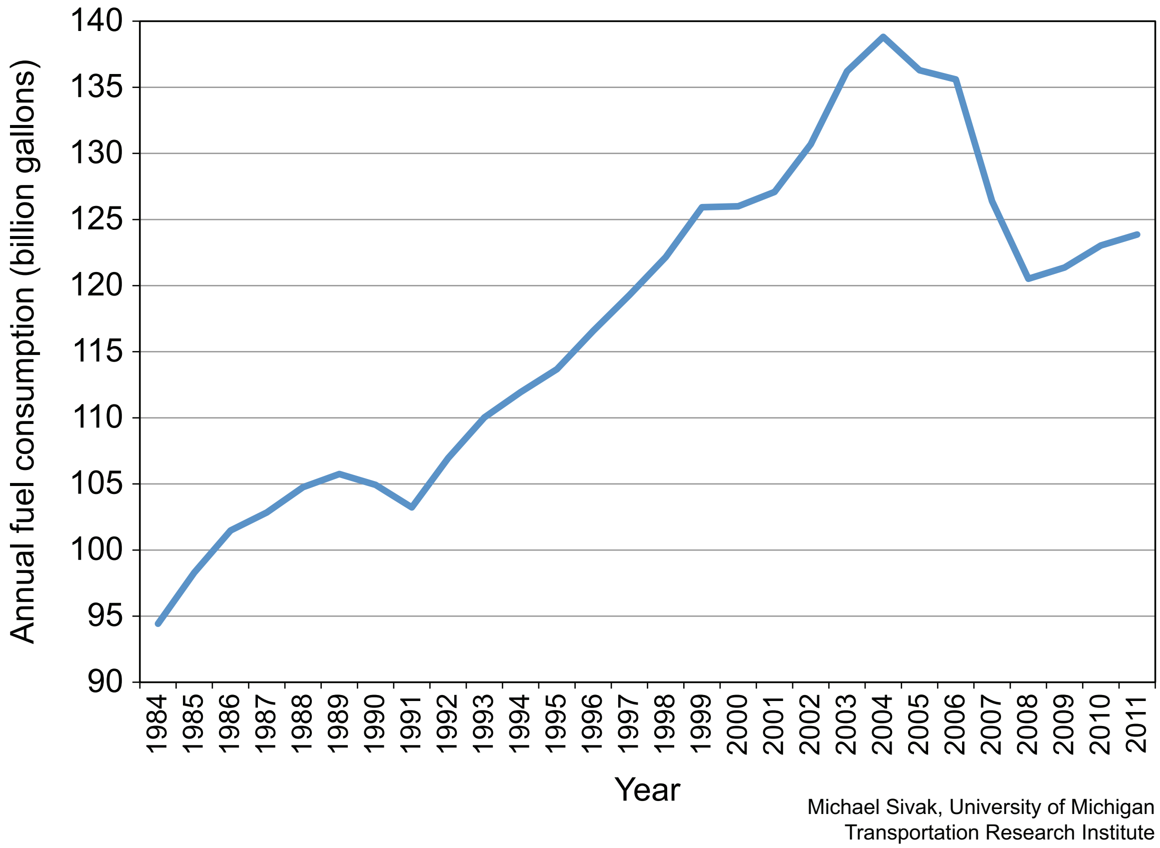

Figure 5. Total amount of fuel consumed by light-duty vehicles, 1984-2011.

Table 1
Total amount of fuel consumed by light-duty vehicles, 1984-2011.
(The maximum is in **bold**.)

Year	Gallons (millions)
1984	94,425
1985	98,290
1986	101,481
1987	102,838
1988	104,752
1989	105,754
1990	104,926
1991	103,223
1992	106,950
1993	110,029
1994	111,940
1995	113,677
1996	116,575
1997	119,280
1998	122,158
1999	125,931
2000	126,004
2001	127,081
2002	130,691
2003	136,213
2004	**138,819**
2005	136,288
2006	135,594
2007	126,393
2008	120,515
2009	121,368
2010	123,039
2011	123,862

Fuel-consumption rates

Figure 6 and Table 2 present the fuel-consumption rates per four variables of interest: person, licensed driver, household, and registered vehicle. The rates reached their maxima in 2004 (except for the rate per vehicle, which reached its maximum in 2003).

Fuel consumed per person. In 1984, the average amount of fuel consumed per person was 400 gallons. This rate increased to a maximum of 474 gallons in 2004. The latest rate—for 2011—was 398 gallons.

Fuel consumed per licensed driver. In 1984, the average amount of fuel consumed per driver was 608 gallons. The rate increased to a maximum of 698 gallons in 2004. The rate for 2011 was 585 gallons.

Fuel consumed per household. In 1984, the average amount of fuel consumed per household was 1,106 gallons. The rate increased to a maximum of 1,240 gallons in 2004. The rate for 2011 was 1,033 gallons.

Fuel consumed per registered light-duty vehicle. In 1984, the average amount of fuel consumed per vehicle was 602 gallons. The rate increased to a maximum of 611 gallons in 2003. The rate for 2011 was 530 gallons.

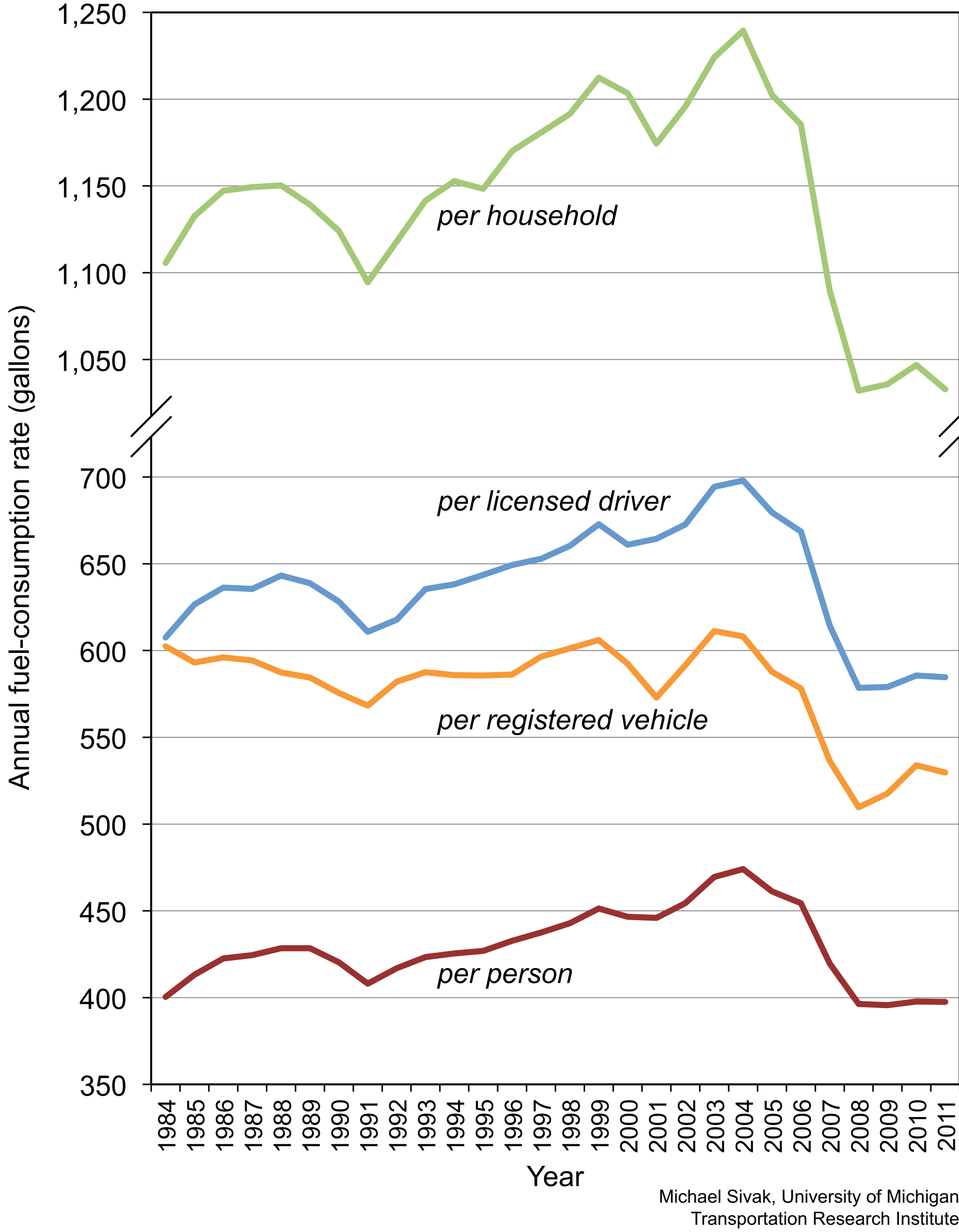

Figure 6. Amount of fuel consumed per person, per licensed driver, per household, and per registered vehicle, 1984-2011.

Table 2
Amount of fuel consumed per person, per licensed driver, per household, and per registered vehicle, 1984-2011. (The maxima are in **bold**.)

Year	Gallons per person	Gallons per driver	Gallons per household	Gallons per vehicle
1984	400.4	607.5	1105.6	602.4
1985	413.1	626.6	1132.5	593.1
1986	422.6	636.3	1147.2	596.1
1987	424.4	635.5	1149.3	594.3
1988	428.4	643.2	1150.3	587.3
1989	428.5	638.8	1139.2	584.5
1990	420.3	628.2	1124.0	575.5
1991	408.0	610.8	1094.5	568.3
1992	416.9	617.8	1117.9	582.1
1993	423.3	635.5	1141.5	587.5
1994	425.4	638.2	1152.7	585.9
1995	426.9	643.6	1148.4	585.6
1996	432.7	649.3	1170.1	586.2
1997	437.5	652.8	1180.8	596.5
1998	442.8	660.4	1191.5	601.3
1999	451.3	672.8	1212.3	606.1
2000	446.6	661.0	1203.4	592.4
2001	445.9	664.4	1174.4	572.9
2002	454.4	672.6	1195.7	591.5
2003	469.5	694.4	1224.1	**611.2**
2004	**474.1**	**698.0**	**1239.5**	608.1
2005	461.2	679.6	1202.4	587.7
2006	454.4	668.6	1185.4	578.2
2007	419.6	614.3	1089.5	536.3
2008	396.3	578.5	1032.0	509.7
2009	395.6	579.0	1035.7	517.6
2010	397.8	585.6	1046.8	533.9
2011	397.5	584.6	1032.8	529.7

All four fuel-consumption rates in 2011 were lower than the corresponding rates in 1984—the first year of the analysis. Table 3 shows the percentage changes in the fuel-consumption rates from the peaks in 2004 (or 2003) to 2011. The rates per person, per licensed driver, and per household decreased by about 16% each, while the rate per registered vehicle decreased by 13%.

Table 3
Percentage changes in the fuel-consumption rates
from the peaks in 2004 (or 2003) to 2011.

Fuel-consumption rate	Percentage change from the peak in 2004 (or 2003) to 2011
Per person	-16%
Per licensed driver	-16%
Per household	-17%
Per registered vehicle	-13%

Discussion

Total fuel consumed

Total amount of fuel consumed by light-duty vehicles peaked in 2004 at 138.8 billion gallons; in 2011 the amount was 123.9 billion gallons. Prior to the peak in 2004, the last time this rate was below the 2011 level was in 1998. The decline of 11% since 2004 reflects the decline in distance driven since 2006 (Sivak, 2013b) and the improvement in vehicle fuel economy (Sivak and Schoettle, 2013).

However, it is not clear whether the 2004 maximum would be a permanent peak. The factor that supports a temporary peak only is the expected future increase in the total distance driven (due to the increasing population and the improving economy). On the other hand, the factors that support a long-term peak are the decreased licensure rates of young persons (Sivak and Schoettle, 2012), the apparent peaking of the vehicle-ownership and distance-driven rates (Sivak, 2013a; 2013b), the expected continued improvement in vehicle fuel economy of internal-combustion and hybrid vehicles (Schoettle and Sivak, 2013), and the expected increased penetration of fully electric vehicles (EDTA, 2013). The future interplay of these factors will determine whether or not the 2004 peak will be surpassed in the future.

Fuel-consumption rates

All examined fuel-consumption rates (per person, per driver, per household, and per vehicle) peaked in 2004 (or 2003), several years prior to the onset of the current economic downturn in 2008. These peaks coincide with the peaks in the distance-driven rates (Sivak, 2013b). However, the decreases in the fuel-consumption rates between the peaks and the 2011 values (13% to 17%) are greater than the corresponding decreases in the distance-driven rates (5% to 9%), reflecting the added contribution of the improvements in vehicle fuel economy (Schoettle and Sivak, 2013).

Because the onsets of the reductions in the distance-driven rates were not the results of short-term, economic changes, and because of the expected continuation of the improvements in vehicle fuel economy, the 2004 maxima in the fuel-consumption rates have a good chance of being long-term peaks as well. (An exception is the rate per vehicle. Should the number of vehicles per person, per driver, and per household continue to fall, it is possible that the distance driven per vehicle would start to increase and eventually surpass the 2004 value. In such a case, the relative slopes of the improvements in vehicle fuel economy and the increasing distance driven would determine the eventual outcome.)

Based on the present data, the best estimates of the current annual fuel-consumption rates are as follows: 398 gallons per person, 585 gallons per licensed driver, 1,033 gallons per household, and 530 gallons per registered vehicle. These rates are down 16% to 17% from their peaks in 2004, except that the rate per vehicle is down 13% (from its peak in 2003). (The fact that the fuel-consumption rate per vehicle is down less than the rates per person, driver, and household reflects the analogous relationships among the corresponding distance-driven rates (Sivak, 2013b).)

Private, commercial, and public vehicles

Because data on fuel consumption by only privately owned light-duty vehicles are not available, the analysis dealt with all light-duty vehicles (private, commercial, and public). Thus, the absolute numbers and the rates derived in this study are higher than they would have been if only privately owned vehicles were included. Furthermore, these statistics on all light-duty vehicles cannot distinguish whether trends for privately owned vehicles are different from those for commercial and/or public vehicles.

Vehicle registrations, distances driven, and fuel consumed

Table 5 summarizes the years in which the maxima were reached for the number of registered vehicles, distance driven, and fuel consumed (both the totals and the rates), and the magnitudes of the reductions from the corresponding maxima. The data apply to light-duty vehicles. The information for vehicles and distance driven is from Sivak (2013a; 2013b), while the information for fuel consumption is from the present study.

Table 5
Years in which the maxima were reached for the number of vehicles, distance driven, and fuel consumed (both the totals and the rates), and the magnitudes of the reductions from the corresponding peaks. The data apply to light-duty vehicles.

Measure	Peak year(s)	Reduction in 2011 from the peak	Source
Vehicles	2008	-1%	Sivak (2013a)
Vehicles per person, per licensed driver, and per household	2001 to 2006	-5%	
Distance driven	2006	-5%	Sivak (2013b)
Distance driven per person, per licensed driver, per household, and per vehicle	2004	-9% to -5%	
Fuel consumed	2004	-11%	Present study
Fuel consumed per person, per licensed driver, per household, and per vehicle	2003 to 2004	-13% to -17%	

The bottom line: We drive fewer light-duty vehicles, we drive each of them less, and we consume less fuel

In the previous two studies (Sivak, 2013a; 2013b), I documented the fact that the number of registered light-duty vehicles per person, per driver, and per household, and the corresponding distance-driven rates all reached their maxima between 2001 and 2006. The findings of the present study indicate that the corresponding rates for fuel consumed also reached their maxima during this period (in 2003 or 2004.) Thus, the combined evidence from these three studies indicates that—per person, per driver, and per household—we now have fewer light-duty vehicles, we drive each of them less, and we consume less fuel than in the past: The fuel-consumption rates now are lower than they were in 1984—the first year of this analysis.

References

EDTA [Electric Drive Transportation Association]. (2013). Electric drive sales. Available at: http://electricdrive.org/index.php?ht=d/sp/i/20952/pid/20952.

FHWA [Federal Highway Administration]. (2013). *Highway statistics (annual).* Available at: http://www.fhwa.dot.gov/policyinformation/statistics.cfm.

ProQuest (2012). *ProQuest statistical abstract of the United States, 2013* (1st ed.). Bethesda, MD: Author.

Schoettle, B. and Sivak, M. (2013). *A comparison of CAFE standards and actual CAFÉ performance of new light-duty vehicles* (Report No. UMTRI-2013-35). Ann Arbor: The University of Michigan Transportation Research Institute. Available at: http://deepblue.lib.umich.edu/bitstream/handle/2027.42/100179/102966.pdf.

Sivak, M. (2013a). *Has motorization in the U.S. peaked?* (Report No. UMTRI-2013-17). Ann Arbor: The University of Michigan Transportation Research Institute. Available at: http://deepblue.lib.umich.edu/bitstream/handle/2027.42/98098/102947.pdf.

Sivak, M. (2013b). *Has motorization in the U.S. peaked? Part 2: Use of light duty vehicles* (Report No. UMTRI-2013-20). Ann Arbor: The University of Michigan Transportation Research Institute. Available at: http://deepblue.lib.umich.edu/bitstream/handle/2027.42/98982/102950.pdf.

Sivak, M. and Schoettle, B. (2012). Update: Percentage of young persons with a driver's license continues to drop. *Traffic Injury Prevention*, *13*, 341.

Sivak, M. and Schoettle, B. (2013). *Average sales-weighted fuel economy of purchased new vehicles* [updated monthly]. Available at: http://www.umich.edu/~umtriswt/EDI_sales-weighted-mpg.html.

U.S. Census Bureau. (2012). *Households, by type: 1940 to present.* Available at: http://www.census.gov/hhes/families/data/households.html.