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AutoSmart

Learn the facts: Horsepower's effect on fuel consumption

What is the issue?

Horsepower is an important factor in an automobile's fuel consumption. On average, today's vehicles offer about twice the horsepower of their counterparts from the early 1980s. How much horsepower do you actually need to satisfy your everyday driving needs? Progressive drivers are assessing their vehicle needs based on fuel consumption, not on top speed and quarter-mile time. This change in mindset can save fuel, save money and reduce your impact on the environment.

What do I need to know?

Engine power and torque are related. Power is the speed at which energy is converted, or more formally, the rate of doing work. In an engine, the power from the rotational force of the engine's crankshaft is calculated as a function of the engine torque and engine speed. The relationship between engine power and torque may be expressed as

> horsepower (hp) = [torque (lb-ft) × revolutions per minute (RPM)] ÷ 5252

In simple terms, torque describes how much work an engine can do and horsepower describes how quickly that work can be done. For example, a waterwheel that was used to power a mill would typically have enormous torque, but would rotate at low speed. The calculated horsepower would therefore be relatively small (i.e. the waterwheel could do a lot of work, but slowly).

Vehicle designers optimize horsepower and torque for each application. For example, today's farm tractors and performance cars have similar horsepower ratings. However, a farm tractor reaches this power rating with high torque and low RPM, compared to a performance car that achieves the same power with comparatively low torque but significantly higher RPM.

A high level of horsepower in automobiles is useful in applications such as high-speed racing. But under typical driving conditions for family automobiles, using high horsepower uses more fuel.

Horsepower marketing and reporting has been ubiquitous and persuasive. Since the 1950s, automakers and automotive journalists have been marketing and reporting horsepower levels. This has created more market interest and demand for more horsepower, acceleration and speed. But the 1970s oil crisis made fuel efficiency an important design consideration in the United States and Canada. This event led to reductions in horsepower, average vehicle size, weight and fuel consumption. The trend continued until the early 1980s (see Figure 1) and

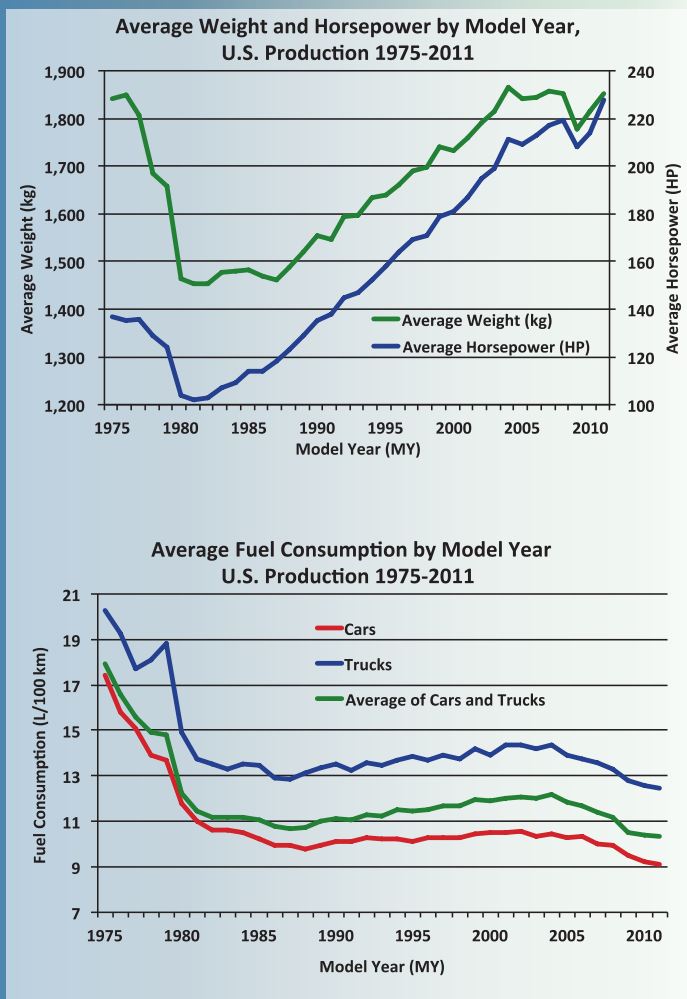

Figure 1. Top: Average weight and horsepower from 1975 to 2011 based on U.S. production figures. Bottom: Average fuel consumption for the same period (EPA 2012).

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was followed by an era of increasing horsepower and weight until the mid-2000s. Fortunately, fuel consumption remained relatively constant during this period of increasing power and weight because of improvements in engine technology and efficiency.

How much horsepower do we really need? There's no easy answer to this question because "need" is open to interpretation. The basic power requirement needed to power accessories and move the vehicle at highway speeds is not significant (in the tens of horsepower, depending on the vehicle size and weight). In the early 1970s, typical subcompact and compact vehicles had horsepower ratings of 50 to 75 hp. Today, the ratings for the same class of vehicles are 100 hp to more than 200 hp. Torque has nearly tripled, weight has nearly doubled, and fuel consumption can be better or worse depending on the engine size (see the table). Today's vehicles are also more reliable and safer.

If automakers were to keep gasoline engines at today's horsepower levels and focus all new technology improvements on reducing fuel consumption, researchers at MIT forecast fuel consumption reductions of 32 to 44% for gasoline vehicles by 2035 (MIT 2008).

	1973 compact car	2012 compact car – standard engine	2012 compact car – performance engine
Number of cylinders	4	4	4
Engine displacement	1.2 L	1.8 L	2.4 L
Engine power	50 hp	140 hp	201 hp
Maximum torque	59 lb-ft	128 lb-ft	170 lb-ft
Acceleration, 0–100 km/h	19.1 sec	8.8 sec	6.0 sec
Curb weight	680 kg	1227 kg	1323 kg
Fuel consumption (highway)	5.9 L/100 km	5.4 L/100 km	6.4 L/100 km

How can I help?

You can make a difference:

- **Make fuel consumption an important consideration when you buy a new vehicle.** Progressive drivers are assessing their vehicle performance based on fuel consumption, not on top speed and quarter-mile time.
- **Buy only what you need.** A good assessment of your vehicle needs is one of the most important steps in choosing a fuel-efficient vehicle. When possible, choose a smaller, lighter vehicle with the smaller, more fuel-efficient engine option. NRCan's on-line Fuel Consumption Ratings tool at **vehicles.nrcan.gc.ca** is a great resource to help you choose the most fuel-efficient vehicle that meets your needs.

What are the savings and benefits?

Because power is the speed at which energy is converted, more power generally means higher fuel consumption. For example, manufacturers often offer two engines choices for a given vehicle model. Consider an existing compact car, with the standard engine rated at 140 hp and the "sport version" rated at 201 hp. The combined city/highway fuel consumption ratings are 6.4 and 8.4 L/100 km, respectively. The more powerful engine also requires premium fuel. At fuel prices of $1.30/L for regular gasoline and $1.45/L for premium gasoline, the increased fuel cost for higher horsepower is $7,720 over 200 000 km. Combined with a higher purchase price for the vehicle, the additional horsepower represent substantial extra costs.

References

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MIT 2008. *On the Road in 2035: Reducing Transportation's Petroleum Consumption and GHG Emissions*. Massachusetts Institute of Technology (2008).

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