INTEGRATED ENGINEERING SOLUTION

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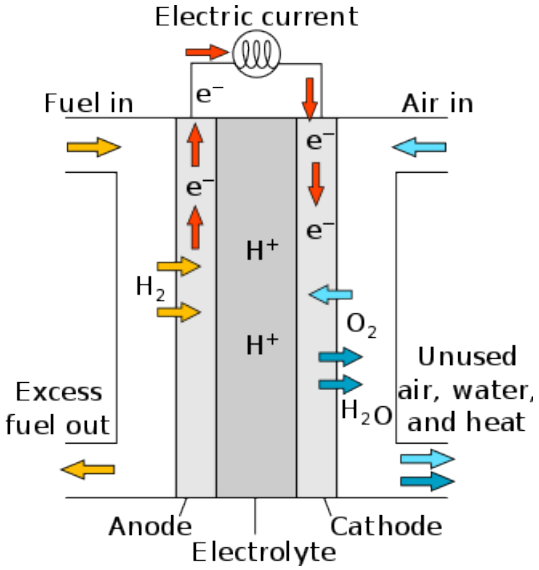
The Introduction of Fuel Cell

Fuel Cell – clean energy source, a solution for net-zero emissions electricity generation era. It converts chemical energy of a fuel (i.e. hydrogen, natural gas, methanol, etc.) to electricity through electrochemical reaction with an oxidizing agent (i.e. oxygen molecules, found in air). Similar to battery, it contains an anode and cathode for electrons to pass through and create a current flow. However, the major difference is that with continual fuel supply, fuel cell generates energy continuously, whilst battery is an energy storage device.



When a hydrogen atom from the fuel source contacts with the negative anode catalyst layer, it splits into a proton and an electron. Proton will be transported from the anode to cathode through electrolyte. On the other hand, the disassociated electron will flow from the anode to cathode through an external circuit, hence creating an electrical current. Water and heat are the biproducts of the electrochemical reaction.

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Types of fuel cells being developed for use in building

1. Phosphoric Acid Fuel Cell (PAFC)

Phosphoric Acid Fuel Cell (PAFC) uses a phosphoric acid electrolyte was the first fuel cell to be commercialized. Because of ionic conductivity of phosphoric acid is relatively low at low temperatures, PAFC is usually operated at around 150–220°C.

Pros:
- High power density and can be responsive to changing electrical loads
- Efficiency can rise to 80% when operated in cogeneration application

Cons:
- Relatively high start-up time; high cost of the catalyst

2. Proton Exchange Membrane Fuel Cell (PEMFC)

PEM fuel cell uses a solid polymer membrane (a thin plastic film) as the electrolyte. Compared to other types of fuel cell, PEMFC generates more power for a given volume or weight of fuel cell. This high-power density characteristic makes PEMFC compact and lightweight, which is widely used in transportation

PEMFC has the lowest operating temperature at around 90°C – with a high purified fuel source. By applying natural gas as a fuel and to be 'reformed'.

PEMFC is only at the development stage for use in buildings.

Pros:
- Light in weight and easy for potable
- Fast start-up time
- More economical

Cons:
- Low electrical efficiency at around 40%
- Requirement of high purity of fuel source

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3. Solid Oxide Fuel Cell (SOFC)

SOFC constructed by hard ceramic electrolyte in which the operating temperature is up to 980°C. It is suitable for different type of fuel gas (such as natural gas)

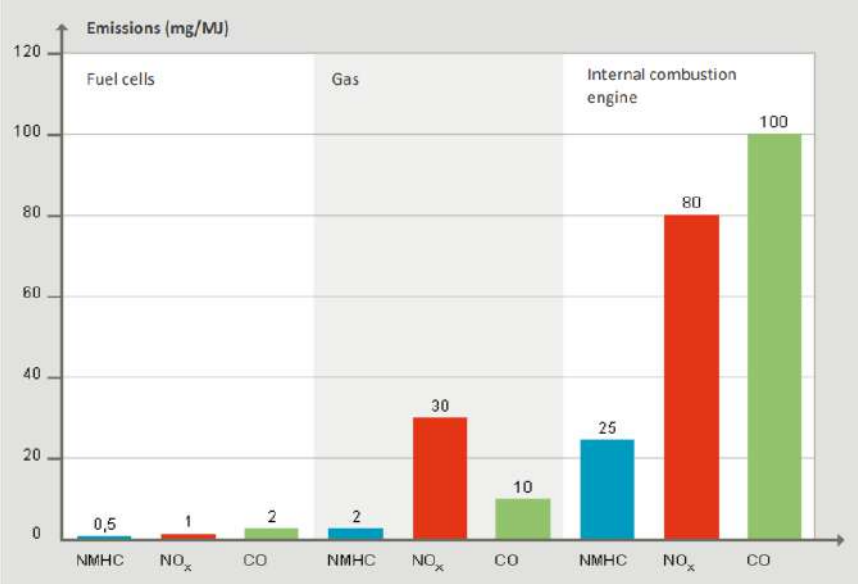
SOFC suits a wide range of applications from household units up to 1MWe capacity. It is developing in application of commercial projects.

Pros:

- High gas output temperatures are more suitable for absorption heating systems
- Higher electrical efficiency (around 50%)
- More economical.
- Can reach efficiency of 85% within a CHP system

Cons:

- Produces emissions
- Relatively un-tested
- Higher operating temperatures require longer start-up times (typically 8 hours)



Pollutant Emission

What's Next

The Introduction of Combined Heat and Power