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ENERGY INTENSITIES OF FLYING AND DRIVING

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16. Abstract

Last year, I issued a report comparing energy intensities of flying and driving from 1970 through 2010. The main finding of that study was that, while flying domestically in the U.S. used to be much more energy intensive than driving, that is no longer the case. Indeed, in 2010—the last year examined in that study—the energy intensity of driving was 57% greater than the energy intensity of flying.

The present study extends the analysis through 2012. Furthermore, this study corrects the publically available flying data for two inconsistencies: (1) the estimates of the energy intensity of flying are based on different carrier groups for fuel consumed and passenger miles flown, and (2) the estimates of the energy intensity of flying include cargo operations (paid freight and mail).

The results indicate that, even before the corrections are made to the flying data, the energy-intensity advantage of flying over driving has increased from 2010 to 2012. Furthermore, the net effect of the corrections to the flying data is that the advantage of flying has increased even further.

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Contents

Introduction

Last year, I issued a report comparing energy intensities of flying and driving from 1970 through 2010 (Sivak, 2014). (Energy intensity is the amount of energy needed to transport one person a given distance.) The main finding of that study was that, while flying domestically in the U.S. used to be much more energy intensive than driving, that is no longer the case. Indeed, in 2010—the last year examined in that study—the energy intensity of driving was shown to be 57% greater than the energy intensity of flying.

The present study extends the analysis through 2012. Furthermore, this study corrects the publically available flying data for two inconsistencies: (1) the estimates of the energy intensity of flying are based on different carrier groups for fuel consumed and passenger miles flown, and (2) the estimates of the energy intensity of flying include cargo operations (paid freight and mail).

Recent trends in the energy intensities of flying and driving

Approach

The variable of interest was BTU per person mile. For flying, "person mile" refers to passenger mile, while for driving it refers to occupant mile.

For flying, only domestic operations were considered (RITA, 2015a). For driving, all light-duty vehicles (cars, SUVs, pickups, and vans) were included; the data were calculated from the information in RITA (2015b).

Correcting the energy-intensity of flying by inclusion of the same groups for fuel consumed and passenger miles flown

According to two footnotes in RITA (2015a), the derivation of the energy intensity of flying was based on four carrier groups for passenger miles flown (majors, nationals, large regionals, and medium regionals), but only three groups for fuel consumed (without medium regionals). Given that data on fuel consumed by medium regionals only are not available, the inconsistency was resolved by subtracting the passenger miles flown by medium regionals from the published total for all four groups. Thus, in the present calculations, both components of energy intensity (fuel consumed and passenger miles flown) were based on the same three groups (majors, nationals, and large regionals). (This correction proved not to be of major significance, because medium regionals currently represent less than 1% of passenger miles flown.)

Correcting the energy-intensity of flying for cargo operations

According to a footnote in RITA (2015a), the published data on energy intensity of flying was based on fuel consumed for both passenger and cargo operations. In other words, fuel consumed included fuel needed to transport paid freight and mail on passenger carriers and on all-cargo carriers. Therefore, in this study, the published data for energy intensities of flying were corrected for the proportion of revenue ton miles that were represented by revenue passenger ton miles only (i.e., not including revenue freight ton miles and revenue mail ton miles). These calculations were performed for the majors, nationals, and large regionals. As an example, Table 1 shows the two calculations for 2012.

Table 1
Calculations to correct the published energy intensity of flying for
carrier-group inclusion and cargo operations for 2012.

Published energy intensity of flying (BTU per passenger mile)*	2,465
Energy intensity of flying, corrected for carrier-group inclusion (BTU per passenger mile)	2,467
Proportion of revenue ton miles represented by revenue passenger ton miles**	.824
Energy intensity of flying, corrected for both carrier-group inclusion and cargo operations: energy intensity of flying, corrected for carrier-group inclusion *times* proportion of revenue ton miles represented by revenue passenger ton miles (BTU per passenger mile)	2,033

* RITA (2015a)
** BTS (2015)

Results

Table 2 presents the energy intensities of flying and driving from 2010 to 2012.

Table 2
Energy intensities of flying and driving, 2010-2012.

Year	BTU per person mile			
	Driving	Flying (domestic)		
		As published in RITA (2015a)	Corrected for carrier-group inclusion	Corrected for carrier-group inclusion and cargo operations
2010	4,218	2,691	2,693	2,204
2011	4,236	2,597	2,600	2,159
2012	4,211	2,465	2,467	2,033

The data in Table 2 indicate that in 2012 the energy intensity of driving was 71% greater than the published energy intensity of flying. Furthermore, after the two sets of corrections to the flying data, the energy intensity of driving was 2.07 times that of flying.

Improving the energy intensity of driving

The energy intensity of driving (as well as of other means of personal transportation) depends on two primary variables: vehicle fuel economy and vehicle load (the number of persons aboard). As vehicle load increases, the amount of fuel consumed per person mile decreases (even after taking into account the increased weight to be carried). Below are calculations concerning the improvements in vehicle fuel economy that would be needed for driving to be as energy intensive as flying.

In 2012, the on-road fuel economy of the U.S. fleet of all light-duty vehicles at the average vehicle load of 1.38 persons was 21.6 mpg (both calculated from the information in RITA [2015b]). To match the energy intensity of driving to that of flying would require improving vehicle fuel economy by the current ratio of the energy intensities of driving and flying. That ratio (after the above corrections) is 2.07 (4,211/2,033). Consequently, at the current average vehicle load of 1.38 persons, the on-road vehicle fuel economy would have to be 44.7 mpg (21.6 × 2.07 = 44.7). (If one would like to base the calculations on the published, uncorrected energy intensity of flying, the needed vehicle fuel economy would have to be 36.9 mpg.)

Discussion[1]

Needed improvements in vehicle fuel economy

Although the fuel economy of new vehicles is continuously improving (Sivak and Schoettle, 2015), and these improvements are likely to accelerate given the recent update to the corporate average fuel economy standards (NARA, 2012), changes in fuel economy of new vehicles take a long time to substantially influence the fuel economy of the entire fleet (Sivak, 2013). This is the case because it takes a long time to turn over the on-road fleet. For example, the 16.5 million light-duty vehicles sold in 2014 (New York Times, 2015), accounted for only about 7% of the entire fleet of light-duty vehicles (FHWA, 2015).

It is important to recognize that the energy intensity of flying will also continue to improve. Consequently, because the future energy intensity of flying will be better than it currently is, the calculated improvements underestimate the improvements that need to be achieved for driving to be as energy intensive as flying.

Electric vehicles

The presented energy intensities of driving slightly underestimate the actual intensities because the electric energy consumed by plug-in hybrid electric vehicles and fully electric vehicles was not included. However, in 2012 these vehicles represented less than 1% of all vehicles on the road (EDTA, 2015; FHWA, 2015).

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[1] Adapted from Sivak (2014).

Driving trips vs. flying trips

The average length of a driving trip is currently about 9 miles (Krumm, 2012). On the other hand, the average domestic flying trip is currently about 100 times longer (895 miles; RITA, 2014). Thus, driving and flying serve different general purposes, with driving used mostly for trips that are too short for flying. However, long-distance driving represents a subgroup of driving trips for which flying is a viable alternative.

As the trip length increases, so does the average fuel economy of driving. This is the case because long-distance driving is frequently done on limited-access highways where vehicle fuel economy is better than the average fuel economy over all roads that were included in this analysis. Similarly, as the trip length increases, so does the average fuel economy of flying. This is the case because airplanes use a disproportionate amount of fuel during takeoffs. For example, one estimate is that on short trips, takeoffs are responsible for as much as 25% of the total fuel consumed (Worldwatch Institute, 2013).

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