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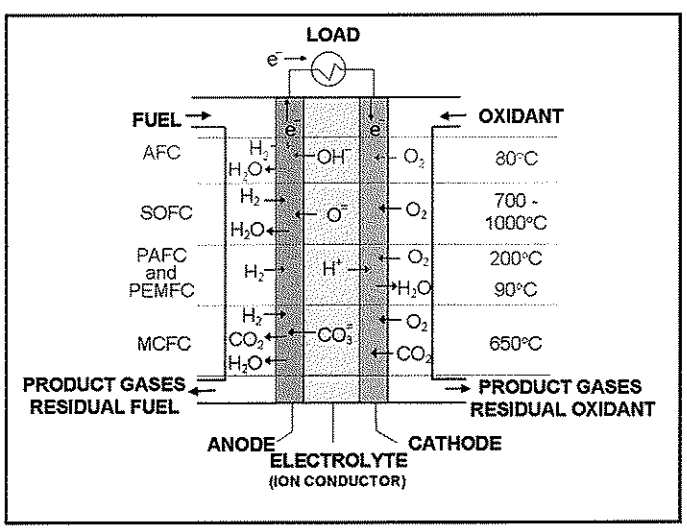
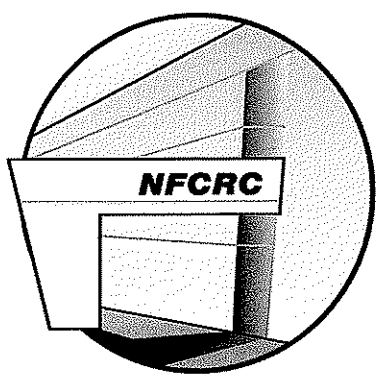
07-7-4

Fuel Cells: Potential Contribution to Reducing Emissions and Natural Gas Consumption in California

Presented to:
California Air Resources Board

June 21, 2007





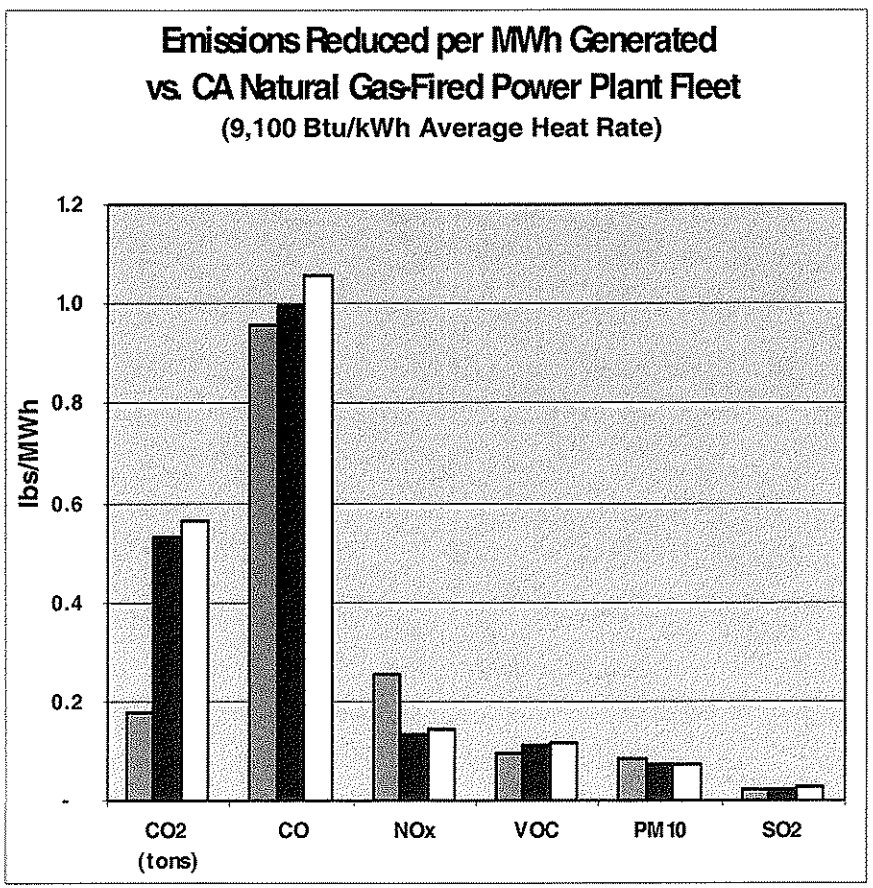
DRAFT
Final to be Completed by 31 July 2007

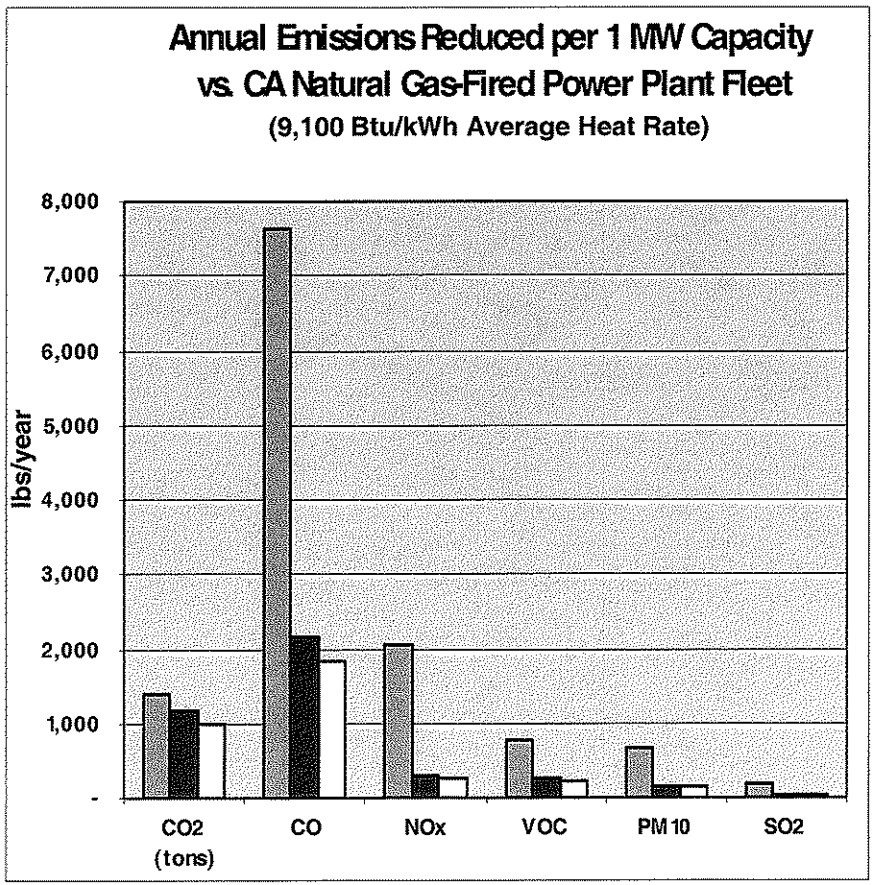
Fuel Cells in California: Today and Tomorrow

- Electricity generated by an electrochemical reaction, not by combustion.
  - Higher electrical efficiency than traditional generation.
  - High annual capacity factor (fewer moving parts).
  - Lower annual emissions.
- 30% of installed MW continue to operate on renewable digester gas.
  - Reduces natural gas consumption.
  - Reduces emissions from avoided fossil fuel generation.
  - Reduces emissions from otherwise flared digester gas.
- 60% of installed MW capture waste heat through cogeneration or combined heat and power ("CHP").
  - Increases efficiency vs. separate electric and thermal processes.
  - Reduces emissions and natural gas consumption from avoided boiler.
- As an emerging technology, today's 18 MW of installed fuel cell capacity could exceed 3,200 MW by 2020 with a long-term balanced portfolio of incentives, including:
  - Mandated CHP portfolio requirement.
  - Continued upfront capacity-based incentives, coupled with performance-based incentives.
  - Removal of utility barriers.*

* Additional details are provided in "Assessment of California Combined Heat and Power Market and Policy Options for Increased Penetration, Section H – Policy Options Lists and Description," PIER Collaborative Report, CEC-500-2005-173, November 2005.

24/7 Fuel Cell Operations = Greater Environmental Benefit vs. Wind and Solar





Fuel Cell @ 91% Capacity Factor; 30% Renewable Fuel; 60% Cogen.

Wind @ 25% Capacity Factor.

Solar PV @ 20% Capacity Factor.

2020: Potential Annual Emissions Reductions & Natural Gas Savings Provided by 3,200 MW of Fuel Cells

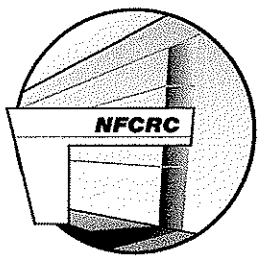
- CO2 reductions = 4.4 million metric tonnes, equivalent to:
  - Carbon sequestration of 723,000 acres of forest.
- Natural gas savings = 674,000,000 MMBtu, equivalent to:
  - 74,000 GWh of electricity, enough to fully satisfy the electricity consumption of 11.4 million homes.
  - 116 million barrels of oil.
- Fuel cells are a necessary contribution to enable California to achieve its AB32 goals.

Fuel Cells Create 6.6¢ - 19.6¢ per kWh of Value to California Ratepayers TODAY

- Over 2/3 of current value results from reduced natural gas consumption, reduced emissions, and related health benefits.
- 3,200+ installed MW by 2020 would increase fuel cell penetration* 200-fold, resulting in:
  - Reduced emissions and increased health benefits.
  - Reduced natural gas consumption.
  - Increased grid reliability and power quality benefits.
  - Increased employment benefits.

* Measured as fuel cell MWh/total MWh consumed.

Build-Up of Fuel Cell Value In California



	¢/kWh
Other Values	TBD
Value of Health Benefits*	2.34 - 2.55
Value of Avoided CO_2 Emissions*	0.11 - 2.21
Value of Other Avoided Emissions (NOx*, SO2*, CO*, VOC*, PM10, PM2.5, Hg)	0.14 - 1.90
Value of Job Creation Potential	0.11 - 0.26
Value of Avoided Water Use	0.00 - 0.26
Value of Fossil Fuel Price Hedge*	0.36 - 0.96
Value of Grid Support	0.03 - 0.40
Value of Deployment Ease and Speed	Site Specific
Value of Avoided Losses (Generation, T&D, Related Emissions)	0.26 - 0.59
Value of Avoided Generation Fuel Cost* (Applied only to Cogen Credit + 30% Renewable Fuel Use)	1.28 - 6.21
Value of Avoided Generation Variable O&M Cost	0.00 - 0.25
Value of Avoided Distribution Cost (All Costs Allocated to Summer Peak)	0.06 - 0.97
Value of Avoided Transmission Cost (All Costs Allocated to Summer Peak)	0.01 - 0.24
Value of Increased Reliability, Power Quality, & Blackout Avoidance	0.00 - 0.22
Value of Avoided Generation Capacity Fixed Operation & Maintenance Cost	0.22 - 0.29
Value of Avoided Generation Capacity Capital Cost (93% Effective Load Carrying Capacity)	1.71 - 2.31

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RANGE OF TOTAL FUEL CELL VALUE: 6.6 – 19.6¢/kWh

* Indicates inclusion of Cogen Credit