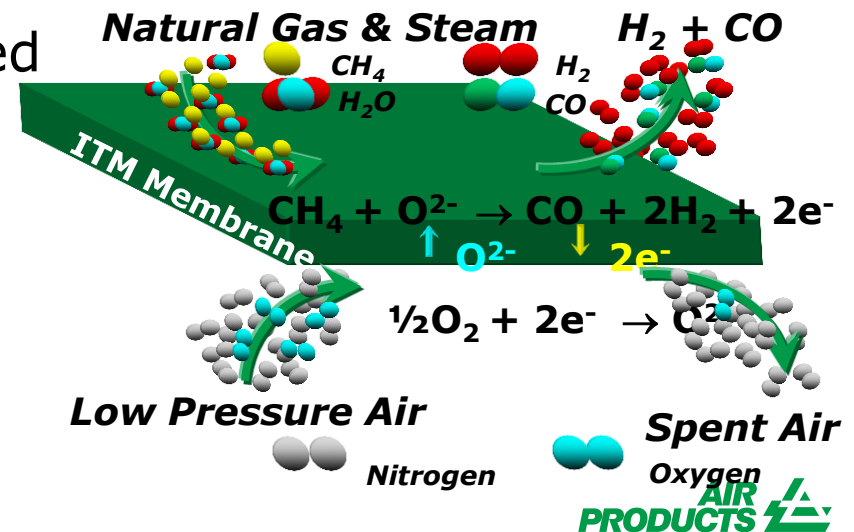


# Air Products: Natural Gas Conversion to H<sub>2</sub>

- Air Products: World's leading supplier of Merchant H<sub>2</sub>, Leading supplier of industrial gases such as O<sub>2</sub>
- Today: Majority of hydrogen is made from natural gas
  - Steam-methane reforming:  $\text{H}_2\text{O} + \text{CH}_4 + \text{heat} \rightarrow \text{CO} + 3\text{H}_2$ 
    - 60% of CO<sub>2</sub> could be readily captured. Remainder lost in low pressure flue gas
- Today: Oxygen made by cryogenic distillation
- Future: Ceramic Membranes: ITM Syngas
  - Up to 90% of CO<sub>2</sub> could be captured
- Future: Ceramic Membranes:
  - ITM Oxygen
  - Polygen to make oxygen, power and steam



# Technical gaps that could be addressed by the DOE and the National Labs:

- Improved ceramic membranes:
  - improved materials
  - membrane designs
  - fabrication methods
- Basic ceramic science and engineering of the application of large scale, ceramics components in demanding service
- Development of enabling technologies for the balance of plant
- Larger scale demonstration projects