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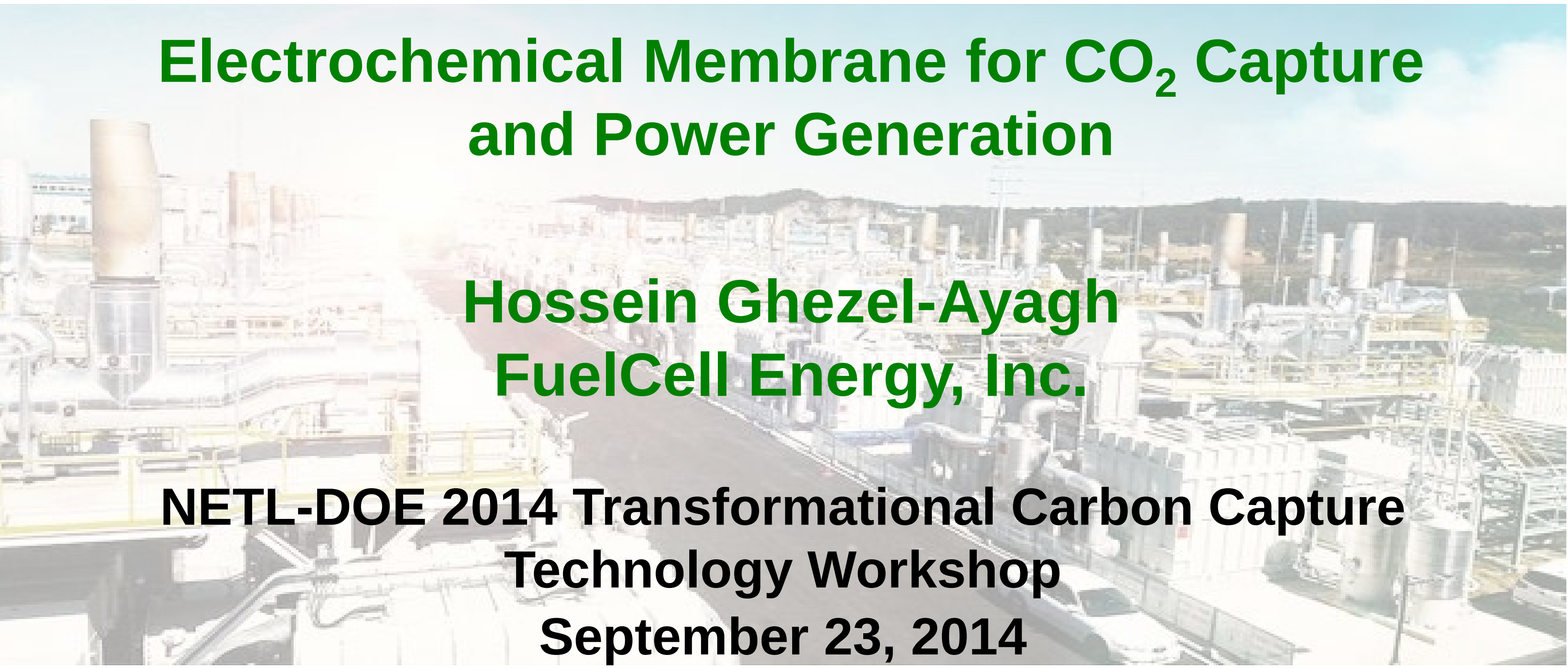

Electrochemical Membrane for CO_2 Capture and Power Generation

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FuelCell Energy, Inc.

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Arlington, VA

Ultra-Clean, Efficient, Reliable Power

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Company Background

Design

Megawatt–class distributed power generation solutions

Manufacture

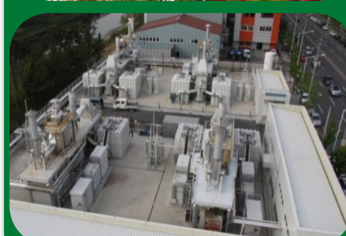
Global manufacturing footprint

- ***North America***
- ***Europe***
- ***Asia via partner***

Sales

Direct & via Partners

Installations & orders in 9 countries



EPC*

Project Development and Project Finance, Engineering & Construction

Over 300 megawatts installed and in backlog

** Engineering, Procurement & Construction*

Services

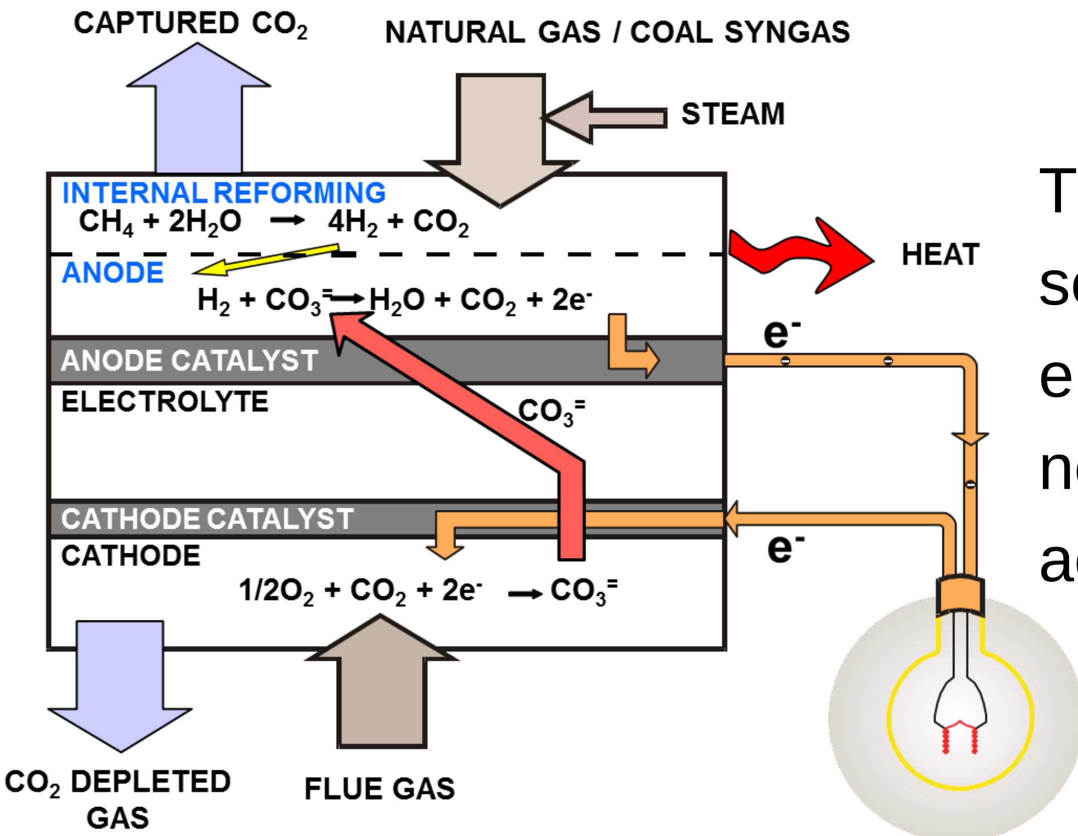
Operate & maintain power plants

- ***Over 100 DFC® plants operating at more than 50 sites globally***
- ***2.4 billion kWh ultra-clean power produced***

Providing turn-key power generation solutions

NASDAQ: FCEL

Electrochemical Membrane (ECM) Technology



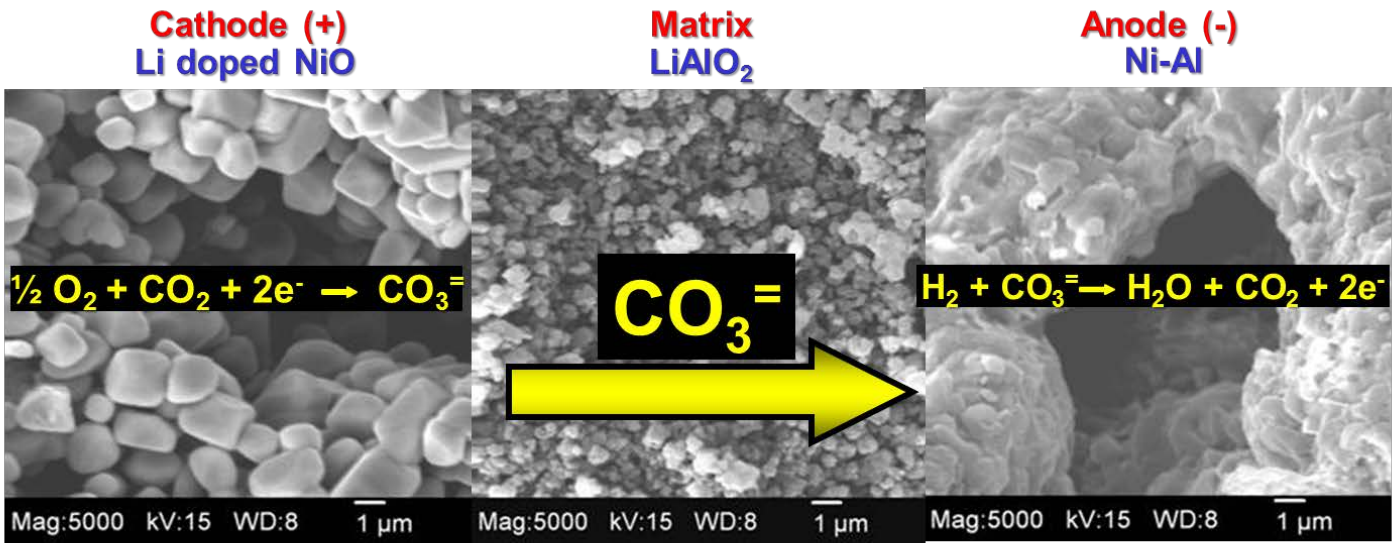
The driving force for CO_2 separation is electrochemical potential, not pressure differential across the membrane

Net Results

- Simultaneous Power Production and CO_2 Separation from Flue Gas of an Existing Facility
- Excess Process Water Byproduct
- Complete Selectivity towards CO_2 as Compared to N_2

ECM Active Components

ECM Structure and Mechanism of CO_2 Transport



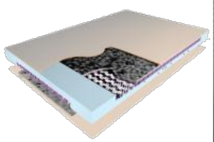
- ECM components are fabricated from inexpensive inorganic materials and conventional manufacturing processes
- Because of fast electrode kinetics at the operating temperatures of 550-650^{o}C, ECM is suitable for CO_2 concentration of <15% normally found in the coal or gas-fired power plant flue gases
- Due to the planar geometry and large gas flow channels, ECM can process large gas volumes without significant back pressures (5-8 cm of water)

ECM Module Manufacturing

Tape Casting
Anode and Membrane Matrix

Powder Processing
Cathode

Planar Electrochemical Membrane assemblies are stacked and incorporated into MW-scale modules



ECM Assembly

ECM Stack

Four-Stack Module

ECM Module Module

ECM is a modular technology:

- Ease of scale up and transport
- Suitable for incremental phased applications to almost any type of CO_2-emitting plant
- Proven technology based on FCE's commercial Direct FuelCell® for power generation applications

ECM Stack Module Commercialization

- ECM utilizes the same technology as FCE's commercial stand-alone fuel cell power plants
- Current manufacturing ramp-up (>70 MW/year) is reducing ECM cost

World's largest fuel cell park located in Hwaseong City, South Korea

- 59MW power plant consisting of 42 stack modules adequate to power ~ 140,000 homes in S. Korea
- Supplying electric grid and district heating system
- Constructed in only 14 months

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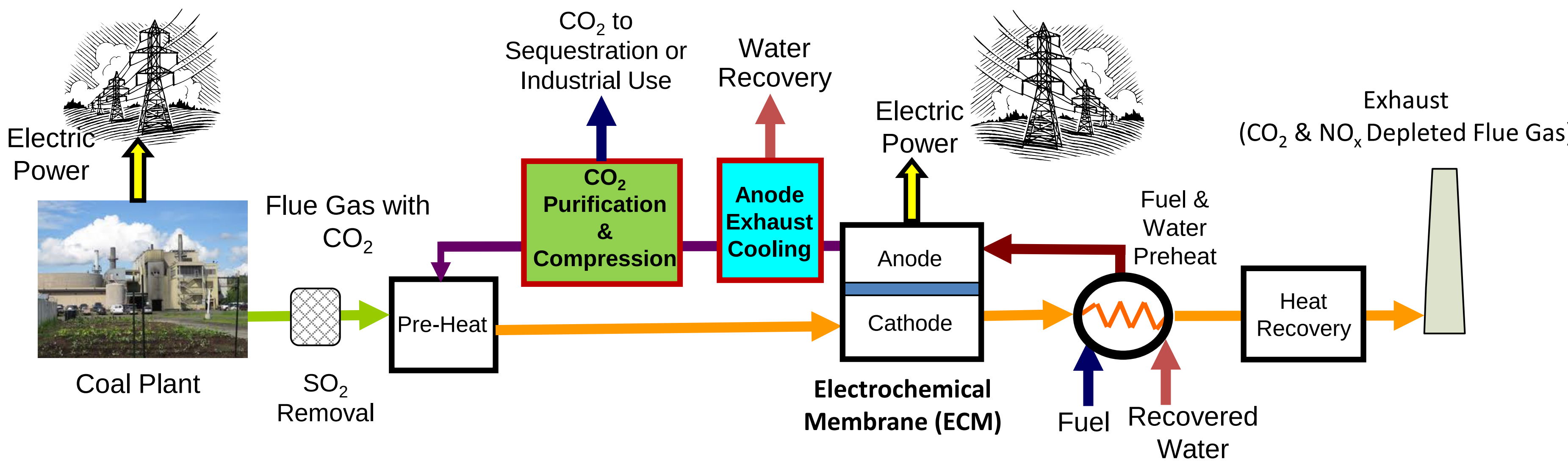
Techno-Economic Analysis

CEPACS System
Simplified Block Flow Diagram

Combined Electric Power and Carbon-dioxide Separation (CEPACS) System Concept Implementation for 550 MW Reference PC Plant*



CEPACS system produces:

- Supercritical CO_2 (90% CO_2 capture from PC Plant)
- Excess Process Water
- Additional 421 MW of clean AC power @ 42.4% Efficiency (based on LHV Natural Gas)

* Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity, Revision 2, DOE/NETL-2010/1397, November 2010.

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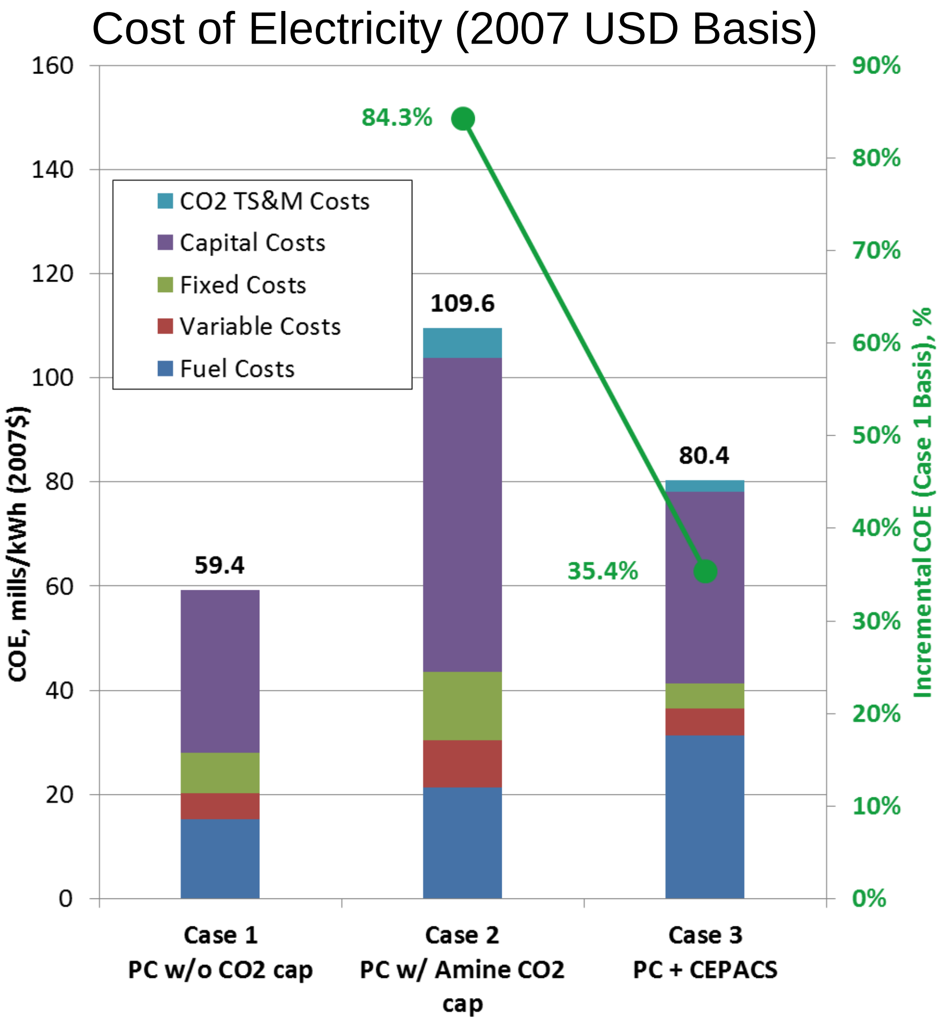
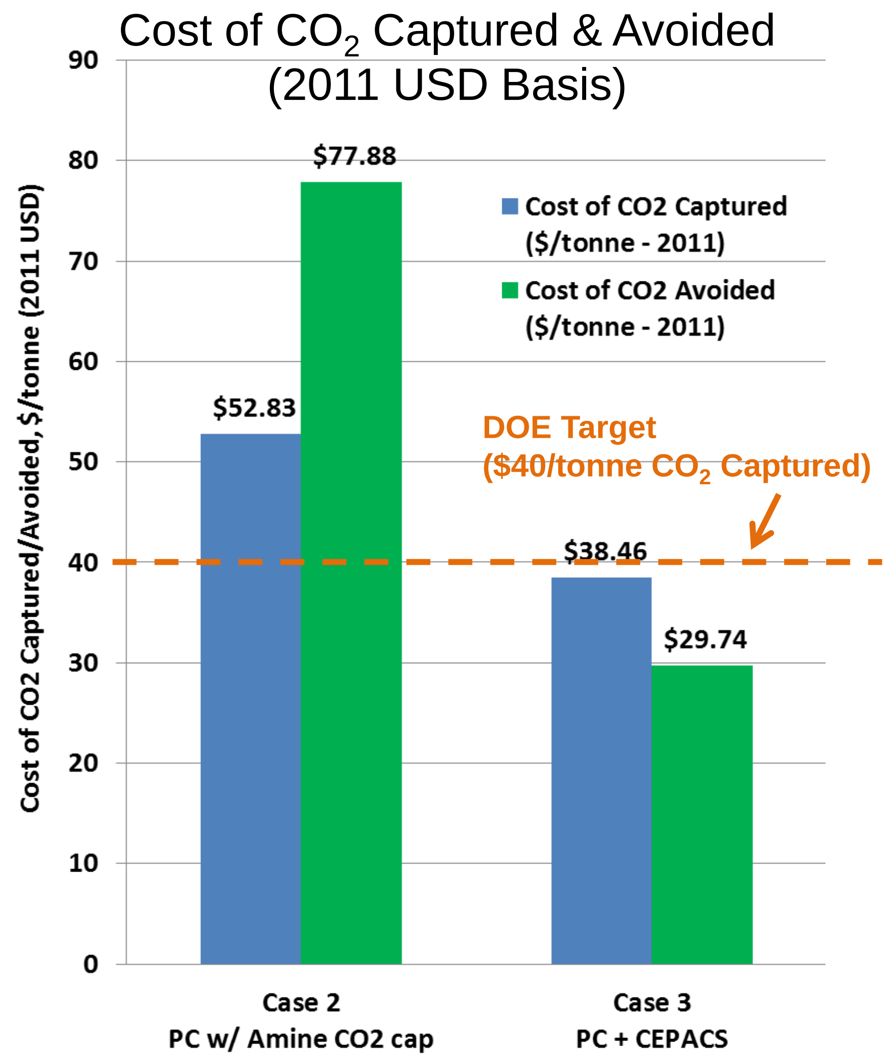
URS

Techno-Economic Analysis Results

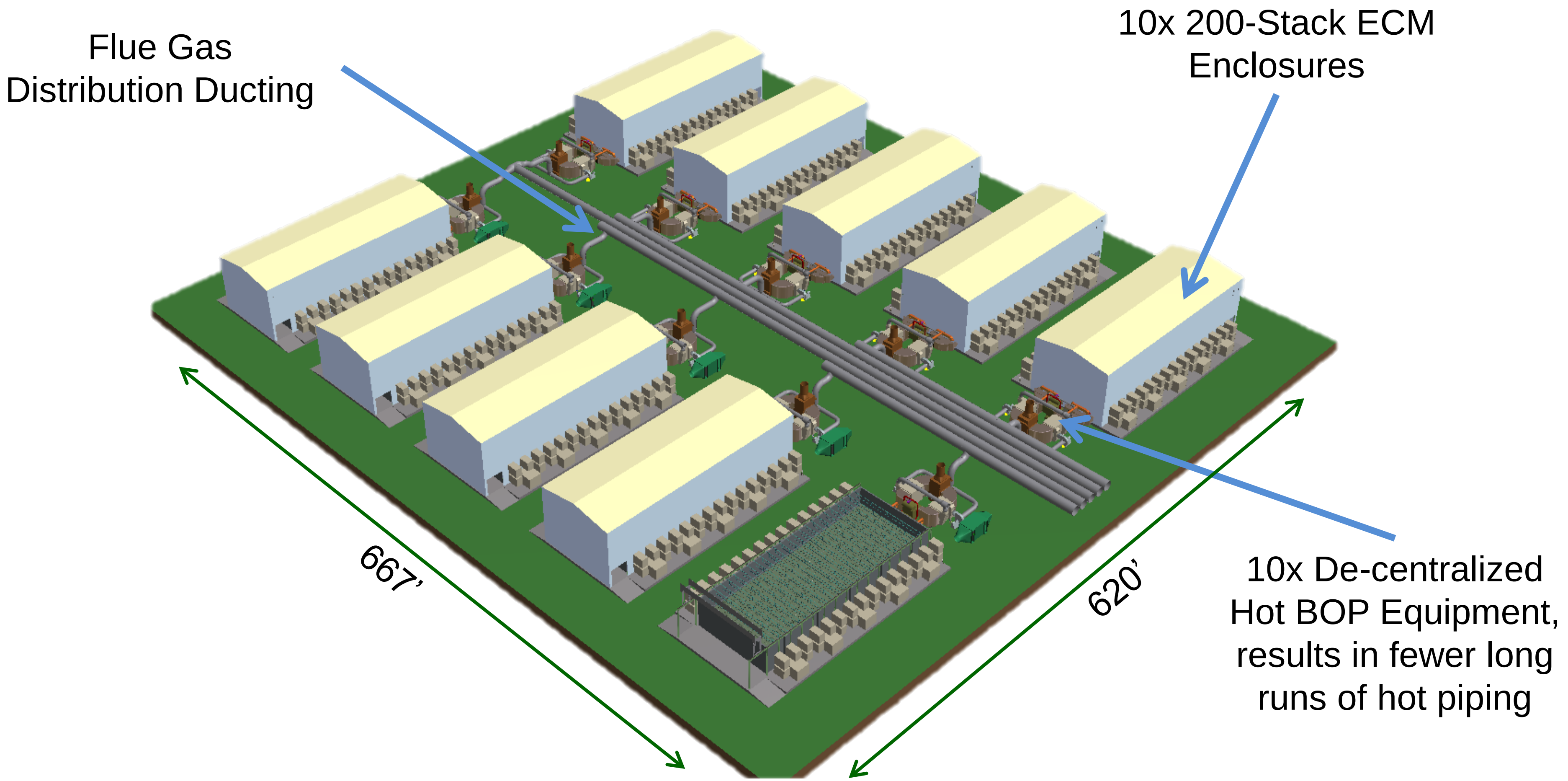




- CEPACS System incremental COE meets DOE target of <35%
- CEPACS System can meet DOE Target of <$40/tonne CO_2 captured (2011 USD)

CEPACS Plant Layout for Large Systems

421MWe CEPACS Plant for >90% Carbon Capture from 550MWe Reference PC Plant requires ~ 12 Acres



CEPACS System modularity allows for isolation of a single enclosure, resulting in near-100% availability with >90% capacity factor

ECM Testing Results

Performance Comparison: Effect of Flue Gas Composition

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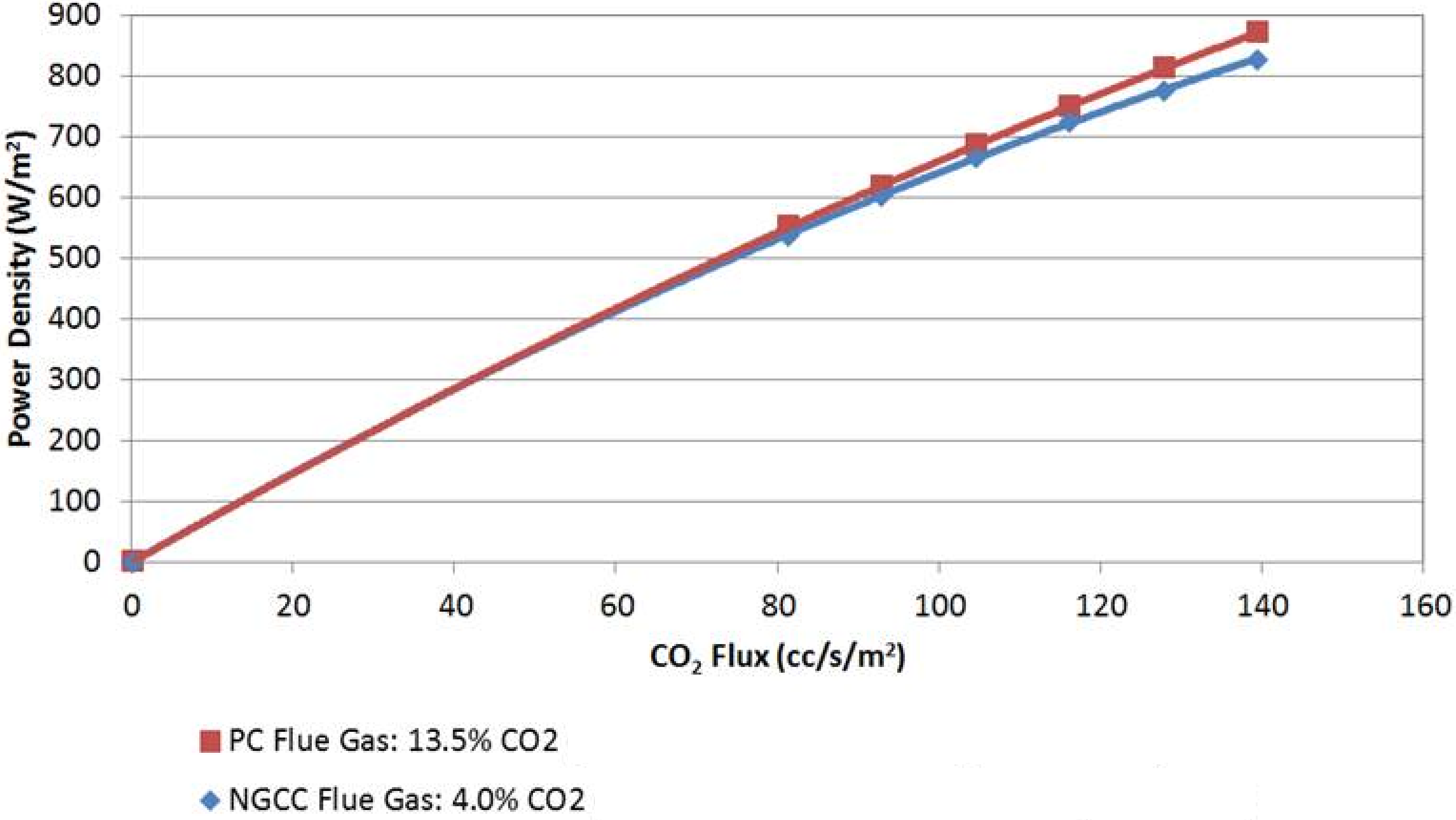
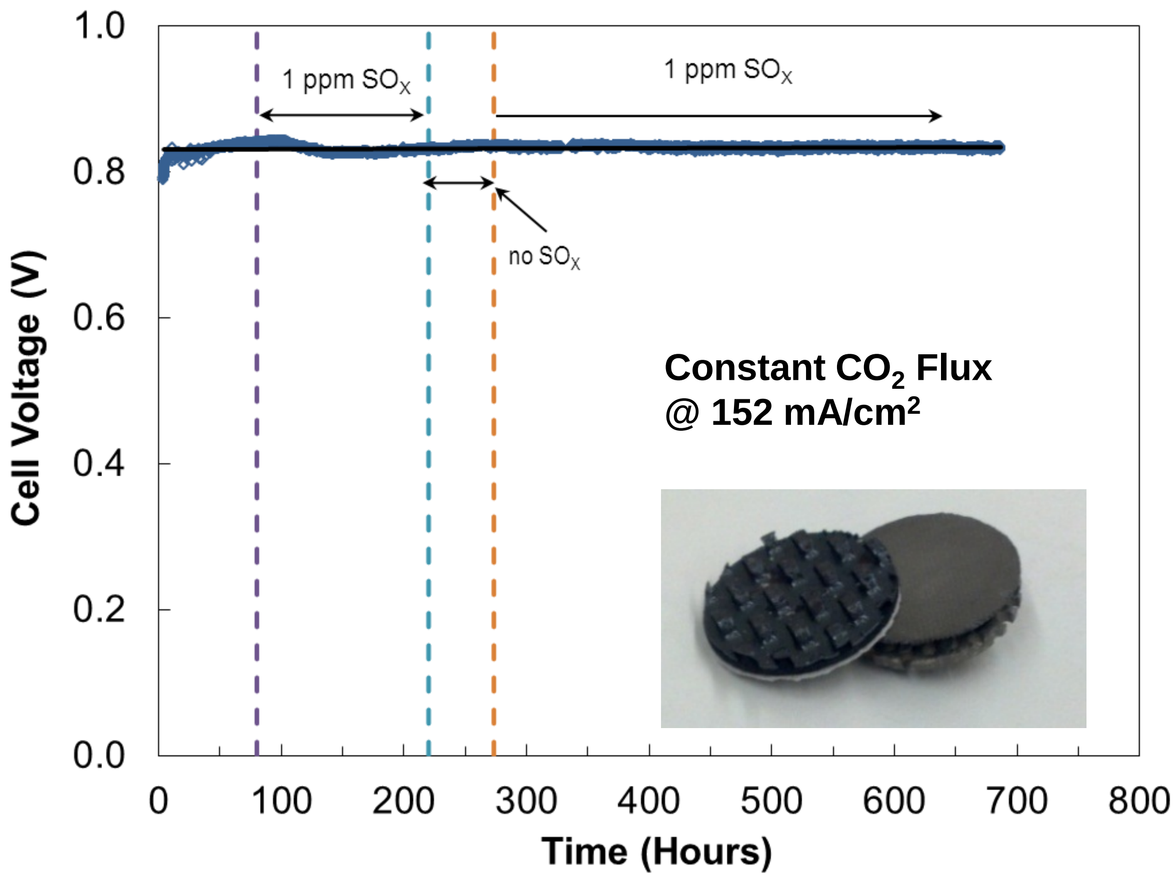
ECM cell performance data for NGCC and PC plant flue gases at 93% carbon capture:



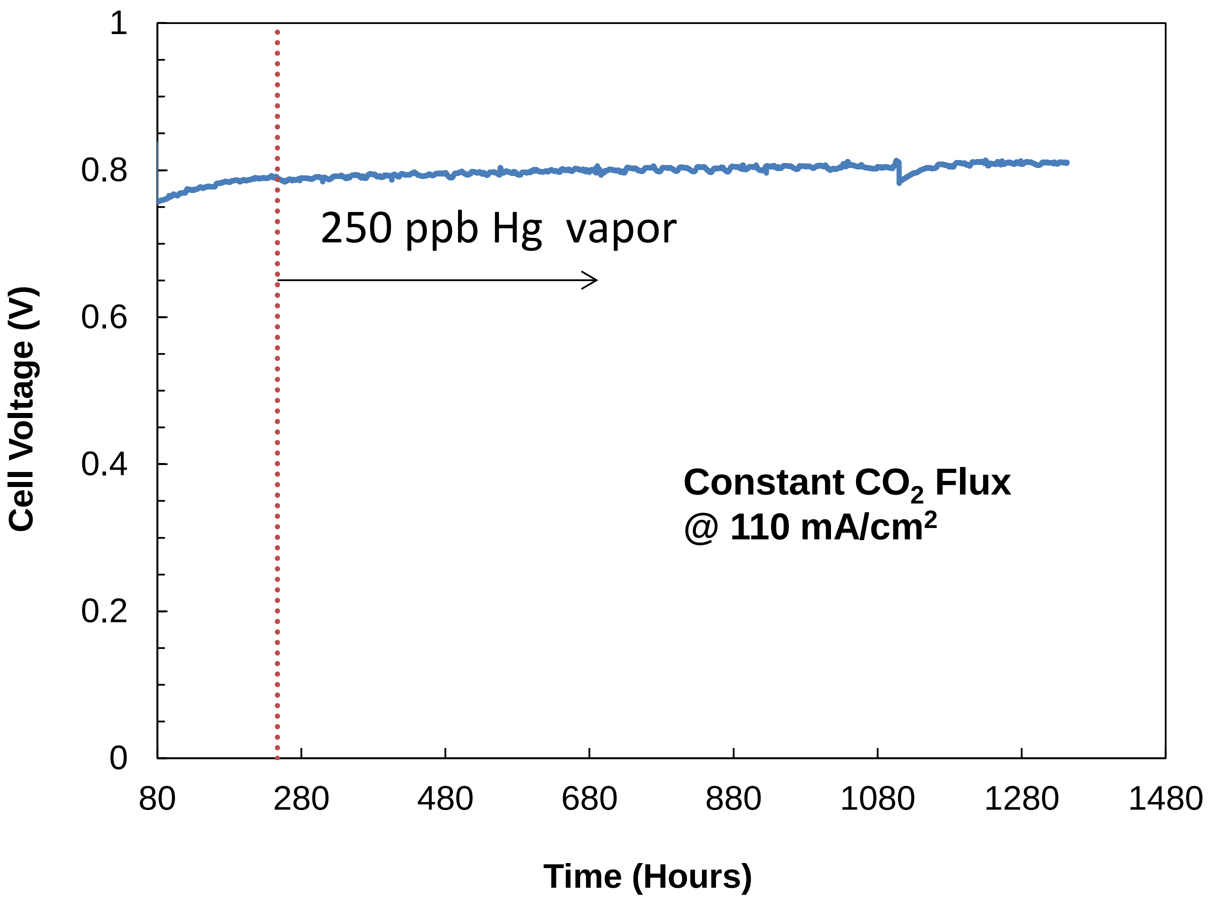
- ECM is capable of operating on flue gases with a wide range of CO_2 partial pressure
- System features (e.g. supplemental air addition, product recycle) allow tuning of cathode-side composition to optimize ECM performance
- High cell power densities at high CO_2 flux is observed in ECM tests

ECM Flue Gas Contaminant Tolerance: SO_2



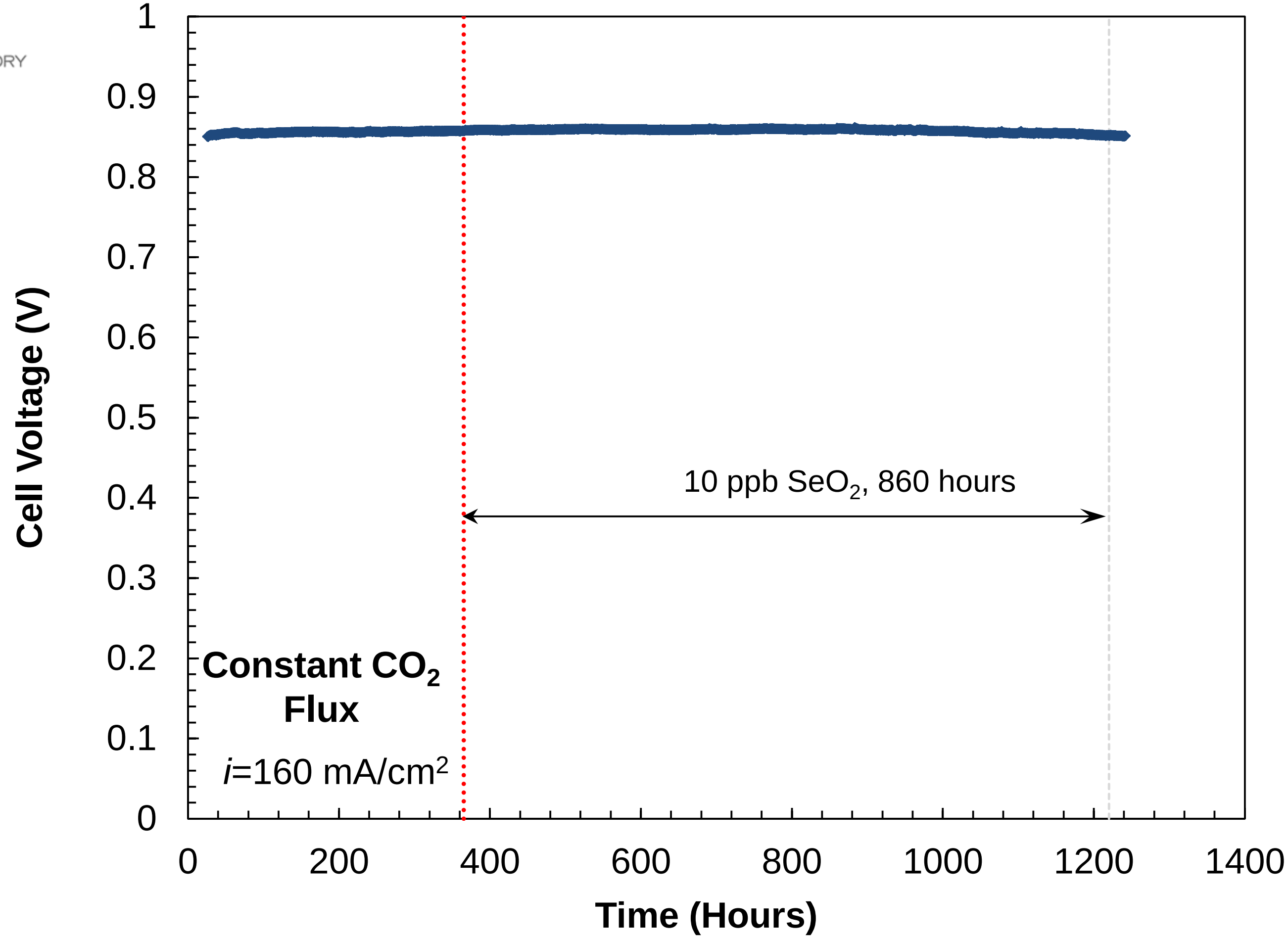
- Polishing equipment upstream of ECM reduces SO_2 concentration in the flue gas (cathode gas) to <1 ppm
- ECM stable operation has been verified with 0.4 - 1 ppm SO_2 in the cathode without significant performance loss in two 600+ hour tests

ECM Flue Gas Contaminant Tolerance: Hg



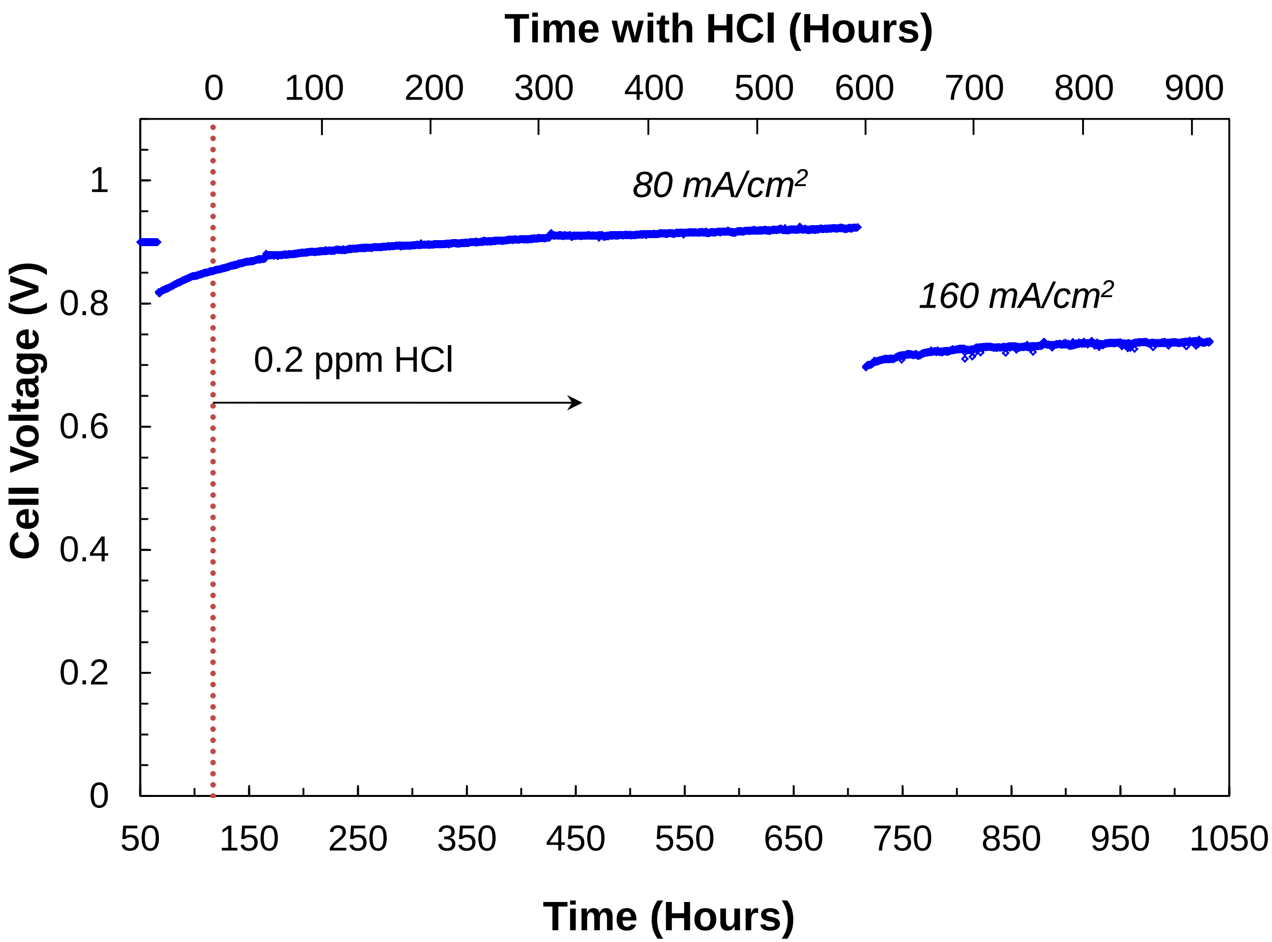
- Stable operation was observed with 250 ppb Hg in ECM cathode gas (500 times higher than typically present in coal plant flue gas) during ~1,100 hour test
- Test data analysis confirmed no accumulation of Hg in ECM components

ECM Flue Gas Contaminant Tolerance: Selenium



- ECM displayed stable operation with 10 ppb Selenium (20-30x higher than expected levels) for over 860 hours of exposure

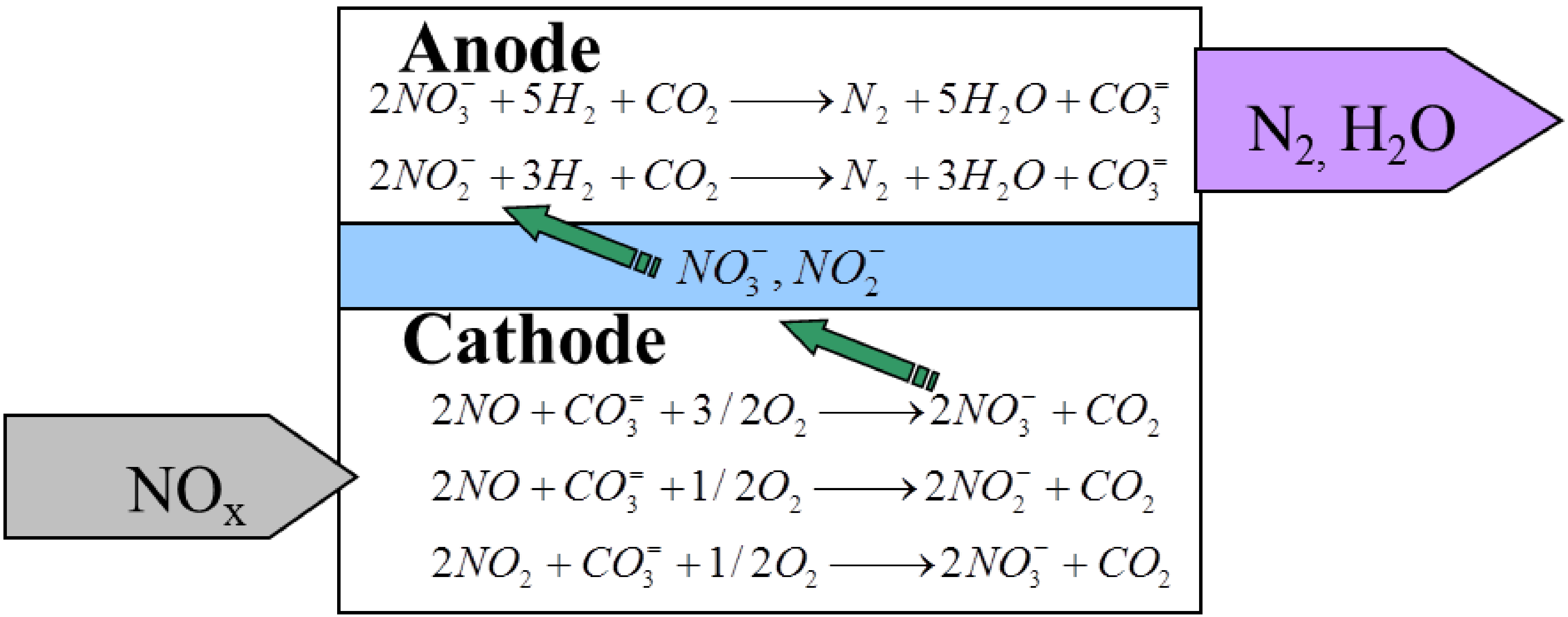
ECM Flue Gas Contaminant Tolerance: Chlorine



- ECM displayed no performance loss with exposure to 200 ppb HCl (10-20x higher than expected levels) for over 900 hours

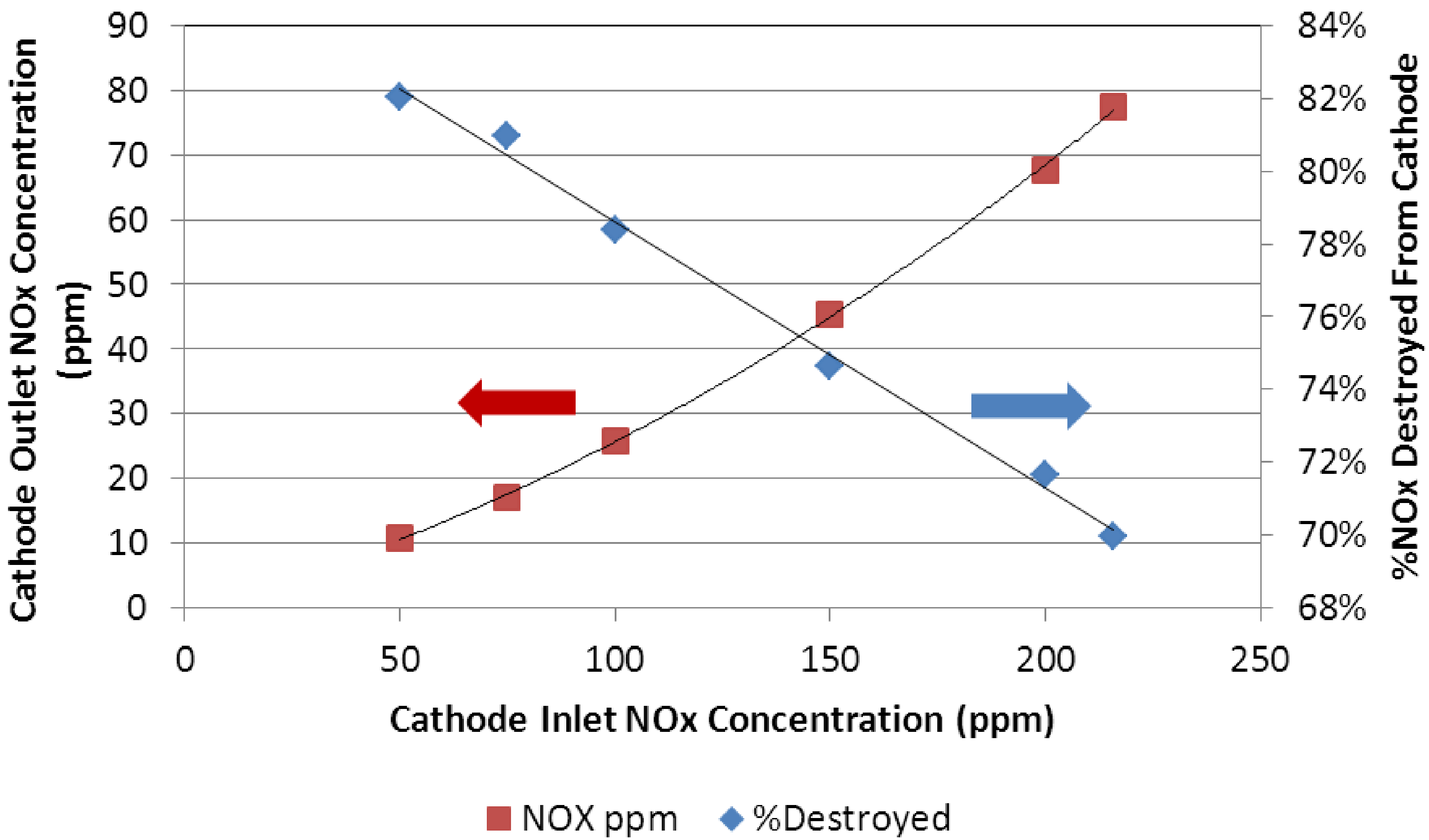
ECM NO_x Removal Mechanism

- Based on FCE's prior experience:
  - ECM materials are not expected to be degraded by NOx in flue gas
  - CEPACS system offers co-benefit of NOx reduction



Reaction Mechanism by which NOx is removed from the Flue Gas (cathode-side), transferred to the anode-side along with CO_2, and subsequently destroyed

ECM NO_x Removal Capabilities



- ECM Capability for NO_x Destruction Remains > 70% at High Inlet NO_x Concentration (200 ppm) During Carbon Capture under System Conditions

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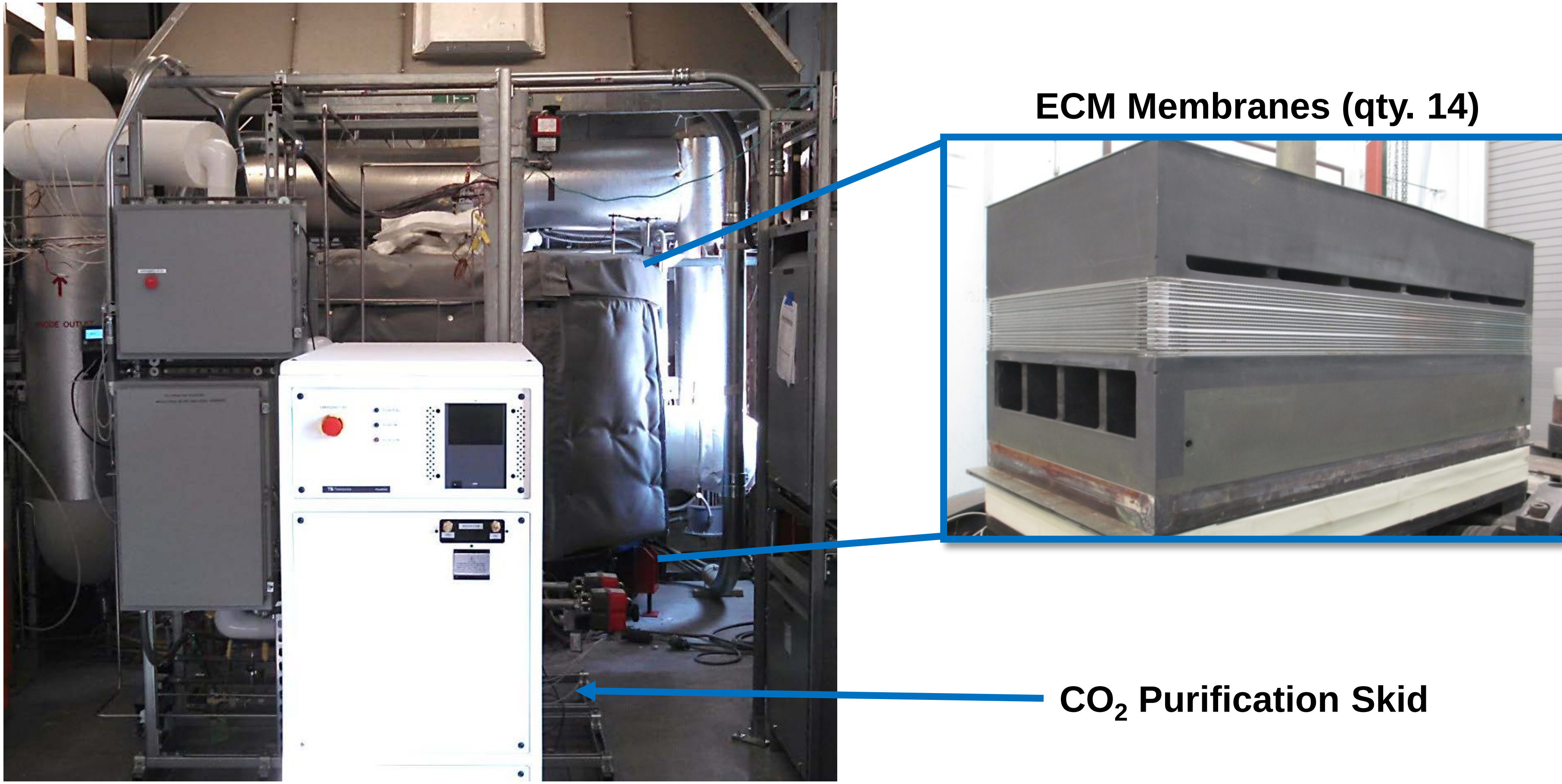
Bench-Scale Demonstration System



CEPACS Demonstration system designed, assembled, and ready for testing

- 100 tons/year liquid CO_2 product
- Approximately 9 kW power production

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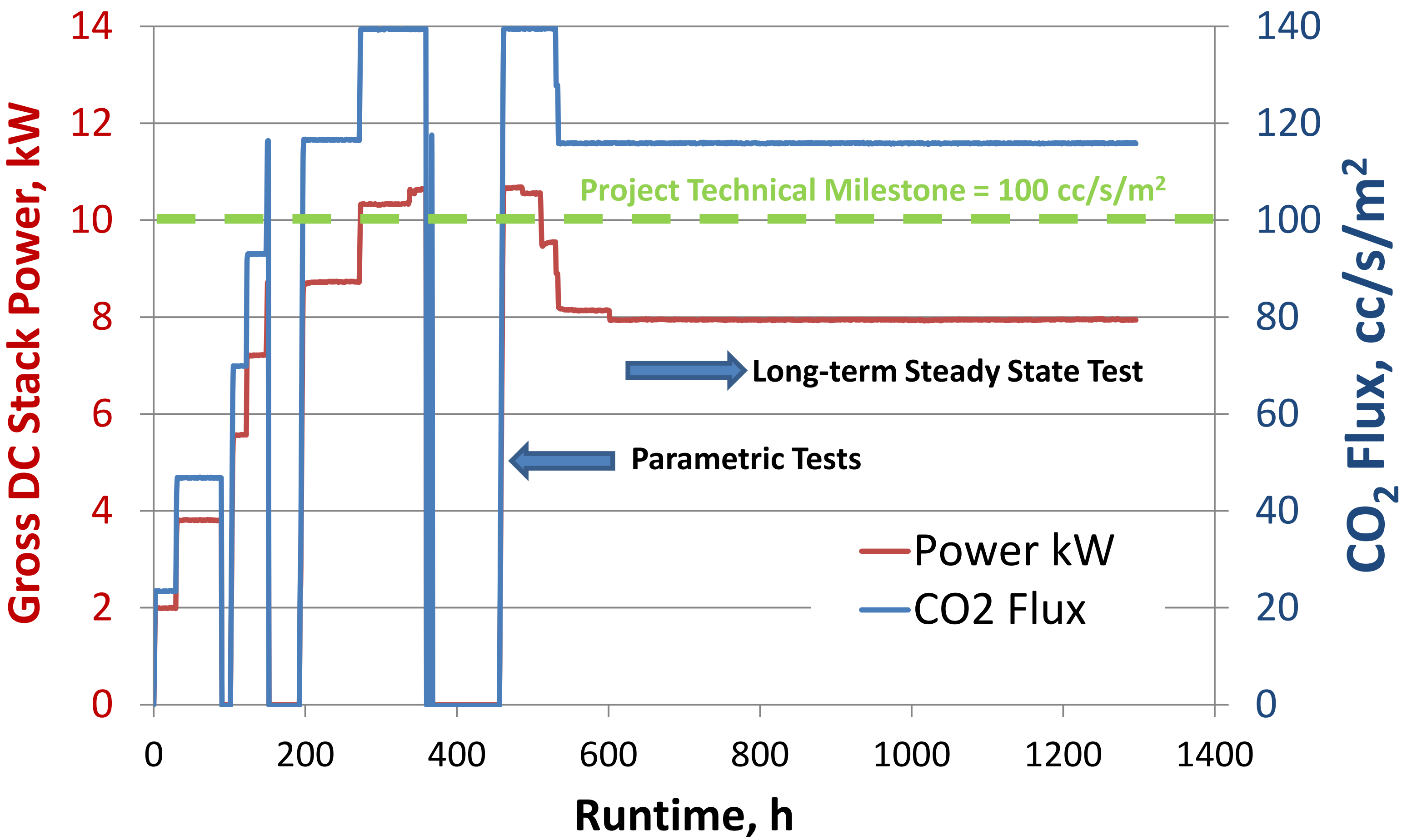
Bench-Scale Demonstration Test Results



Bench-scale CEPACS test results verified CO_2 flux greater than 15% over targeted milestone value.

Accomplishments and Summary

- The Technical and Economic Feasibility Study (T&EFS) of a CEPACS system to separate 90% of CO_2 from the flue gas of a Reference Plant (550 MW PC) has verified:
  - Incremental cost of electricity (COE) of 35% and cost of CO_2 captured of \$38/tonne CO_2 (2011 USD)
  - Excess water available for export
- Large-area ECM laboratory tests verified:
  - High CO_2 flux (>120 cc/m^2/s) while separating >90% of CO_2 from simulated PC or NGCC plant flue gas
  - Capability to destroy 70-80% of NO_x from flue gases
  - Stability of CO_2 flux as the membrane ages

Fuel Cell Manufacturing Facility, Torrington, CT

- Contaminants tests indicated ECM is stable in the presence of S, Se, Cl, and Hg levels expected from a conventional wet-FGD polisher
- The Technology Gap analysis indicated that available commercial equipment can be used in CEPACS system with no R&D needed for BOP
- ECM is suitable for a wide range of carbon capture applications: Enhanced oil recovery, SAGD Tar Sands, coal and natural gas power plants, and industrial sites (cement factory & refineries)
- Next step: Complete bench-scale CEPACS demonstration system for 100 tons/year carbon capture

Acknowledgements

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