# Polymer Electrolyte Membrane Fuel cells

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May 6, 2014

# Outline

# Conserving energy.





## Flaws in our current energy infrastructure

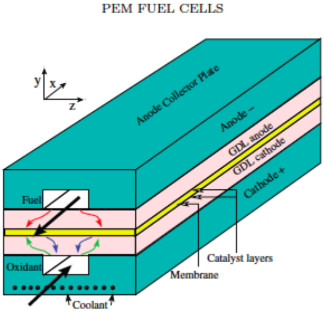
- Our current energy infrastructure relies heavily on cheap high density fuels extracted from fossil reserves that are combusted to produce energy
- The accumulating of carbon dioxide on the global environment causing global warming

## Change in direction

- A better approach is energy from ambient sources(wind, solar panels, geothermal, etc) but hard to allocate energy due to its large scale.

# Introduction to fuel cells

Fuel cells are efficient electrochemical (chemical to electric) energy converting devices. The fuel cell are responsible for converting the oxygen and hydrogen fuel that are fed into it to electrical current and water. The device is divided into anode and cathode layers.



# Chemical equations



**At the anode**

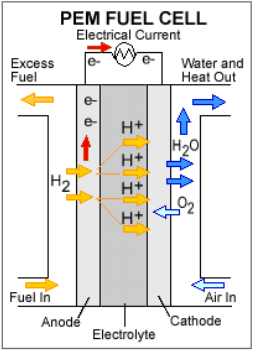
$$H_2 \longrightarrow 2\,H^+ + 2\,e^-$$

**At the cathode**

$$\tfrac{1}{2}O_2 + 2\,H^+ + 2\,e^- \longrightarrow H_2O$$

**Whole reaction**

$$H_2 + \tfrac{1}{2}O_2 \longrightarrow H_2O$$



# Circuit

- $\vec{F} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$ (Coulomb's Law)
- $\vec{F} = G\frac{m_1 m_2}{r^2}\hat{r}$ (Newton's Law)
- $i = \frac{\delta Q}{\delta T}$
- $\vec{F}_B = q(\vec{v} X \vec{B})$ Right hand rule to find parameters direction
- Junction rule
- Loop rule
- V = iR
- $P = iV = i^2 R = \frac{V^2}{R}$

# Potential energy

$$dW = Vdq = \frac{q}{C}dq$$

$$U = W = \int dW = \frac{1}{C}\int_0^q qdq = \frac{q^2}{2C}$$

$$U = \frac{q^2}{2C}$$

plugging in q = CV we get

$$U = \frac{1}{2}CV^2$$

# Conclusion

- The transition to a energy infrastructure will require the efficient conversion of energy from chemical to electrical
- The modeling and analysis of these network that will improve the devices performance and construction will require development of mathematical structures, sub-scale models and continuum mechanics.

# Thank you

Thank you. Simulation.