



Institute of Natural Resources
Department of Fuel Engineering and Chemical Cybernetics

Alternative Fuels: sources, production, types

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• Plan

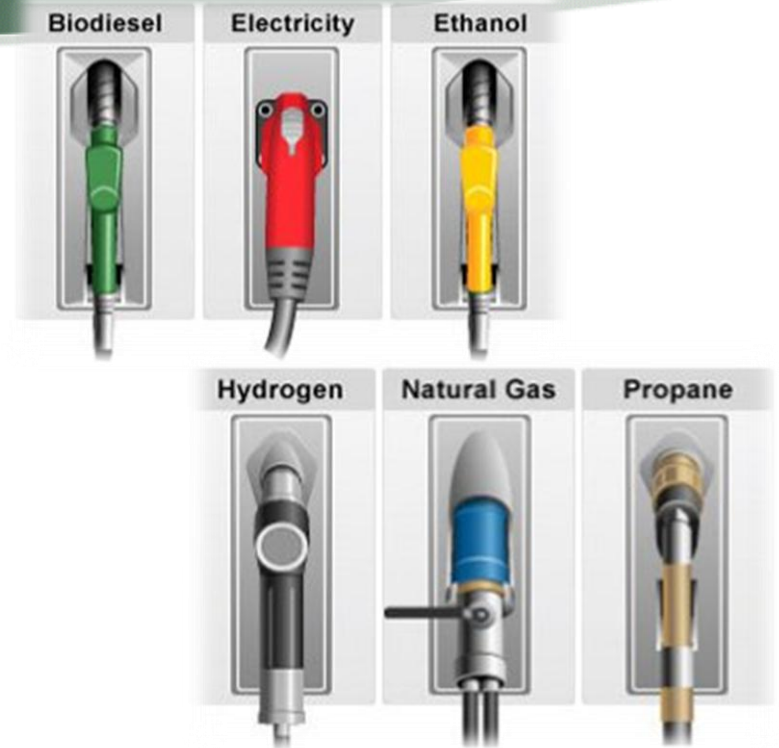
What is Alternative fuel?

Types of Alternative fuels

LPG, CNG and LNG

Methanol, ethanol and Biodiesel

Electricity and Hydrogen



● What is Alternative fuel?

Alternative (non-conventional/advanced) fuels are any materials or substances that can be used as fuels, other than conventional fuels.

Conventional fuels include:

- ✓ oil,
- ✓ coal,
- ✓ natural gas,
- ✓ nuclear materials.



Alternative fuels may be used in a pure form, or in a mixture with other fuels.



● Types of Alternative fuels

➔ **Liquefied Petroleum Gas (LPG)**

➔ **Compressed Natural Gas (CNG)**

➔ **Liquefied Natural Gas (LNG)**

➔ **Methanol (M85)**

➔ **Biodiesel**

➔ **Ethanol (E85)**

➔ **Electricity**

➔ **Hydrogen**

● Types of Alternative fuels

Alternative Fuel Solutions

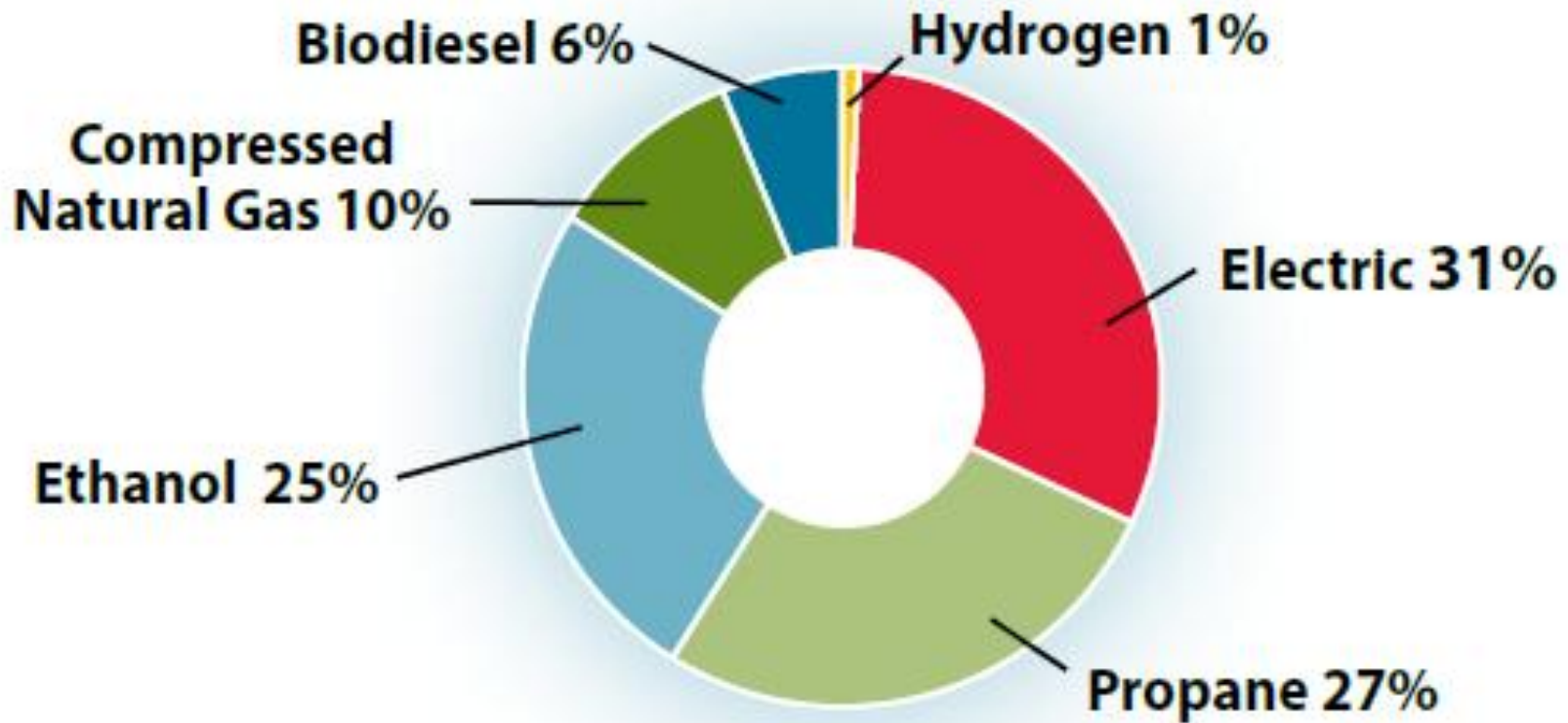


Figure 1. Alternative fuel coverage by percent

Types of Alternative fuels

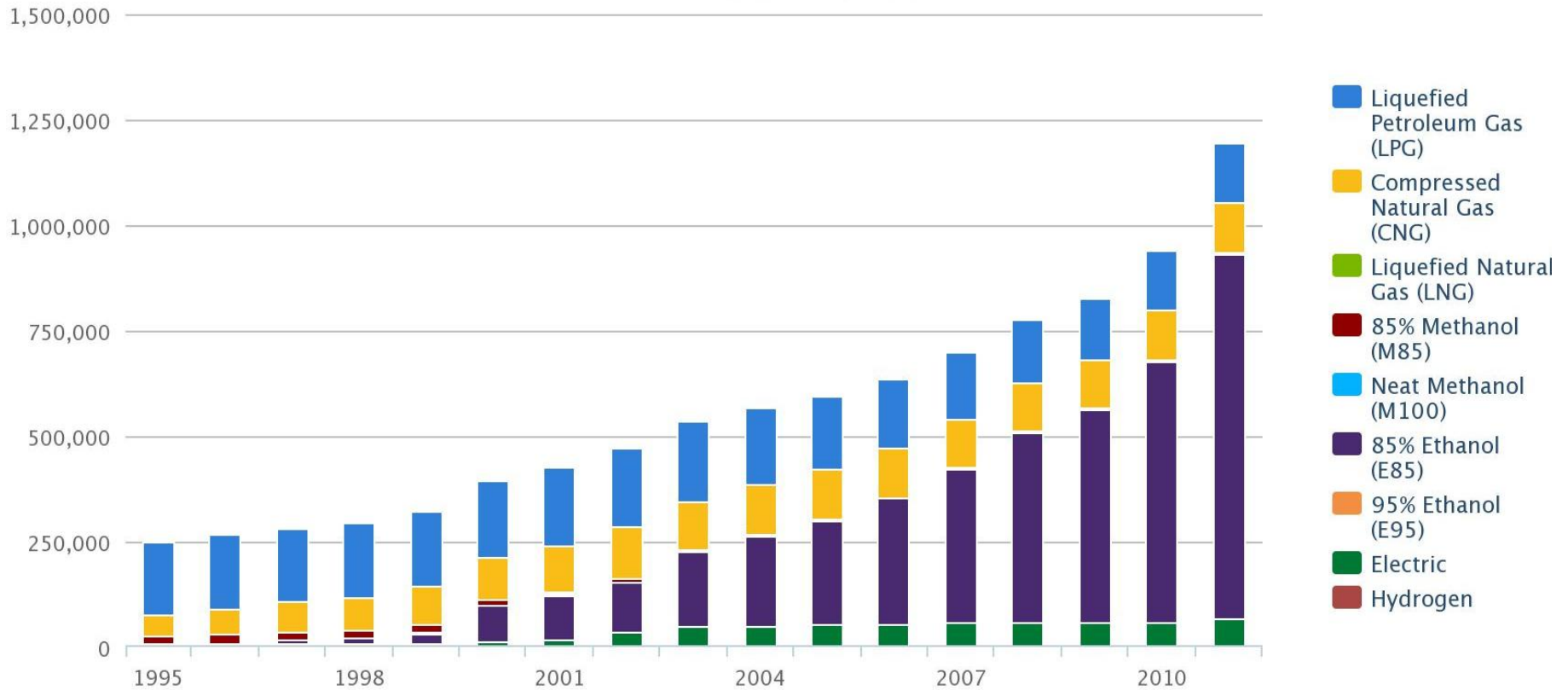


Figure 2. Alternative fuel vehicles in use

● Liquefied Petroleum Gas (LPG) or Propane

Liquefied petroleum gas (LPG)/propane/autogas is a clean-burning, high-energy alternative fuel.

- ✓ is the world's third most common engine fuel;
- ✓ excellent fuel for spark-ignited internal combustion engines.



Propane is produced as a by-product of natural gas processing and crude oil refining.

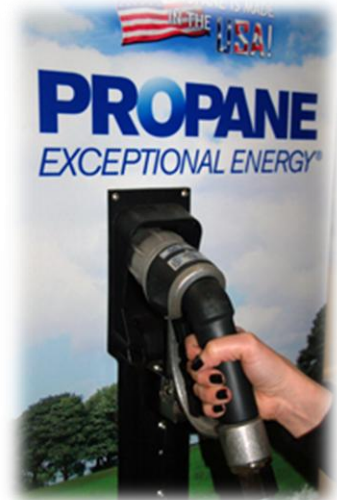
● Liquefied Petroleum Gas (LPG) or propane

Propane is stored onboard a vehicle in a tank pressurized to about 20 times atmospheric pressure.



As pressure is released, the liquid propane vaporizes and turns into gas that is used for combustion.

- ✓ has a higher octane rating than gasoline;
- ✓ has a lower energy content than gasoline;
- ✓ allow the engine to have increased service life.



● Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG)

Because of the gaseous nature of this fuel, when stored onboard a vehicle, it must be in either a compressed gaseous (CNG) or liquefied (LNG) state.

Natural gas is sold in units of:



Gasoline gallon equivalents (GGE)



Diesel gallon equivalents (DGE)



● CNG and LNG



Compressed Natural Gas (CNG)

- ✓ is stored in cylinders at a pressure from 20 to 25 MPa.
- ✓ GGE equals about 5.66 pounds of CNG.
- ✓ is used in light-, medium-, and heavy-duty applications.



Liquefied Natural Gas (LNG)

- ✓ is produced by purifying natural gas and super-cooling it to -260°F to turn it into a liquid.
- ✓ is stored in double-walled, vacuum-insulated pressure vessels.
- ✓ is typically used in medium- and heavy-duty vehicles.
- ✓ GGE equals about 1.5 gallons of LNG.



● Methanol (M85)

Methanol is an alternative fuel for internal combustion and other engines, either in combination with gasoline or directly («*neat*» methanol).

Methanol is made from natural gas or by fermenting biomass.

M85 is a blend of 85% methanol with 15% unleaded premium gasoline.

M85 in comparison with gasoline:

- ✓ fuel system needs to be slightly changed in order to run on M85;
- ✓ has higher octane number;
- ✓ has low energy content (19.7 MJ/kg);
- ✓ more corrosive;
- ✓ burn at lower temperatures and is less volatile.





● Ethanol (E85)

Ethanol is a renewable fuel made from various plant materials collectively known as «biomass».

E85 is a blend of 85% ethanol with 15% gasoline.

E85 in comparison with gasoline:

- ✓ can be used in flexible fuel vehicles;
- ✓ has a higher octane number;
- ✓ providing premium blending properties;
- ✓ contains about 25% less energy than gasoline.





● Biodiesel

Biodiesel is a domestically produced, renewable fuel that can be manufactured from vegetable oils or animal fats.

Biodiesel is used to fuel compression-ignition engines, which run on petroleum diesel.

B100 is a neat biodiesel.

B20 is a blend of 20% biodiesel and 80% petroleum diesel fuel.

B20, B100 in comparison with diesel fuel:

- ✓ safe and biodegradable;
- ✓ reduces air pollutants;
- ✓ usage may require certain engine modifications;
- ✓ usage may not be suitable for wintertime use.

Clean
Responsible
Green
Energy *BioDiesel*





● Electricity

Electricity can be produced from primary energy sources:

- ✓ oil,
- ✓ coal,
- ✓ nuclear energy,
- ✓ moving water,

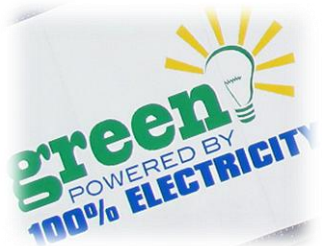
- ✓ natural gas,
- ✓ wind energy,
- ✓ solar energy.



Plug-in vehicles are drawing electricity from off-board electrical power sources (electricity grid) and storing it in batteries.

Onboard rechargeable batteries store energy to power electric motors.

Vehicles that run only on electricity produce no tailpipe emissions.





● Hydrogen

Hydrogen (H₂) is a potentially emissions-free alternative fuel that can be produced from domestic resources.

Hydrogen can be made by:

- ✓ reforming natural gas or another fossil fuel;
- ✓ by using electrolysis to split water into oxygen and hydrogen.



Hydrogen can be used to power fuel cell electric vehicles.

A fuel cell is an electrochemical device that combines hydrogen and oxygen to produce electricity, with water and heat as its by-product.



**Clean, quiet
and highly
efficient
process.**

WHY WE WILL NEVER HAVE THE ULTRA-ALTERNATIVE FUEL CAR.

