SESSION 3

STATIONARY FUEL CELL PROJECT
FEBRUARY 2ND, 2011

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Energy and Hydrogen Fueling Station at Orange County Sanitation District

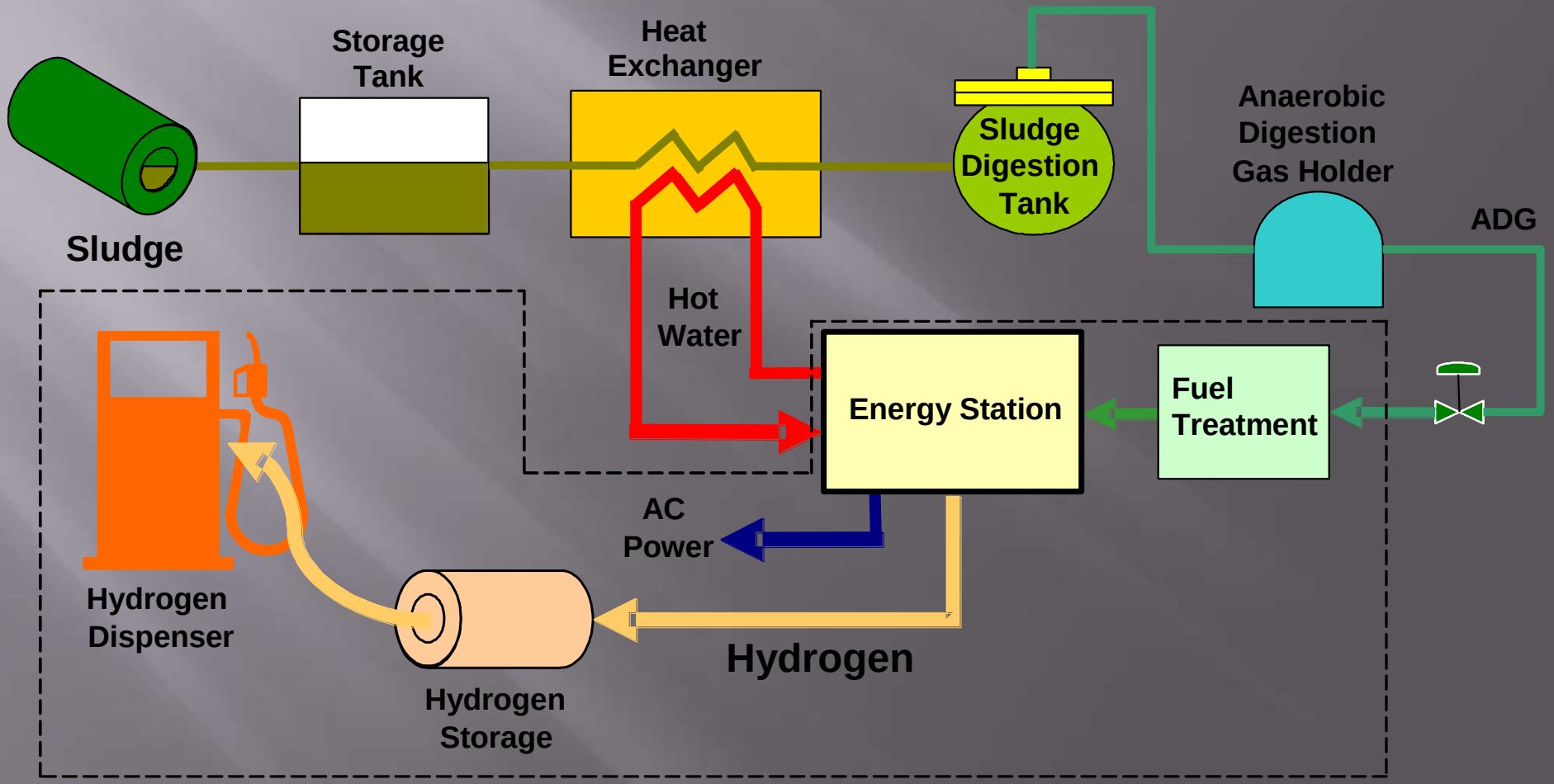
Hydrogen Energy and Fueling Station

- 100% renewable hydrogen & 100% renewable electricity produced from a molten carbonate fuel cell (MCFC)
- MCFC produces electricity, hydrogen and heat from anaerobic digester gas renewably generated from waste water
- Electric power and heat to operate the station
- Hydrogen will be dispensed from a refueling station for fuel cell powered vehicles

Hydrogen Energy and Fueling Station

- Internal Reforming
  - $CH_4 + 2H_2O = 4H_2 + CO_2$
- Anode
  - $H_2 + CO_3^{--} = H_2O + CO_2 + 2e^-$
- Cathode
  - $\frac{1}{2} O_2 + CO_2 + 2e^- = CO_3^{--}$

Overview of Production of Hydrogen from Anaerobic Digester Gas via Hydrogen Energy Station



Project Status

- Completed testing of energy station equipment at fuel cell energy site in Connecticut
- Operated energy station on simulated digester gas by addition of carbon dioxide to the methane supply. System performance matched predictions for power and hydrogen production.
- Completed a 7-day continuous operating test of hydrogen energy station

Project Status

- To date, operated DFC-300 and equipment for over 6,000 hours with stable performance
- Produced over 200 kw of power
- Generated 200+ lbs/day of hydrogen
- Developed operating procedures for flexible output of power plus hydrogen
- Hydrogen quality met automotive fuel cell quality requirements

Fuel Cell Specifications

- 300 kW
- 109,000 Btu/hr waste heat recovery
- 70% CHP efficiency
  - 45% fuel cell electrical efficiency
- 100 kg/day Hydrogen production

Hydrogen Fueling Station

- 100 kg/day capacity
- 350 and 700 bar fueling capability
  - 350 bar; 5 kg fill in app. 8 mins.
  - 700 bar; 4.5 kg fill in app. 3 mins.
- Co-located with existing CNG dispenser

Project Status

- DFC-300 fuel cell operated at full load on natural gas
- Supplying power to OCSD's local grid
- Hydrogen quality
  - 0.2 ppm CO, 10 ppm CH_4, 1 ppm CO, 5 ppm H_2O
- Currently operated on natural gas

Digester Gas Clean-UP

- Anaerobic Digester Gas (ADG) Clean-up system
  - Siloxanes; carbon-based filter
  - Hydrogen sulfide; catalytic iron system
  - Oxygen; carbon bed
  - Water; chilling gas
- ADG system operational in February 2011

Project Funding

Hydrogen Energy and Fueling Station Project	
	Amount
AQMD	$750,000
Air Products	$2,857,472
CARB	$2,700,000
DOE	$2,077,283
Fuel Cell Energy	$51,979
Total	$8,436,734