



Learn the facts: Direct fuel injection and its impact on fuel consumption

What is the issue?

Progressively more stringent greenhouse gas (GHG) emission standards for light-duty vehicles are in place in Canada. In response, vehicle manufacturers are improving engine efficiency by using innovative technologies such as direct fuel injection.

What do I need to know?

Direct fuel injection systems can optimize fuel delivery by injecting fuel directly into the cylinder at a high pressure, in contrast to conventional systems that inject fuel into the intake air stream at a lower pressure. Direct injection systems allow better control of the fuel-air mixture and can reduce fuel consumption by 1 to 3%, saving you money and reducing your impact on the environment.

How do direct fuel injection systems work?

- ➔ Manufacturers use two basic approaches to inject fuel: direct fuel injection or manifold (indirect) fuel injection. Direct fuel injection is a more advanced technology, but is less common than the manifold fuel injection system.
- ➔ In modern vehicles, engine sensors send data about fuel burn quality, engine pressure and temperature to the vehicle's electronic control unit (ECU). With this information, the ECU constantly optimizes the amount of injected fuel and the injection timing in response to changing driving conditions.
- ➔ Direct fuel injection systems must withstand the harsh combustion environment and operate at high fuel pressures, which increases their cost and complexity compared to manifold injection systems. Direct fuel injection enables more precise control over the quantity of fuel injected into the cylinder, the timing of the injection and the spray pattern. This increased control leads to a higher quality of combustion and greater fuel efficiency

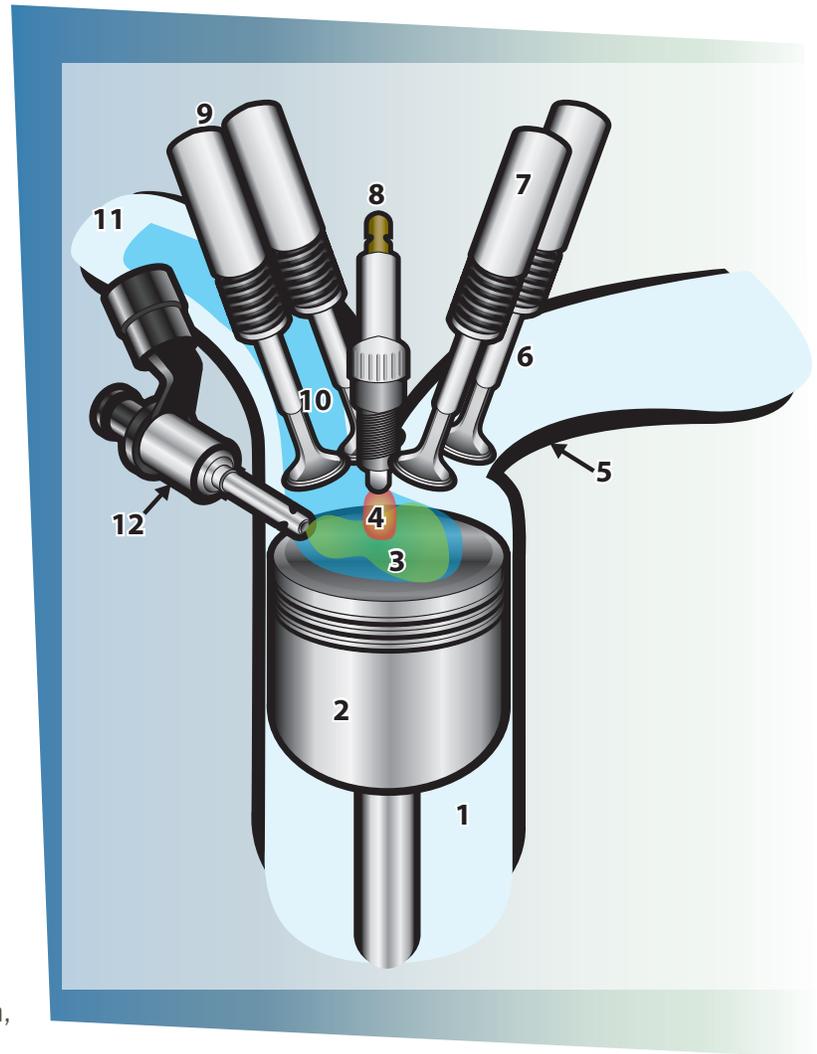


Figure 1: Direct fuel injection showing fuel spray patterns inside a cylinder's combustion chamber [EPA 2011].

Legend: 1. Cylinder, 2. Piston, 3. Fuel, 4. Spark, 5. Exhaust manifold, 6. Exhaust gas, 7. Exhaust valves, 8. Spark plug, 9. Intake valves, 10. Air, 11. Intake manifold, 12. Direct injection nozzle

than in the conventional manifold injection systems. The additional cost of the more complex system is offset by the fuel savings.

➔ Direct fuel injection increases combustion efficiency, which results in greater power, which in turn allows for a smaller capacity engine.

How can I help?

Be a knowledgeable buyer. Research before you buy and include a lifetime estimate of fuel consumption as a cost and performance requirement.

What are the savings and benefits?

Improvements in engine technology and efficiency can save you money, as illustrated in the table below. A direct fuel injection system can reduce fuel consumption and GHG emissions by 1 to 3%, compared to conventional technology. Over 10 years, this reduction corresponds to fuel cost savings of \$160 to \$1,090 and carbon dioxide (CO₂) reductions of 280 to 1 930 kg. At the high end, this is equivalent to:

- about half an Olympic-sized swimming pool of CO₂
- nearly 10% of our annual per capita emissions in Canada, which is 22.1 tonnes

Average (L/100 km)	Fuel consumption		Potential annual savings		Potential 10-year savings	
	With a 1% reduction (L/100 km)	With a 3% reduction (L/100 km)	Fuel cost savings	CO ₂ reduction	Fuel cost savings	CO ₂ reduction
14.0	13.86	13.58	\$36-109	64-193 kg	\$360-1,090	640-1 930 kg
12.0	11.88	11.64	\$31-94	55-166 kg	\$310-940	550-1 660 kg
10.0	9.90	9.70	\$26-78	46-138 kg	\$260-780	460-1 380 kg
8.0	7.92	7.76	\$21-62	37-110 kg	\$210-620	370-1 100 kg
6.0	5.94	5.82	\$16-47	28-83 kg	\$160-470	280-830 kg

Note: For illustrative purposes, savings are based on an annual driving distance of 20 000 km, a fuel cost of \$1.30/L and a CO₂ emissions factor of 2.3 kg/L of gasoline