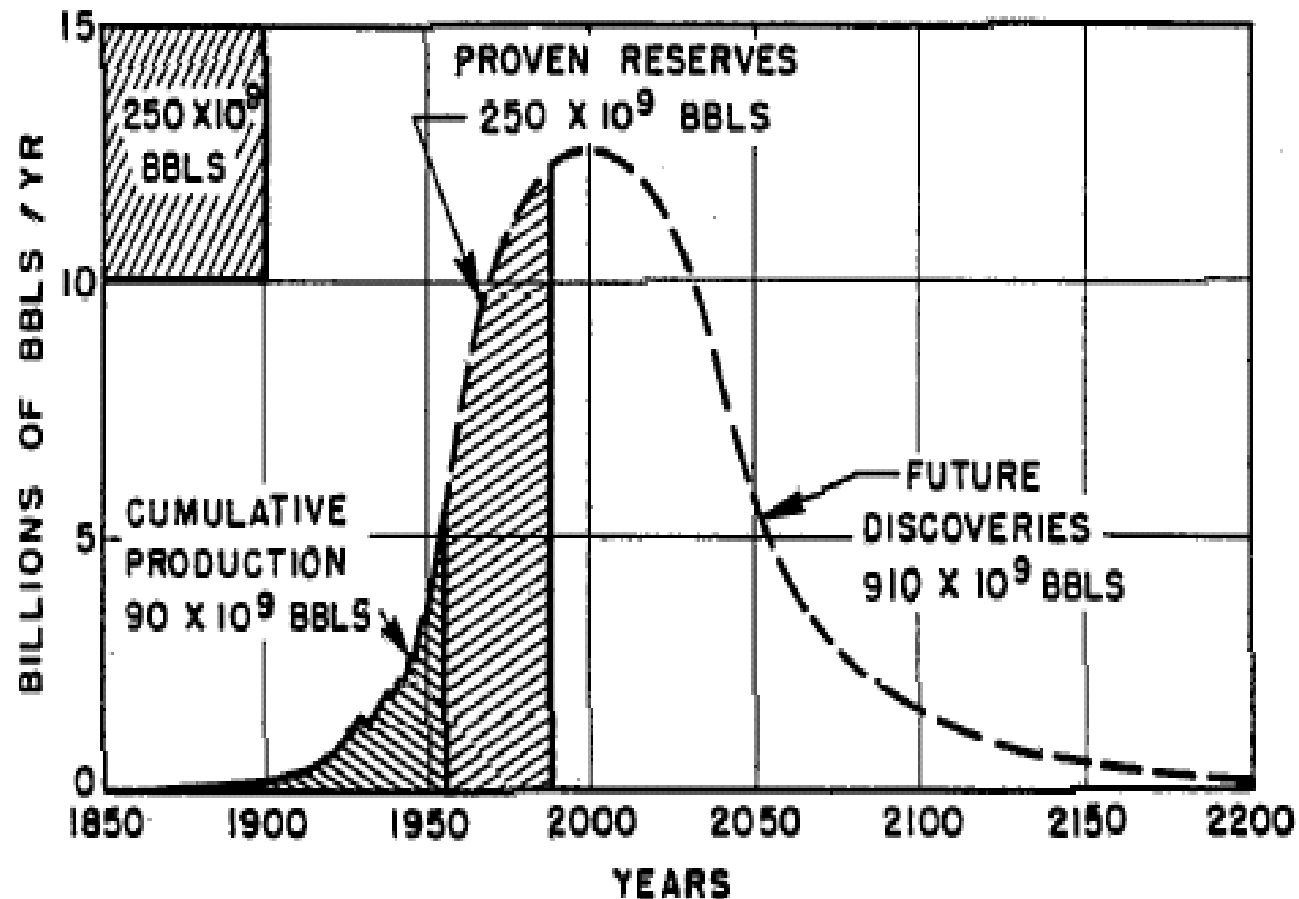


OVER ALL VIEW OF ALTERNATIVE FUELS

IS THERE LIFE AFTER PETROLEUM?

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HUBBERT'S PEAK THEORY



For any given geographical area, from an individual oil field to the planet as a whole, the rate of oil production tends to follow a bell-shaped curve

In 1956, Hubbert proposed that crude oil production in a given region over time would follow a bell-shaped curve without giving a precise formula. The idea is that after oil reserves are discovered, oil production increases exponentially at first as more efficient facilities are installed. At some unique point, a peak is reached and oil production begins an exponential decline.

US oil production peaked in 1971.

WHEN WILL THE PEAK TAKE PLACE?

- U.S oil production peak
- Peak of world oilified discoveries
- Hubbert's estimation for world peak
- Nowadays, the facts are
 - Oil production in decline in 33 out of 48
 - 2 out of 3 largest oil fields have peaked

CLASSIFICATION OF ALTERNATIVE FUELS

- Gasoline type biofuels
- Diesel type biofuels
- Other types of internal combustion
- External combustion
- No combustion

GASOLINE TYPE BIOFUELS

- Ethanol
- Butanol : Alcohol, can be fermented from Biomass,
- Methanol : Easy to manufacture from methane but highly toxic and volatile
- P-Series : Mixture derived from natural gas, not widely used
- Hydrogen

DIESEL TYPE BIOFUELS

- Vegetable oils
 - Waste vegetable oils
 - Straight vegetable oils
- Biodiesel

OTHER TYPES OF INTERNAL COMBUSTION

- Liquefied Natural Gas (LNG)
- Compressed Natural Gas (CNG)
- Propane
- Synfuel : Liquied obtained from natural gas or coal

EXTERNAL COMBUSTION

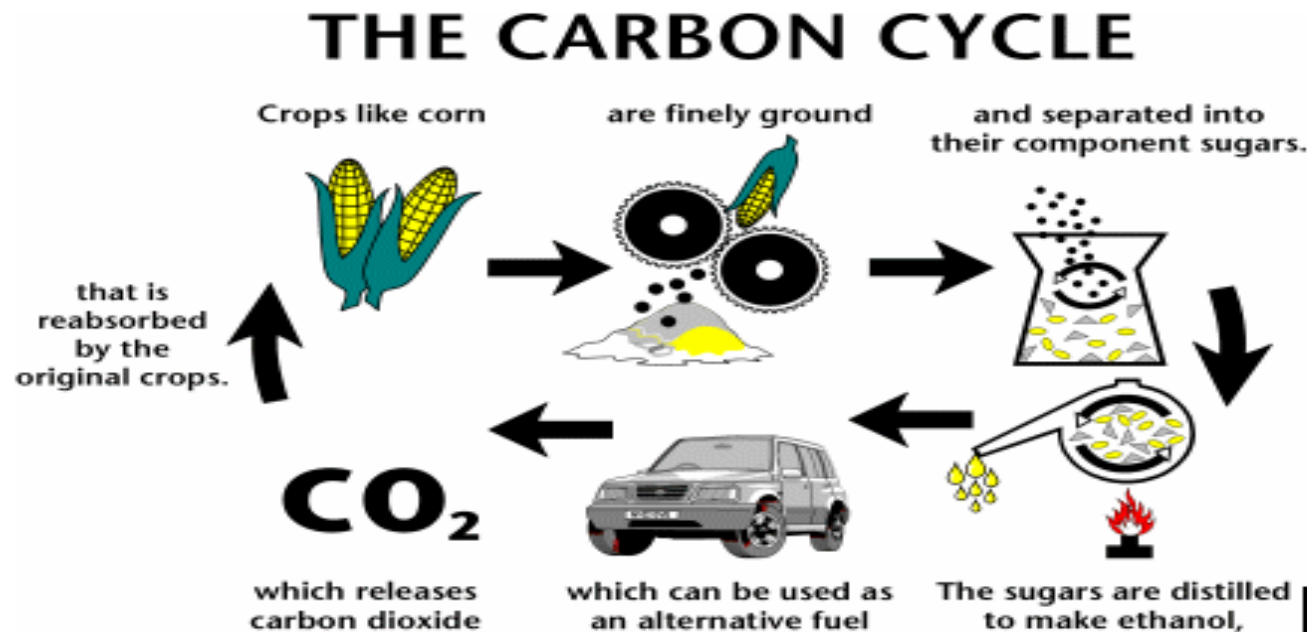
- Steam : Based upon the rankine cycle
- Organic waste

NO COMBUSTION

- Electric : Interesting alternative but dont forget electricity comes from combustion
- Solar cell cars : At first too large for consumer cars, but smaller with time

BIOETHANOL

Alcohol product produced from corn, sorghum, potatoes, wheat, sugar cane, even biomass such as cornstalks and vegetable waste.



BIOETHANOL

- Use in combustion engines
 - Hydrous ethanol
 - Anhydrous (or dehydrated) ethanol
 - ETBE

BIOETHANOL - E100

- Modifications in the engine to use the BioEthanol as pure fuel
 - To increase the relation of compression.
 - To change the mixture of fuel / air.
 - To place spark plugs resistant to major temperatures and pressures.
 - To place conduits resistant to the assault of tar after caulking.
 - To add a mechanism that should facilitate the take-off in cold.

BIOETHANOL - PROS

- Domestically produced
- Burns 10 % more efficiently than gasoline
- FFVs are available and becoming more affordable.

BIOETHANOL - CONS

- Less energy content than gasoline.
- Fueling stations yet difficult to find.
- Production is yet limited.
- Infraestructure for fueling and distribution is yet insufficient.

EXAMPLE OF BIOETHANOL : FOCUS FFV

- 1.8-litre engine
- Produces 70 % less carbon dioxide than its petrol equivalent.
- It develops 123 bhp.
- Fuel E85 is a mixture of ethanol (85%) and petrol (15%).
- Price: 193 973 SEK

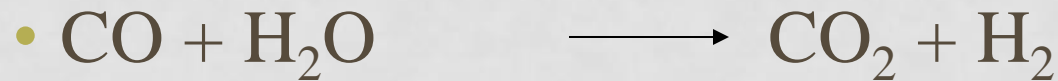


HYDROGEN

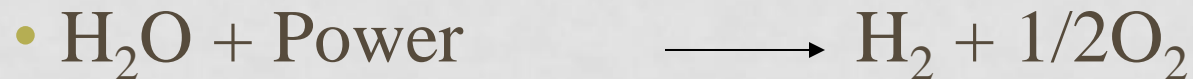
- Is the lightest element
- Is the most abundant element in the Universe
- Is not a direct energy source
- It can be obtained by means of solar energy, eolic or hidraulic electricity.
- Nowadays 95% is obtained from fossil fuels

OBTAINING HYDROGEN

- Reformed with steam



- Water electrolysis



- Photoelectrolysis

OBTAINING HYDROGEN

- Using the biomas
 - Biomass gasification
 - Pyrolysis
- Photobiologic production

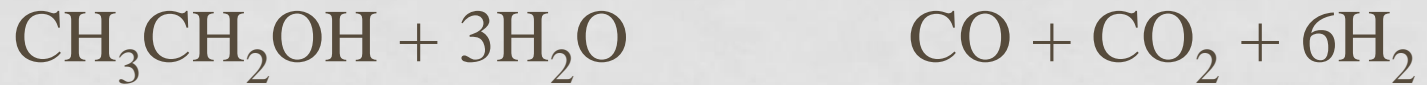
OBTAINING HYDROGEN

- Hydrogen production on board the vehicle

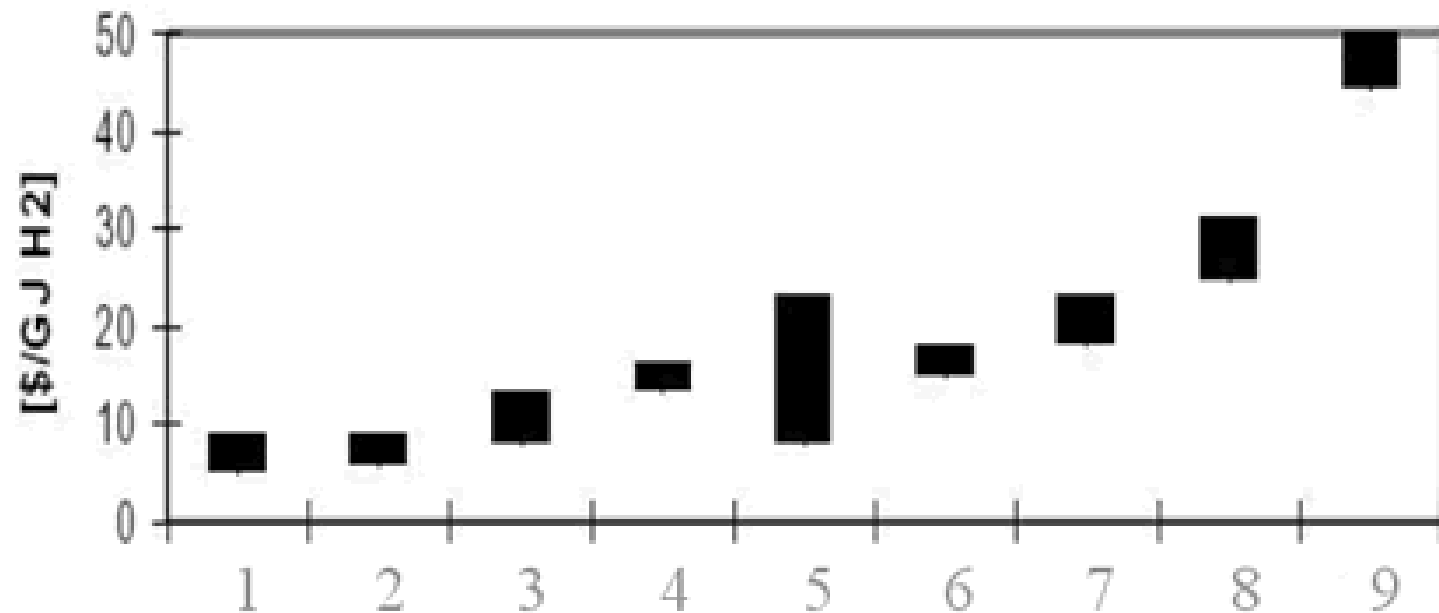
- Using methanol as fuel



- Using ethanol as fuel



PRODUCTION COST OF HYDROGEN



1 Gas Natural-CO₂

2 Carbón-CO₂

3 Biomasa

4 Energía Nuclear

5 Rector de gas de alta temperatura (HTGR)

6 Energía eólica onshore

7 Energía eólica offshore

8 Energía solar térmica

9 Energía solar fotovoltaica

USE OF HYDROGEN IN AUTOMOTION

- Hydrogen combustion in a MCIA
- Fuel batteries

HYDROGEN COMBUSTION IN A MCIA

- **Mazda Rx8 Hydrogen**



HYDROGEN COMBUSTION IN A MCIA

- **BMW 7 Series Hydrogen**



FUEL BATTERIES

- Electrochemical systems where energy from a chemical reaction is directly turned into electricity.
- Hydrogen + Oxygen => Electricity + Water

ADVANTAGES OF USING HYDROGEN AS A FUEL

- Abundant element in the Universe
- High efficiency
- Emission zero of pollutants
- Low working temperatures and pressures
- Silent functioning

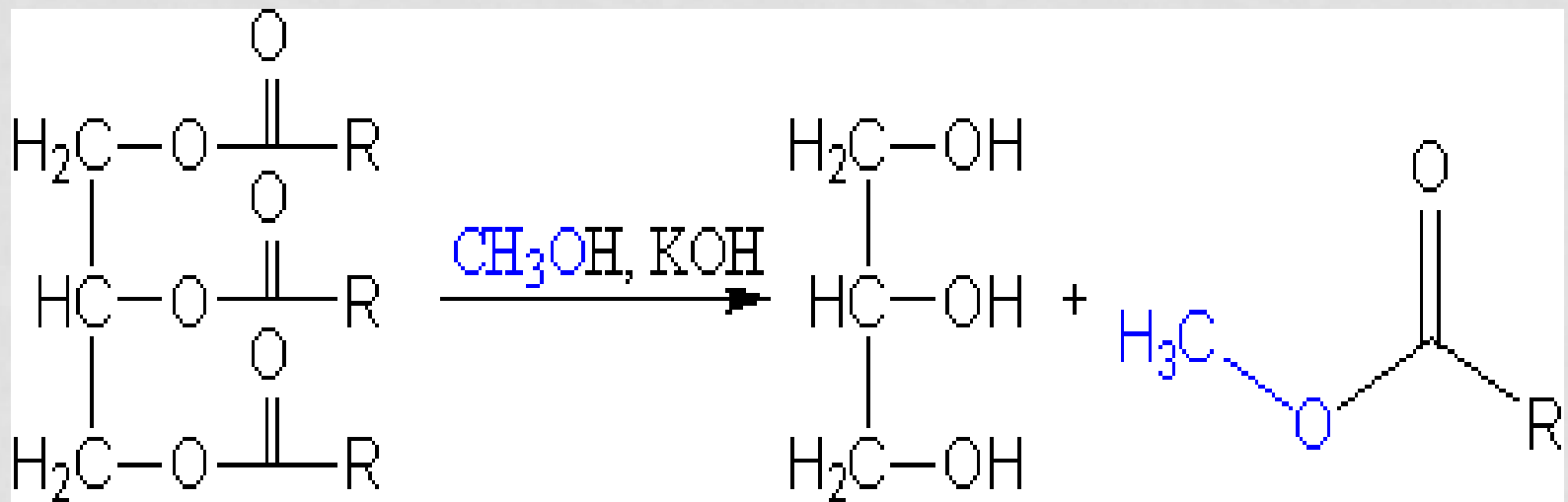
DISADVANTAGES OF USING HYDROGEN AS A FUEL

- It is not a primary source.
- Obtaining pure hydrogen is really expensive.
- High storage and supply costs.
- High weight of fuel cells for the current prototypes
- High energetic expense to liquefy the hydrogen

BIODIESEL

- Diesel equivalent, processed fuel derived from biological sources.
- It is composed by mono-alkyl esters made from the transesterification of both vegetable oils and animal fats.
- Glycerine is produced as a second product.

OBTAINING BIODIESEL



SOURCES FOR BIODIESEL

- Vegetable oils
- Genetically modified vegetable oils
- Waste vegetable oils
- Bad quality vegetable oils

COMPARISON TO PETROLEUM

- Carbon monoxide: -50%
- Carbon dioxide: -78%
- Nitrogen oxide: +20%
 - BUT catalytic converters
- Biodegradable and non-toxic
- The U.S. Department of Energy confirms that biodiesel is less toxic than table salt and biodegrades as quickly as sugar.

NATURAL GAS

- Natural gas is a mixture of hydrocarbons, mainly methane (CH_4).
- Other components: ethane, propane, nitrogen, helium, carbon dioxide, hydrogen sulfide, water vapour,...

PRODUCTION OF NATURAL GAS

- Water or sewage treatment.
- Gas wells.
- Crude oil production

USE OF NATURAL GAS AS A FUEL

- Light-duty applications
 - Natural gas vehicles
- Heavy-duty and medium-duty applications
 - Natural gas engines

ADVANTAGES OF NATURAL GAS

- Carbon monoxide 90 %
- Nitrogen oxide 60 %
- Carbon dioxide (greenhouse gas) 30-40%
- CO and particulate matter > 90 %
- NO_x > 50 %

Advantages of natural gas vehicles compared to gasoline vehicles

CONCLUSIONS

*Our ignorance is not so vast as our failure to use
what we know*

Marion King Hubbert (1903-1989)