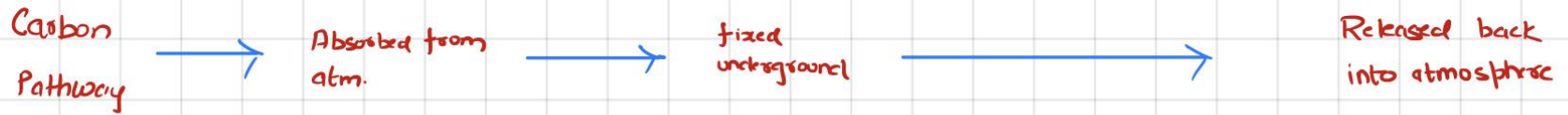
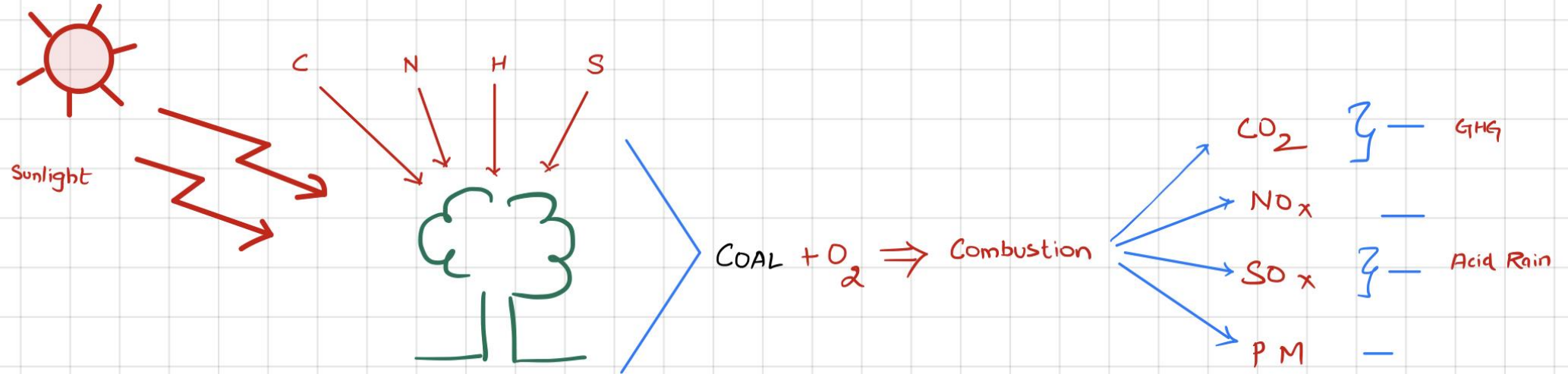
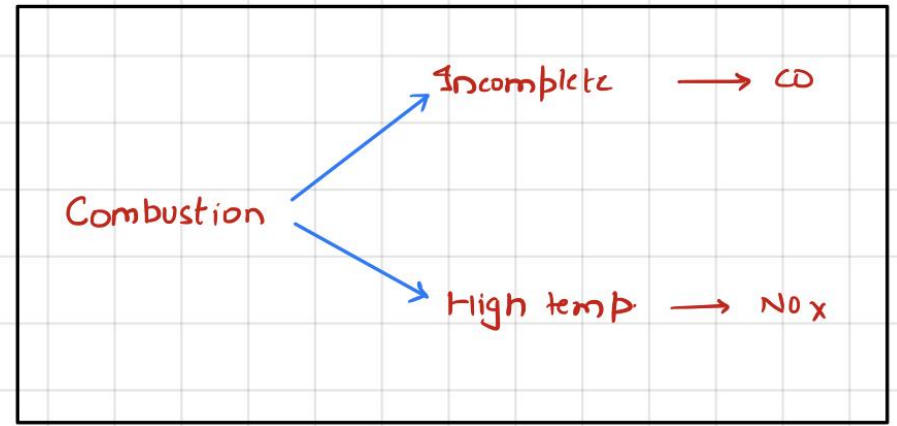
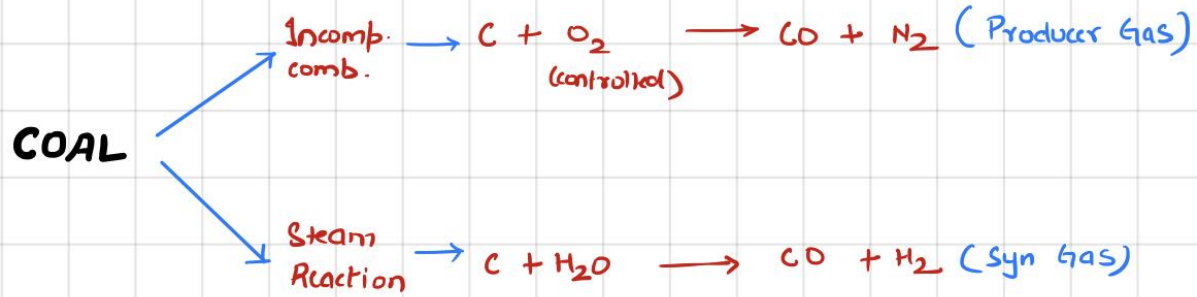


FUELS

FUELS



Coal Gasification



Carbon Sequestration



Geo sequestration

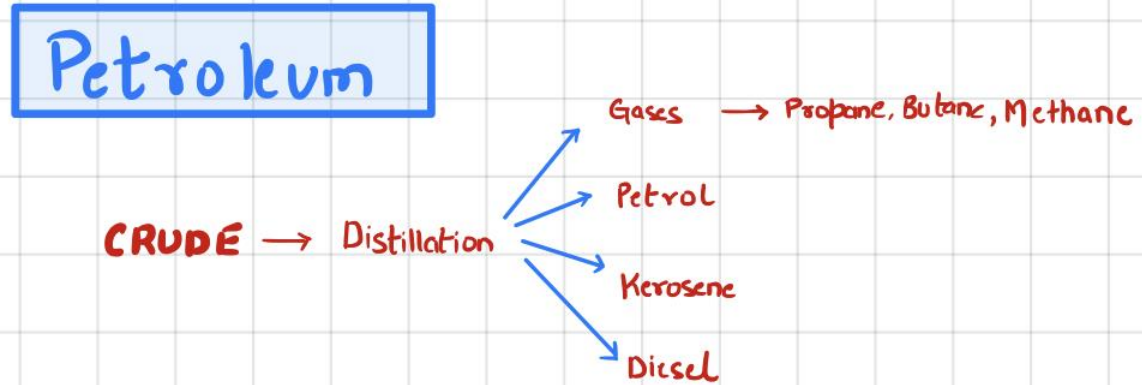
Saline Aquifers

Charcoal / Aquifers

Direct Capture - Algae

Mineral Storage

Enhanced Oil Recovery



Pollutants

Petrol Engine → CO ↑↑

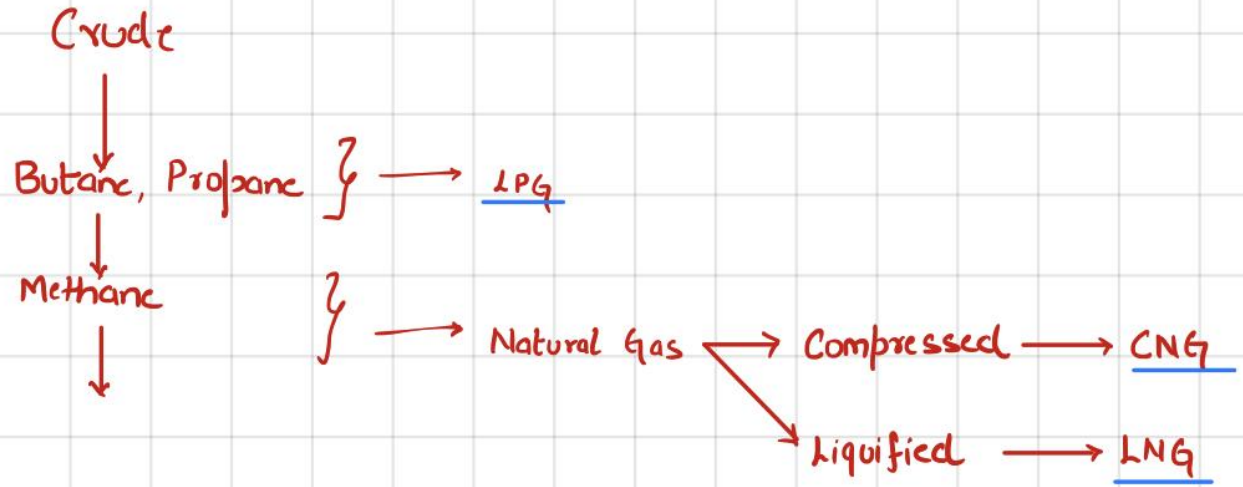
Diesel Engine → NO_x ↑↑, PM ↑↑

Pollution Control

- Low Sulphur Oil
- Selective Catalytic Reduction

Alternative Fuels

GAS



LIQUID

- Methanol : Syn Gas → Methanol.
- Di-methyl Ether

Hydrogen

Adv.

Low/No pollution

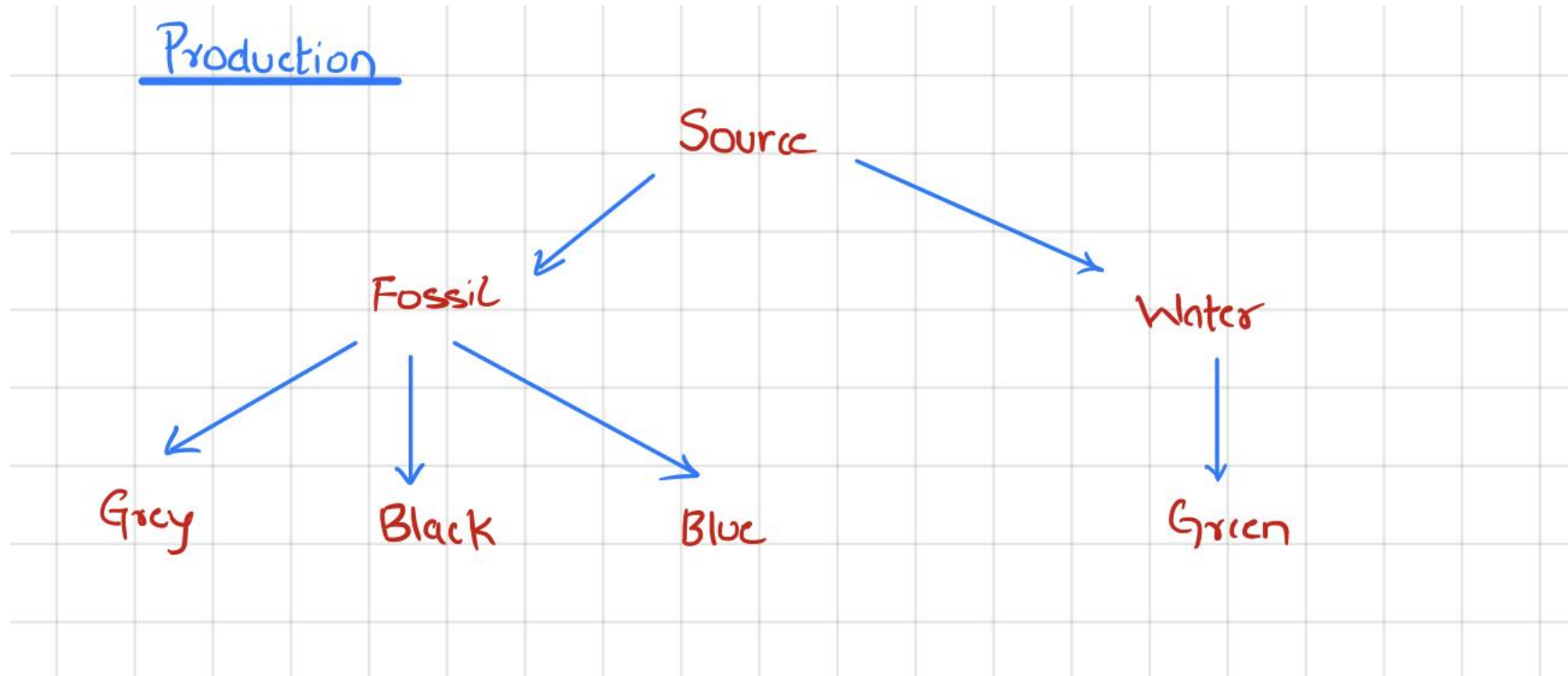
Ubiquitous Avail.

High energy density per gram

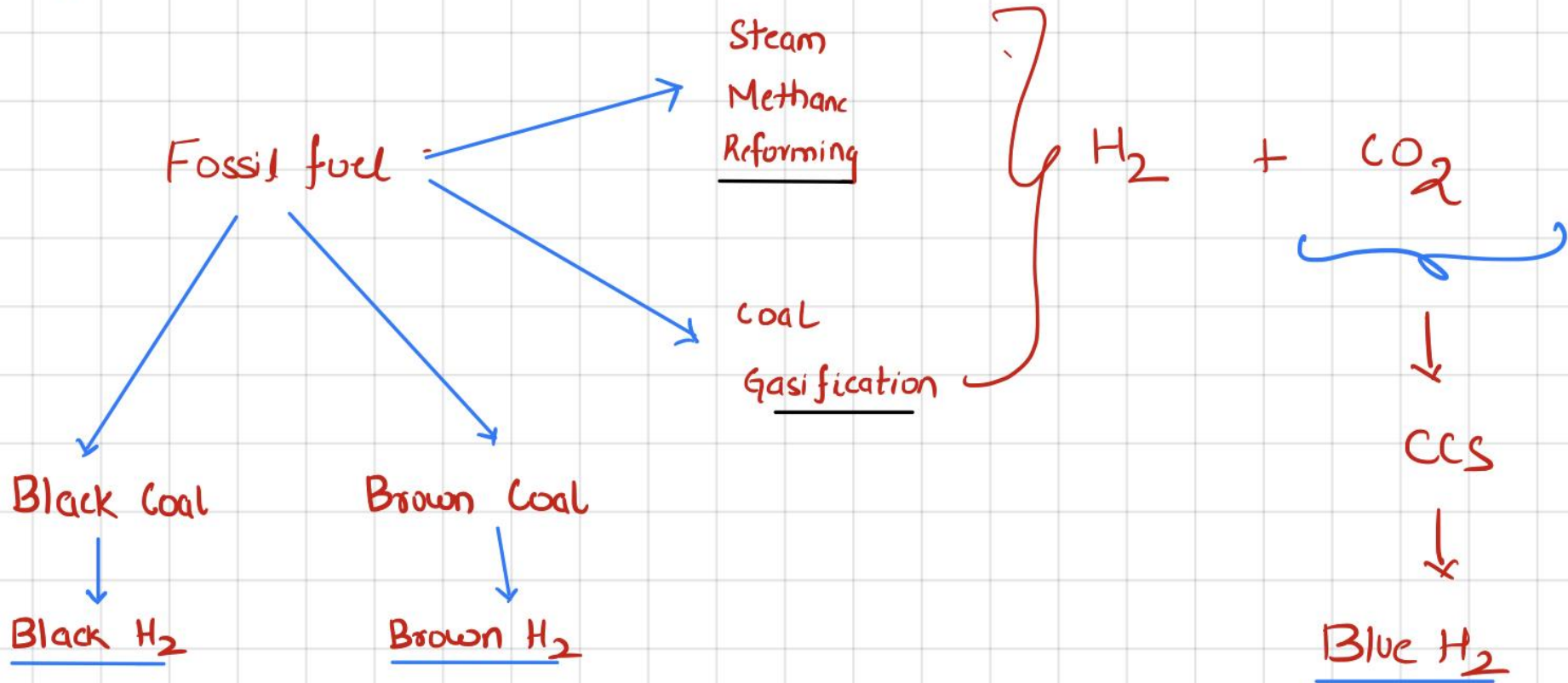
Disadv.

Cost. of extraction

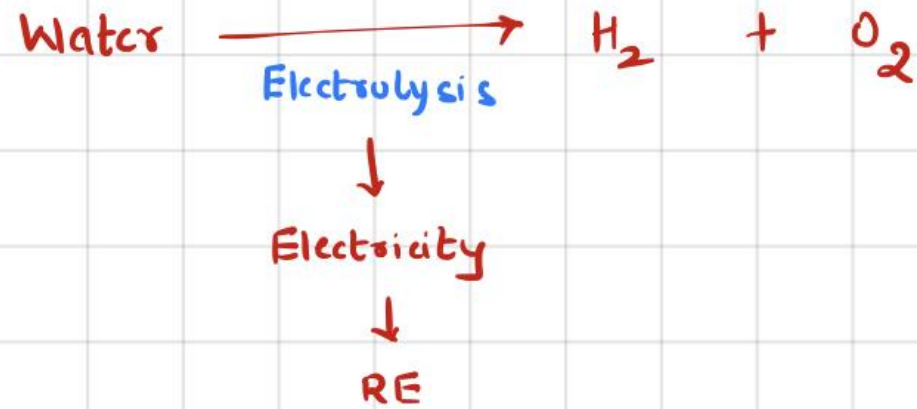
Low energy density per volume



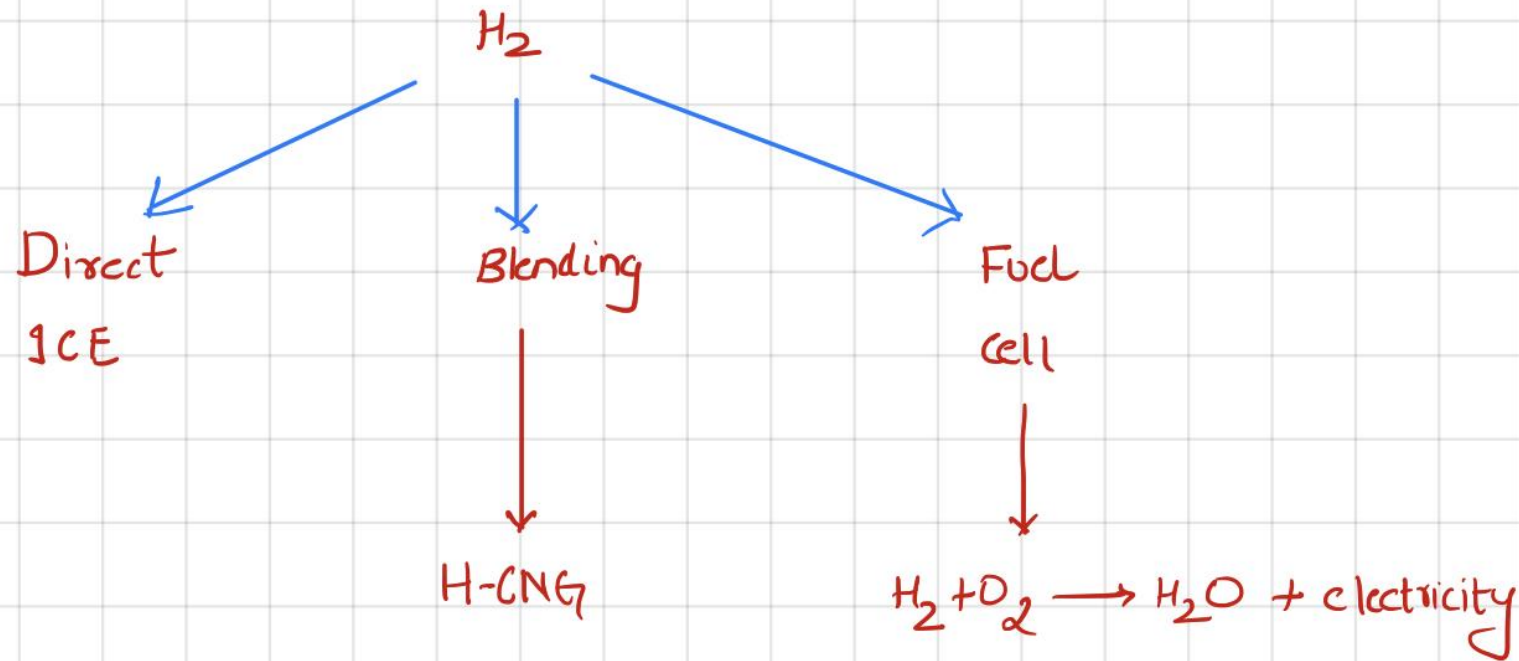
Grey H₂



Green H₂

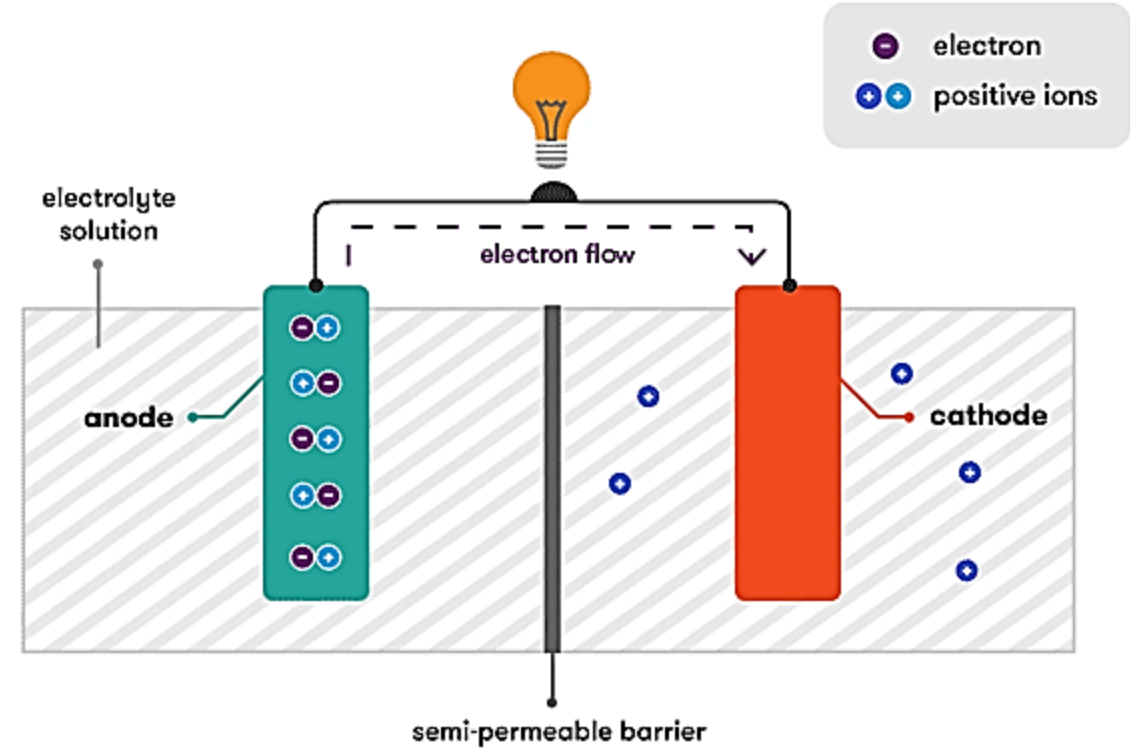
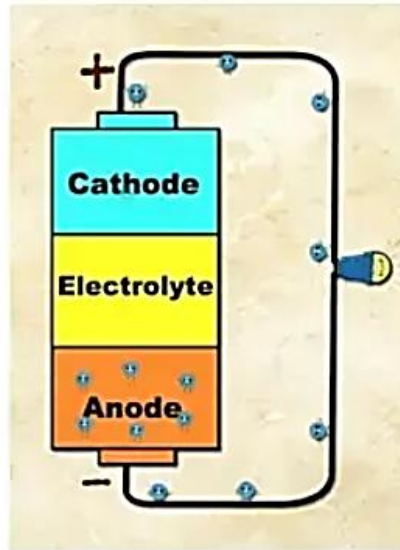
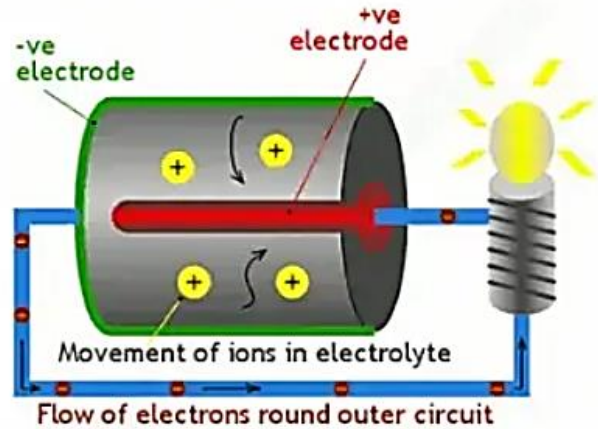


Usage

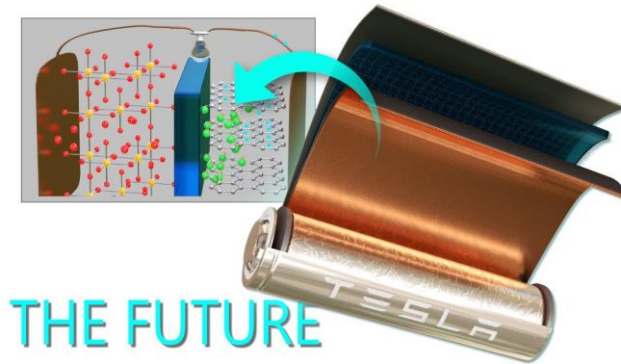
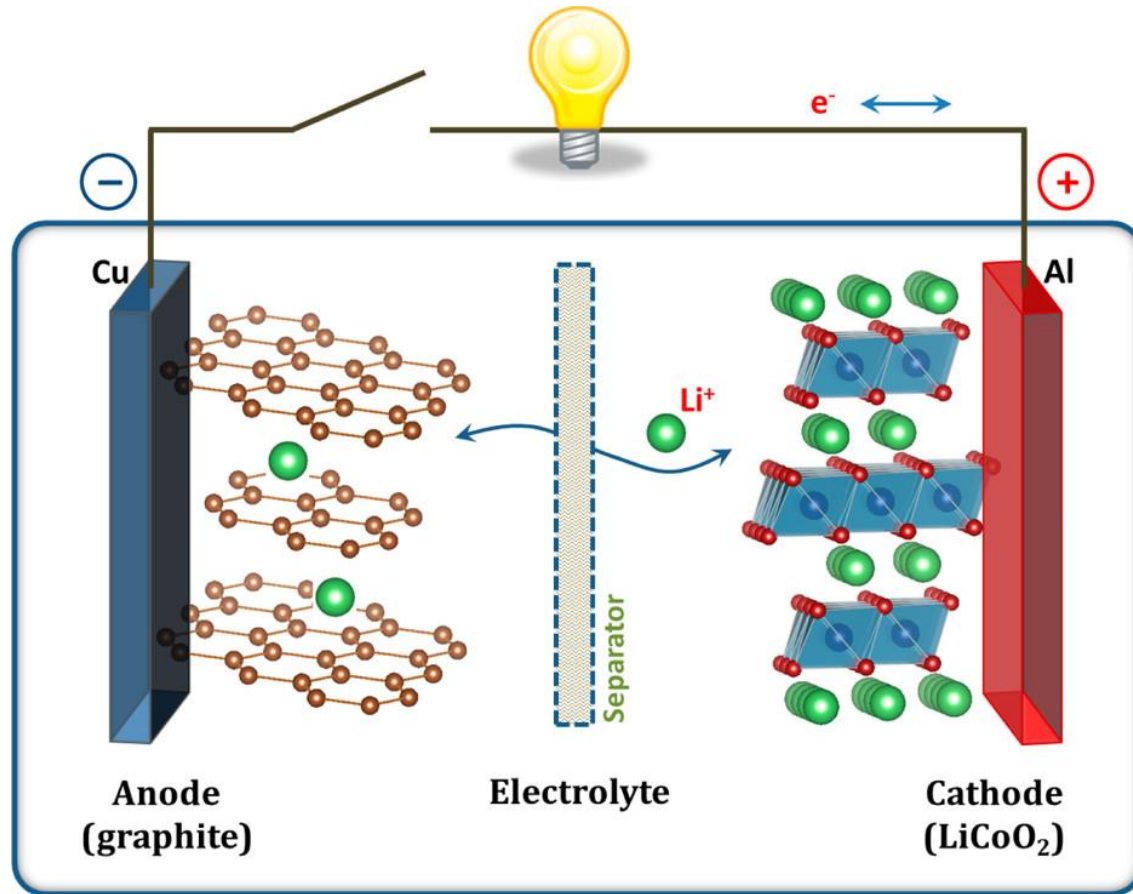


Batteries

How Does a Battery Work?



Li – Ion battery



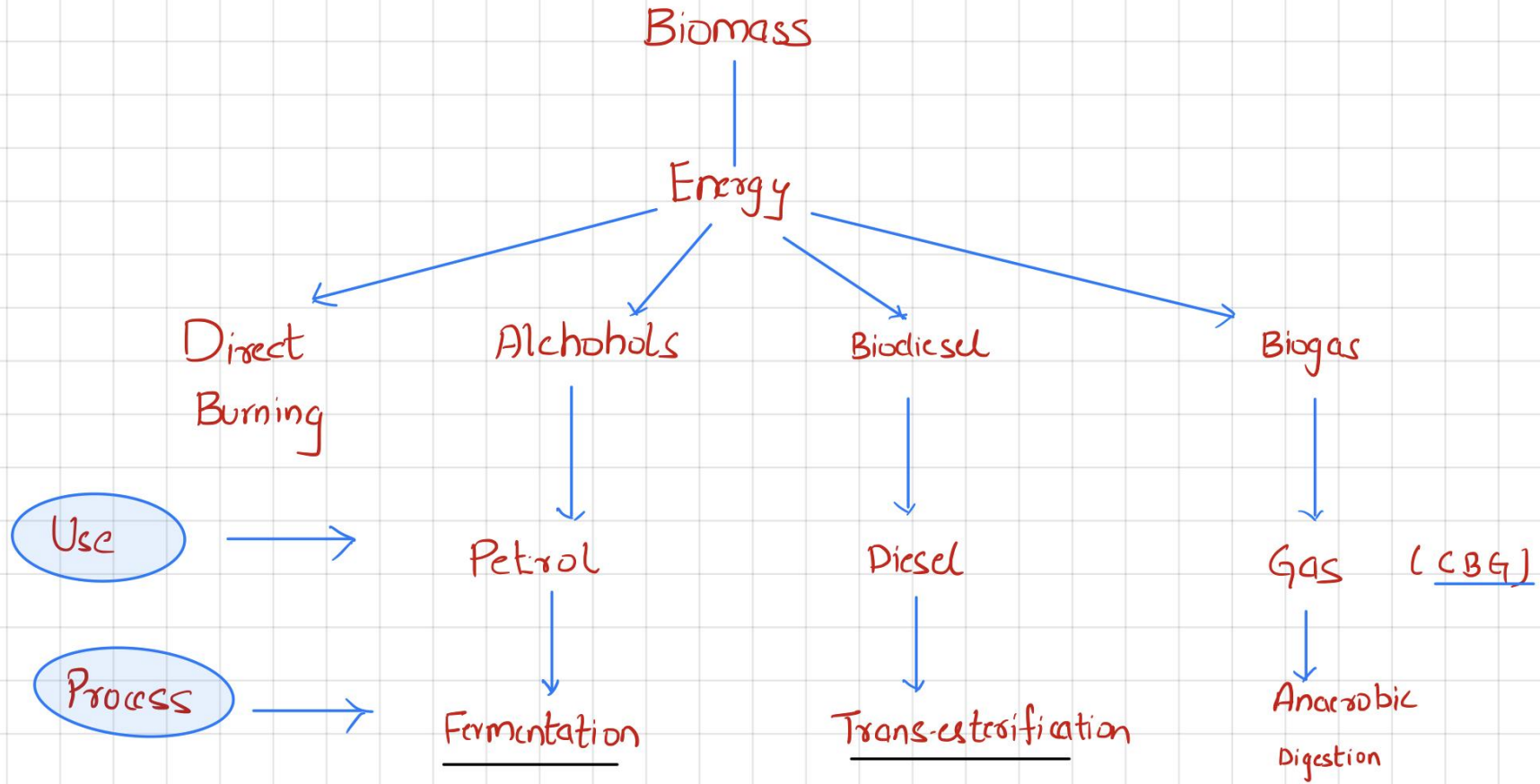
THE FUTURE

Li	→	3.04 V
Mg	→	2.37 V
Al	→	1.66 V
Zn	→	0.76 V
Fe	→	0.44 V
H	→	0 V
Hg	→	-0.24 V
Cu	→	-0.34 V
Ag	→	-1.69 V
F	→	-2.8 V

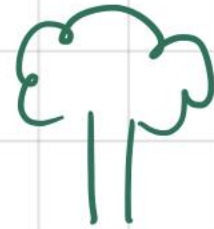
Sodium Ion battery

CHARACTERISTIC	Na-ion	Li-ion
Energy density	70-160 W h/kg, with potential to go to 200 W h/kg	Ranging from about 150 W h/kg for lithium-iron-phosphate cathodes to 275 W h/kg for nickel-manganese-cobalt cathodes
Manufacturing	Yet to be manufactured at commercial scale	Proven at scale and in high-performance cars
Raw material cost	Sodium hydroxide is \$300-\$800 per metric ton	Lithium hydroxide is \$78,000 per metric ton
Safety	No risk of thermal runaway	Can overheat and catch fire
Cycle life	Some developers have struggled to overcome performance fade	Steady performance over a high number of cycles
Performance at low temperature	Maintains >90% performance at -20 °C	Drops considerably in cooler temperatures
Recyclability	Simple recovery process	Complex separation of metals may be required

BIOFUELS



Biomass



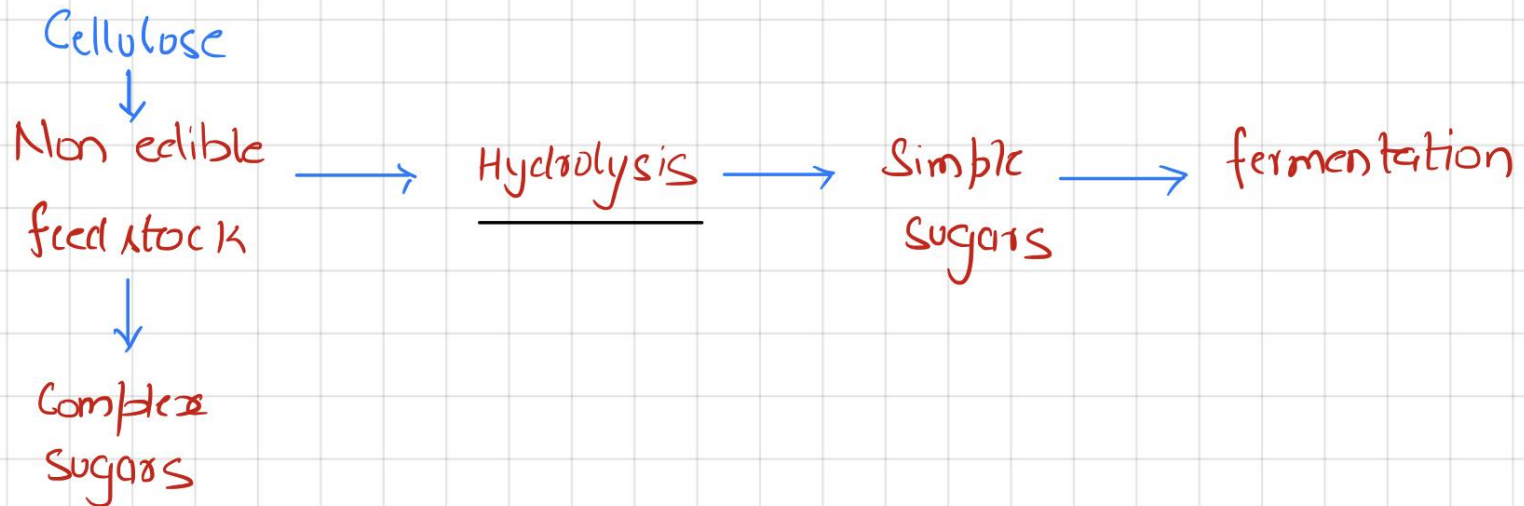
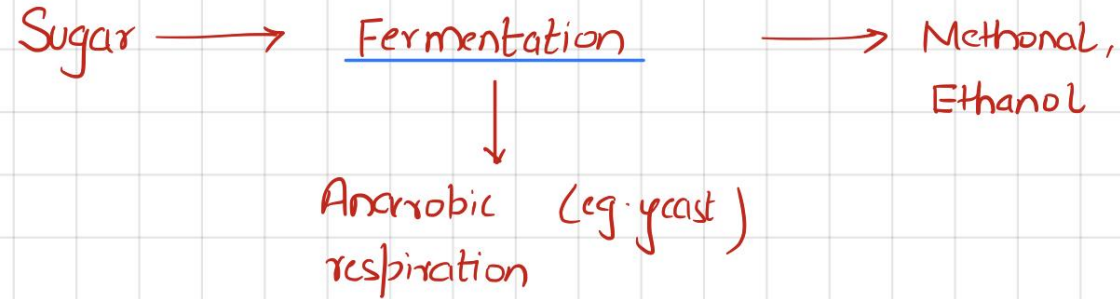
Sugar Polymers

Cell Wall

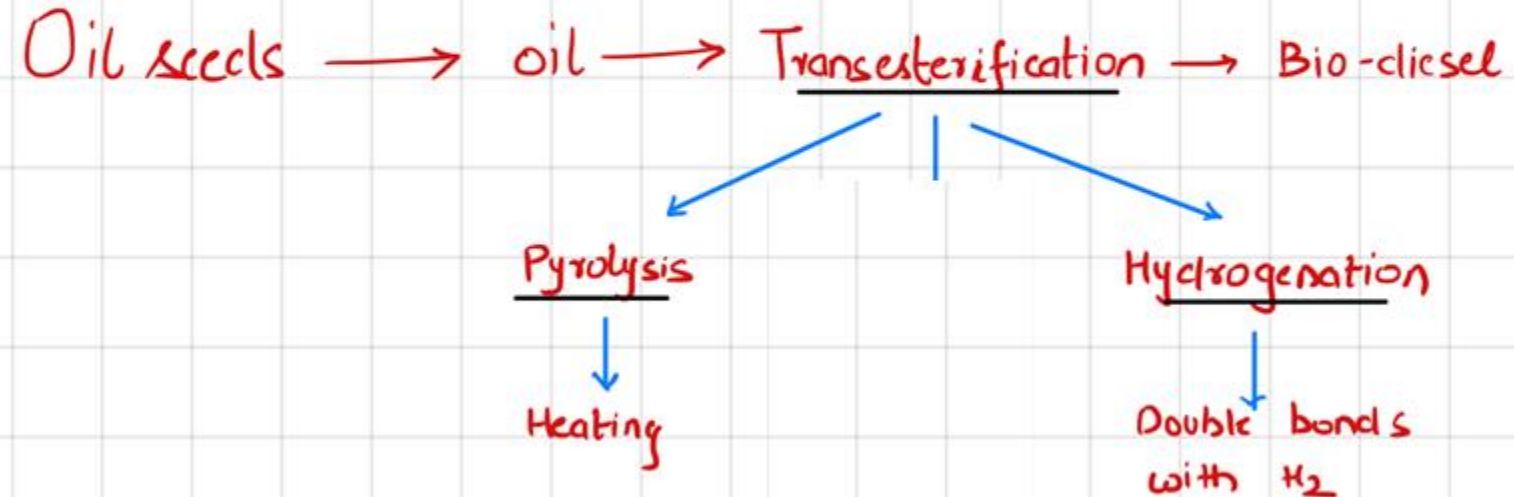
Cellulose

Lignin

Alcohols



Bio Diesel



Generations

