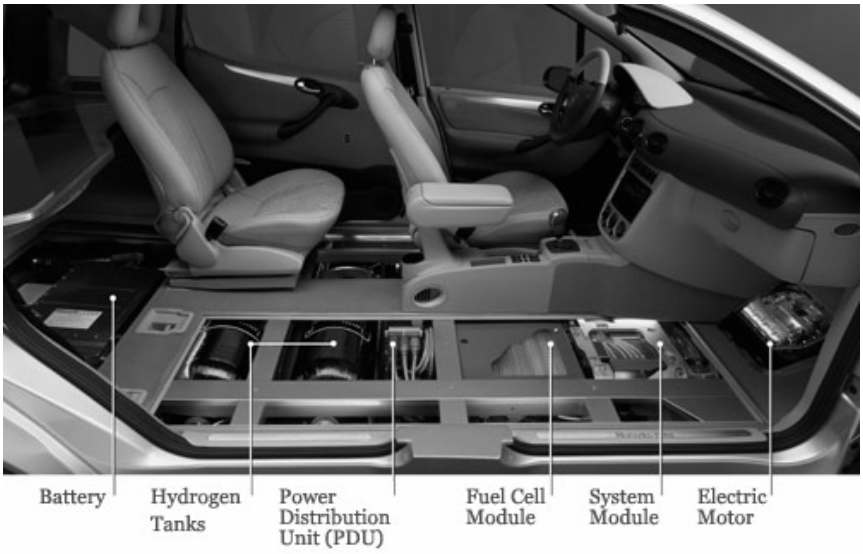
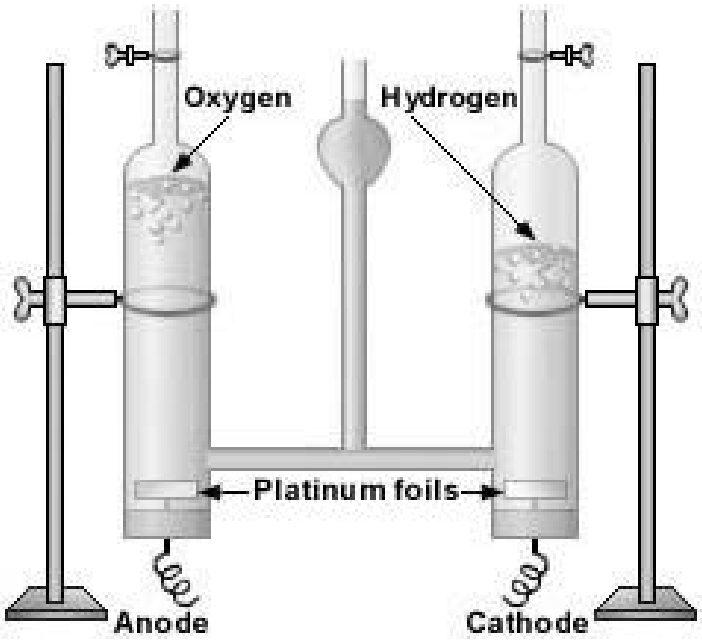
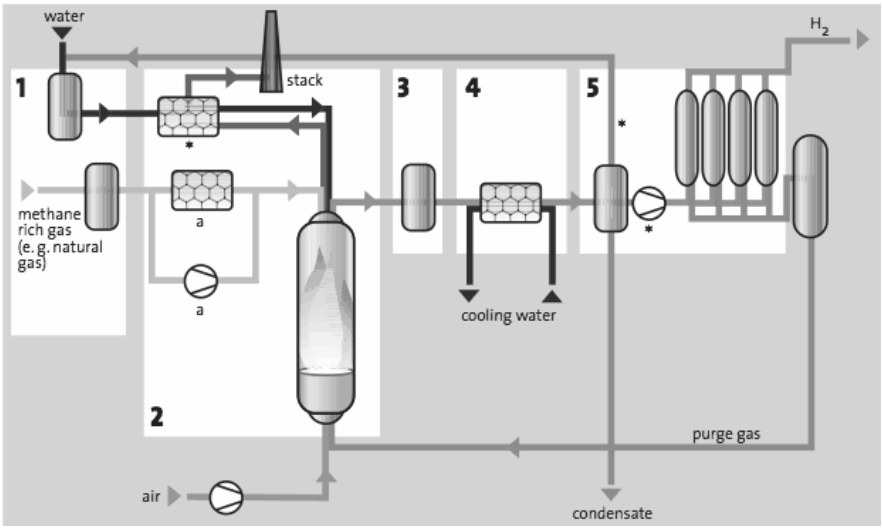
Fuel Cell Vehicles: A Viable Alternative?

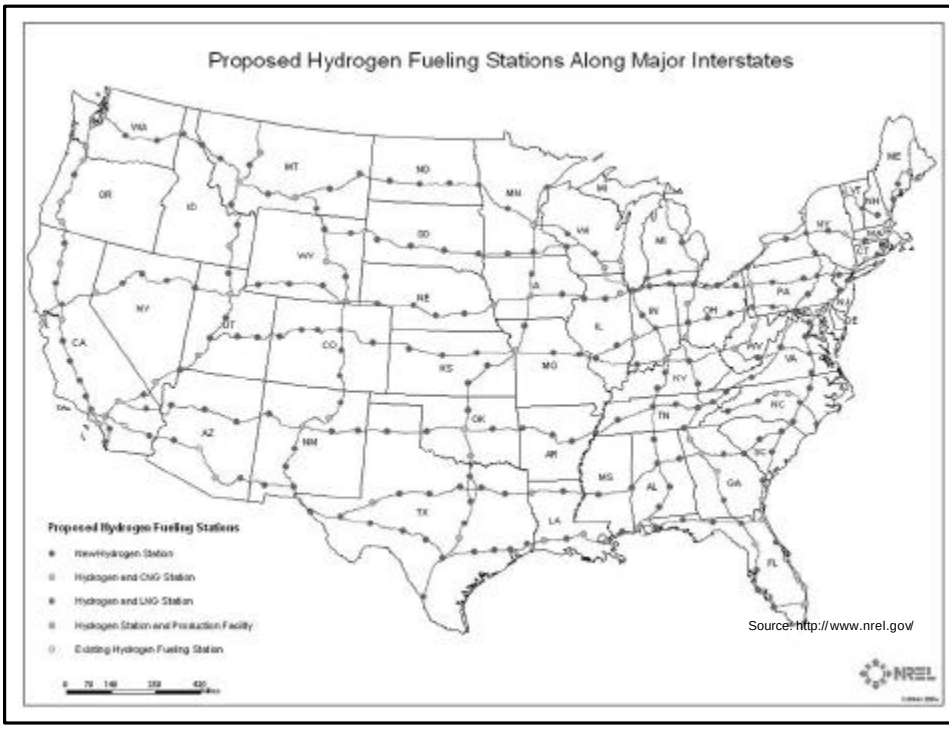


Electrolysis of H_2O

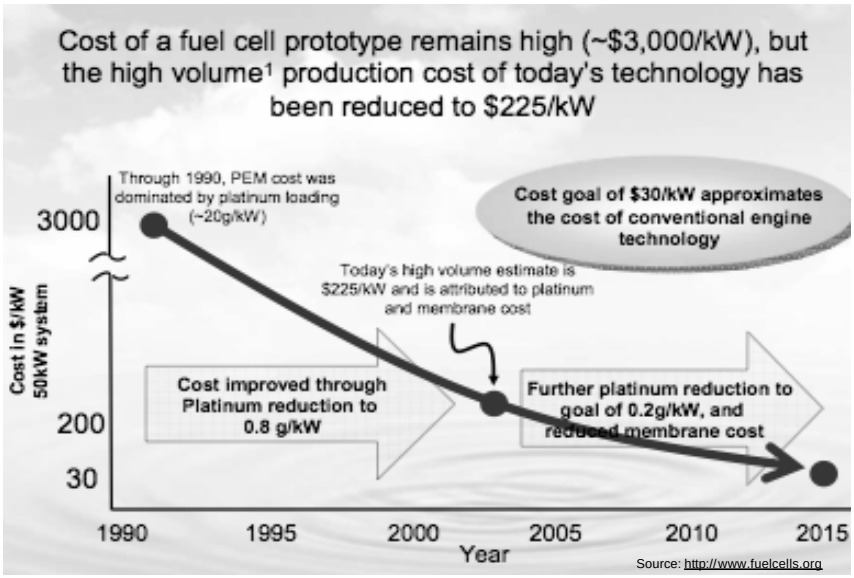


Steam Reforming of Natural Gas





Cost: Can FCVs become affordable technology?



Technological Challenges

Onboard Storage

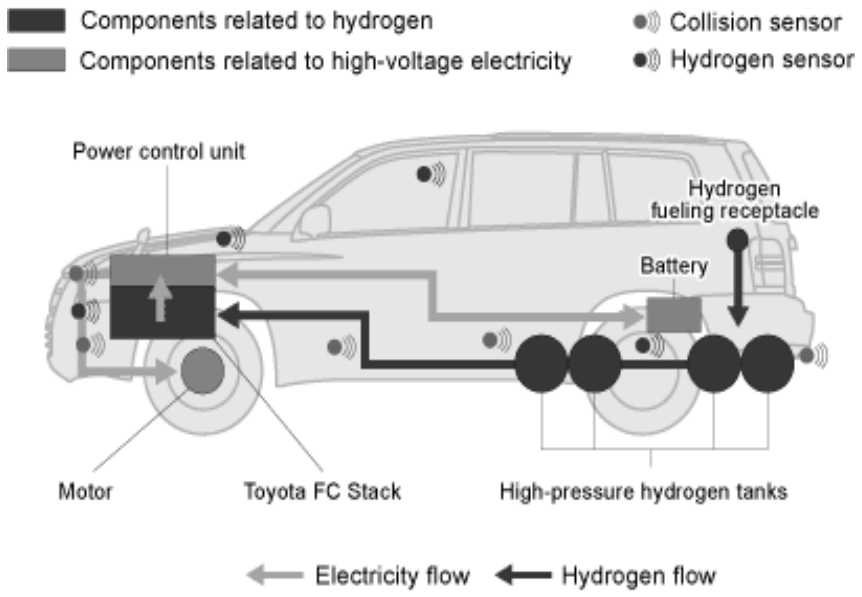
Limits of Hydrogen Volumetric Densities

Fuel System	H2 Density, g/L
Gaseous H2	25
Liquid H2	70
Methanol	99
Liquid Ammonia	110
Reversible Metal Hydride	125

Practical Hydrogen Volumetric Densities

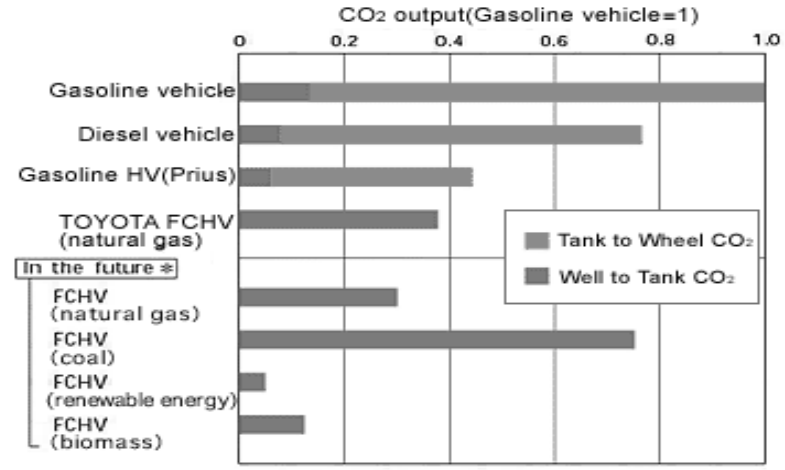
Fuel System	Practical H2 Density, g/L	Storage Efficiency, %
Compressed H2	10	40
Reversible Metal Hydride	20	16
Methanol Reformer	23	23
Liquid H2	26	37
Ammonia Dissociator	44	40

Safety Issues



Prospects for Implementation

■ **Well-to-wheel CO_2 output**



In the Japanese 10-15 test cycle, Toyota in-house testing
FCHV: Hydrogen fuel
* FCHV refers to direct hydrogen method; items in parentheses are sources of hydrogen.