Real World Graduation: Question 85: Energy Efficiency

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Question 85

Four people commute to work in the following ways. Person A drives a very fuel efficient car that gets 50 miles to the gallon; he drives alone 75 miles each way to work. Person B drives alone in an old inefficient pickup truck that gets 12 miles to the gallon; he drives 12 miles each way. Person C drives a car that gets 25 miles to the gallon. He drives it alone 5 miles each way to a light-rail station. There he gets on public light-speed rail; each train consists of 4 cars, and each car holds up to 30 people. The train is electric, but its energy usage is the equivalent of 2 miles to the gallon, and his commute on the train is 20 miles each way. Person D takes the city bus 16 miles each way; the bus gets 4 miles per gallon, and holds up to 60 people. Assume that all the mileages are calibrated to the same blend of gasoline (although they may actually use different fuels). Which person uses the most efficient means in of energy expenditure in the course of getting back and forth to work?

a) Person A
b) Person B
c) Person C
d) Person D
e) Indeterminate exactly, but it is either Person A or D

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Answer to Question 85

This is a trick question, because there was not enough data provided to solve it. To figure out who is the most efficient in their energy usage, it is necessary to calculate how many equivalent gallons of gas are used by each one. The total equivalent amount of gas consumed per person is given by the formula:

$$\frac{gallons}{person} = \frac{total\ miles}{miles\ per\ gallon} \frac{1}{number\ of\ \ people\ carried}$$

Person A travels by himself 150 total miles in a car that gets 50 MPG, so he uses 3 gallons per day. Person B travels by himself 24 miles in a car that gets 12 MPG, so he uses 2 gallons per day. Right away, this shows the need to beware of the euphemisms about relative energy efficiency. In this case, Person B, who drives a "gas-guzzler", is actually more fuel-efficient than Person A, who drives a "gas-sipper".

Person C drives by himself 10 miles total in a car that gets 25 miles to the gallon, so this portion of his trips uses 0.4 gallons. Then he travels 40 total miles on the rail line. If the train is full the entire distance both ways, then the average number of gallons used by person C for this portion is 40/240 = 0.1666. But if Person C is the only one on the train for the entire distance both ways, the number of gallons used for this portion alone is 40/2 = 10 gallons. For the two extremes, person C uses either 0.5666 or 10.4 gallons per day. Most likely, his real average usage is somewhere between these, but there is not enough data provided to calculate it.

Person D travels 32 total miles entirely on a city bus that carries 60 people and gets 4 MPG. If the bus is full both ways, then the average number of gallons used by Person D is 32/240 = 0.133. But if he is the only one on the bus both ways, then his average energy usage is the equivalent of 32/4 = 8 gallons. Again, his average consumption somewhere between 0.133 and 8, but there is insufficient data to calculate his real average usage.

Unless the average number of people riding on the public transportation at all times is known, it is impossible to determine which is the most efficient. Many times one can see city buses traveling empty, and yet they are consuming energy. Also, public facilities require additional energy to light the parking lots, to maintain centralized maintenance terminals, etc. The main point here is that when evaluating energy usage, one should reduce it down to either total costs or total energy usage with all these other factors included. One of the most important factors is the average number of riders per trip on public facilities.

In fact, the better argument for public transportation is congestion relief, not energy efficiency. There are some places, like New York City, where the subway is clearly better than cars from both an energy usage and congestion standpoint. It works because there are a lot of riders going from many stops on the line to many other stops on the line. But such a system may be inefficient in a place like Albuquerque, where the large number of riders per trip cannot be assured.

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