

# FLEXI-FUEL

## The Path to Fossil Fuel Independence

Starting from the early 1970s, Volvo Cars' commitment to the environment covers the entire lifecycle of the car, from design, engineering and production to useful life, service and recycling. Efficient energy and resource utilization and reduced emissions is in focus, as is an allergy-friendly in-car environment. Flexifuel cars have been accessible to Volvo buyers for the past decade now, where the alternate fuels are readily available.

### Definition

Flexible fuel vehicles (FFVs) are designed to run on gasoline or a blend of up to 85% ethanol (E85). Except for a few engine and fuel system modifications, they are identical to gasoline-only models.

FFVs have been produced since the 1980s, and dozens of models are currently available

across many brands, especially in some parts of Europe and South America. Since FFVs look just like gasoline-only models, you may drive an FFV and not even know it. FFVs experience no loss in performance when operating on E85. However, since a certain volume of ethanol contains less energy than the same volume of gasoline, FFVs typically get a range reduction of about 20-30% when fueled with E85.

Since the introduction of the Flexible Fuel concept to Sweden, Volvo has embraced it and integrated its application into the heart of its environmental strategy. Today, almost every Volvo model is available in Flexifuel wherever the fuel is available, and of course Sweden and Brazil are now the leading nations where ethanol is being widely adopted with a fully integrated production and distribution infrastructure.

### Production

Ethanol is an alcohol-based fuel made by fermenting and distilling starch crops: corn, sugar cane mostly to name a couple. Renewable energy companies have taken to producing it, in a few countries around the world. On one acre of corn can be processed into about 330 gallons of combustible ethanol.

Although the harmful emissions of ethanol burning flex engines are far less than when they burn gasoline, the argument lays in the harmful

emissions that result from the harvesting and distillation of the crops into alcohol. The streamlining and massive agricultural techniques used today however prove that a gallon of ethanol yields more energy than it takes to produce it; however skeptics are glad to argue the opposite.

In the end it's undeniable that the dilution of 15% gasoline with 85% ethanol will most definitely extend the date when the world will run out of fuel, and that is the worst case scenario, but the question will remain as to how many nations will adopt the alternate fuel

scheme especially with the current price of oil. After all the areas planted for the express production of Ethanol yielding crops are increasing in size and global footprint and the use of corn has driven up the price of corn worldwide. In essence Ethanol is not the ultimate fuel and like everything it has its negatives, but the criteria that trumps everything is the fact that once you harvest and produce, you go to planting again, making it a fuel whose production yields no significant negative byproducts, and whose utilization leads to a longer lease for humans on planet earth.



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**Technical Application,**

The idea that sits behind a Flexifuel engine is basically a simple one in terms of Internal Combustion Engines. Flex-fuel engines are capable of burning any proportion of the resulting blend in the combustion chamber as fuel injection and spark timing are adjusted automatically according to the actual blend detected by electronic sensors.



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The Flexifuel car engines are gasoline units that undergo limited modification to support ethanol characteristics and changes included are compression ratio, amount of fuel injected, replacement of materials that would get corroded by the contact with ethanol (pipes, gaskets and manifolds), use of colder spark plugs suitable for dissipating heat due to higher flame temperatures, and an auxiliary engine block heating system to assist in cold weather starts. In extreme cold temperatures, the Ethanol/Gasoline blend is

recalibrated to E75 (in Sweden) to eliminate cold start problems. Last but not least, sensors to identify the blend ratio are present and order the ECU to modify its mapping and alternate spark timing.

Flexfuel vehicles are distinguished from bi-fuel vehicles, where two fuels are stored in separate tanks and the engine runs on one fuel at a time, for example, compressed natural gas (CNG), liquefied petroleum gas (LPG), or hydrogen.

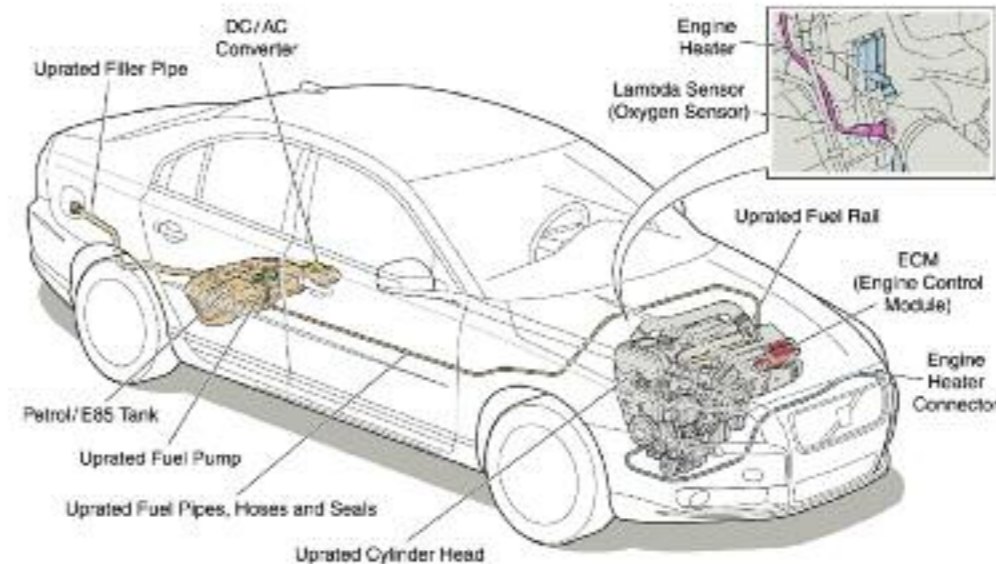
Volvo introduced its S40 and V50 with flexible-fuel engines, joined in late 2006 by the then new C30. All Volvo models were initially restricted to the Swedish market, until 2007, when these three models were launched in eight new European markets, as well as to other markets where the E85 fueling infrastructure.

Wide range of alternative fuels and technologies

Volvo Cars has one of the car market's broadest ranges of E85 models. All told, five models are on offer, each available with one or two Flexi fuel engines. In 2008, the Volvo V70 and Volvo S80 were introduced with a five-cylinder 2.5-liter turbocharged Flexifuel engine producing 200 hp and 300 Nm of torque. The Flexifuel variants of the Volvo S40, V50 and C30 have a four-cylinder 1.8-liter engine (1.8F) producing 125 hp and 165 Nm of torque. The newest Flexifuel market is Thailand, where Volvo offers C30 1.8F and S80 2.5FT. The Swedish market company competed in the 2008 Swedish Touring Car Championship (STCC) with an E85 bioethanol-powered Volvo C30, and finished on 4th position. It aims to win the 2009 season championship.

Further, Volvo Car Sweden has commenced a cooperation with Gothenburg based supplier Alternative Fuel Vehicles, who will modify the V70 2.5FT drivable on E85 or petrol to include also biogas/natural gas and hythane (biomethane with low-blend of hydrogen) as additional fuels for this model – making it a true multi fuel vehicle. Multi fuel Volvo vehicles are also under development or on offer in Italy, Germany and Switzerland by working with external suppliers.

**Volvo Flexifuel System (E85 Bioethanol)**



Volvo S80 2.5FT

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