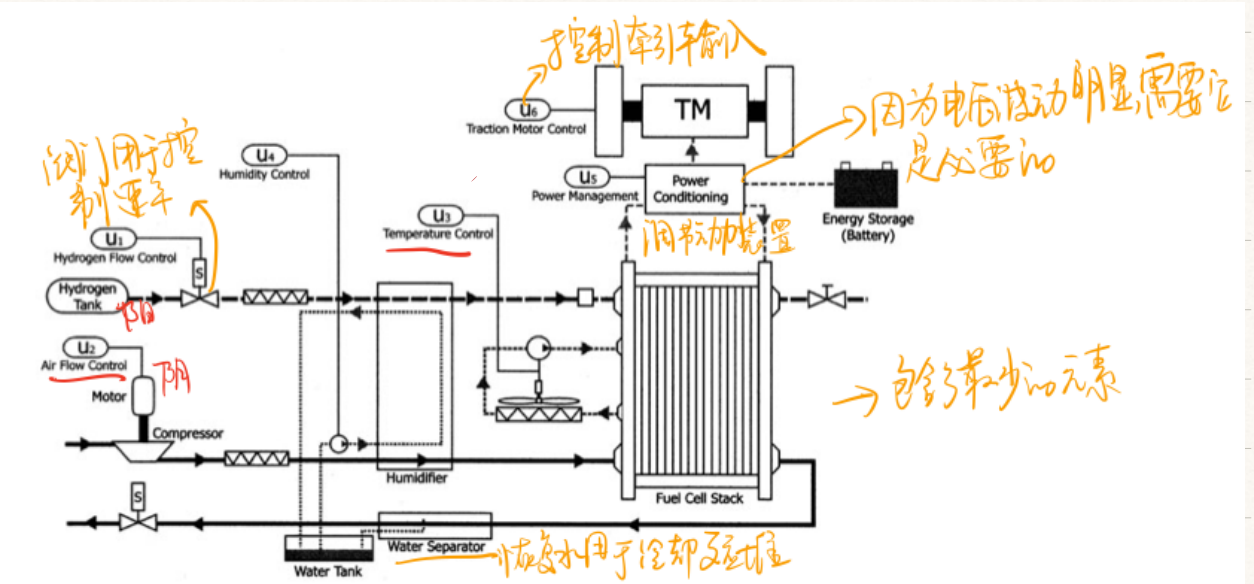
FC { hydrogen supply to the anode
air supply to the cathode
de-ionized water serving (coolant)
de-ionized water serving to the humidifier.



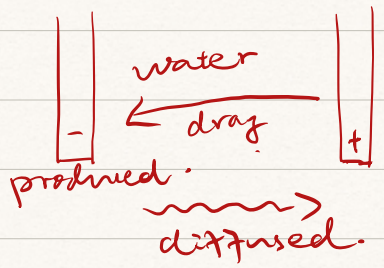
reactant flow rate < valve for hydrogen flow rate
total pressure / compressor motor for airflow
reactant partial pressure
temperature - water pump/radiator fan speed
membrane humidity - humidifier.
* changes in the parameters are not independent

Subsystem { reactant flow
heat & temperature
water management
power management

Reactant flow: hydrogen & air supply loops.
adjust using a positive-pressure flow device.

Heat and Temperature Subsystem
{ fuel cell stack cooling
reactant temperature system
1. de-ionized water used as the coolant
2. PEMFC is designed to work at around 80°C
=> Heat rejection
3. adjust cooling fan and ele recirculation pump speed
=> fast warm-up with no stack temperature overshoot and low auxiliary fan and pump power.

Water Management system: maintain hydration of the polymer membrane & balance water usage/consumption



20% ~ 100% possibly drop.

Power Management: Assist PEMFC
giving satisfactory vehicle transient response.

Fuel Processor

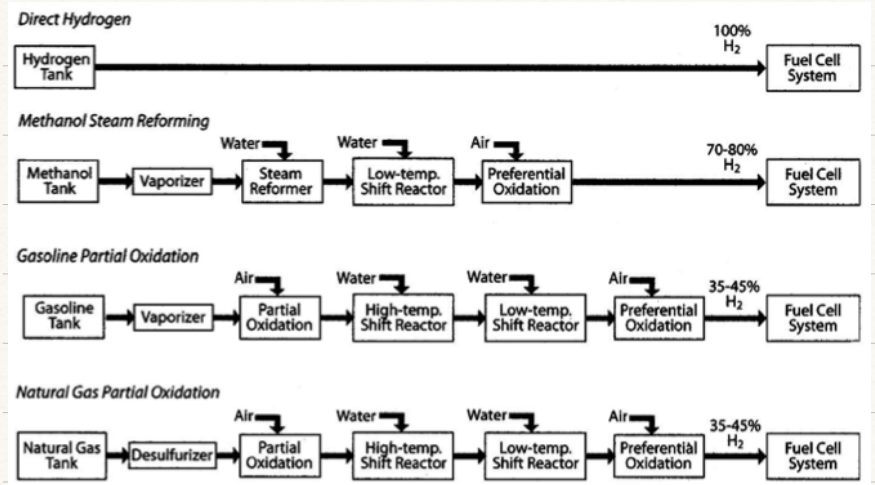


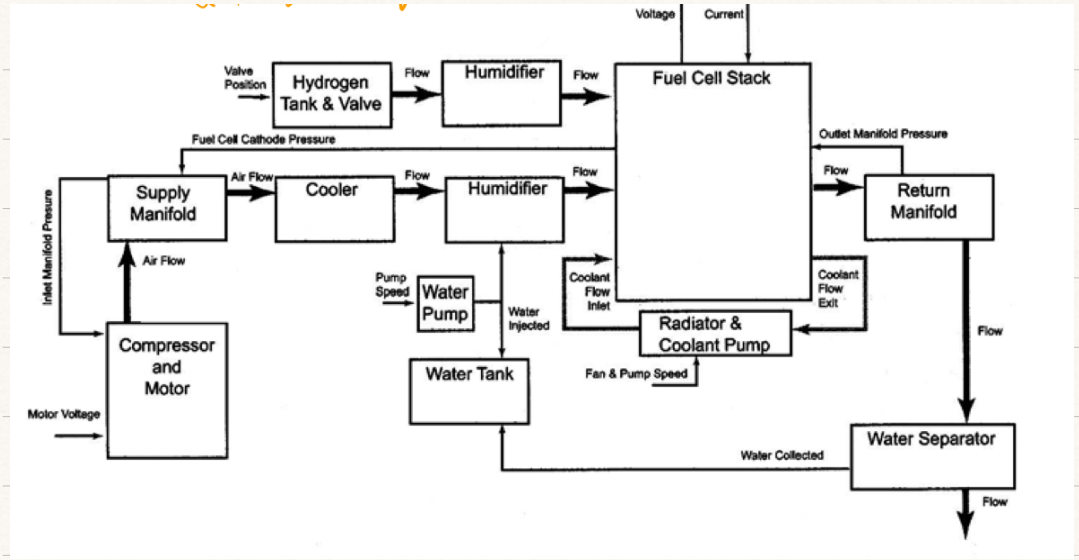
Fig. 1.6. Fuel sources for fuel cell systems [18, 23]

models: { detailed FC models based on partial differential equations.
steady state FC model based on experimental maps/look up tables.
dynamic FC system models neglect spatial variations

Auxiliary components.

{ Electrochemistry (10^{-19} sec) ← ignore
Hydrogen and air manifolds (10^{-1} sec)
Flow control/supercharging device (10^{0} sec)
Vehicle inertia dynamics (10^{1} sec)
Cell and stack temperature (10^{2} sec)
Membrane water content (unclear)

} must be considered.



Compressor Model { static compressor map
compressor & motor inertia.