

# Fuel Cells in Enbridge's Alternative Energy Portfolio



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May 16, 2011

# Enbridge Overview



Enbridge is a leader in energy transportation and distribution in North America

- World's longest liquids pipeline system – 2 MMB/D
- Canada's largest natural gas distribution system – 5 BCF/D
- Oil and Gas cavern storage
- Green power projects, stationary fuel cells, CCS
- \$24 billion in assets
- 6,000 employees

- **Green Energy business model fits Enbridge's low risk model**
- **Attractive returns available**
- **Diversified portfolio emerging, including fuel cells**
- **Corporate social responsibility**
- **Societal transition to renewable and low-carbon energy over 50 years**



Magrath Wind Farm



Sarnia Solar



US Geothermal Raft River Site



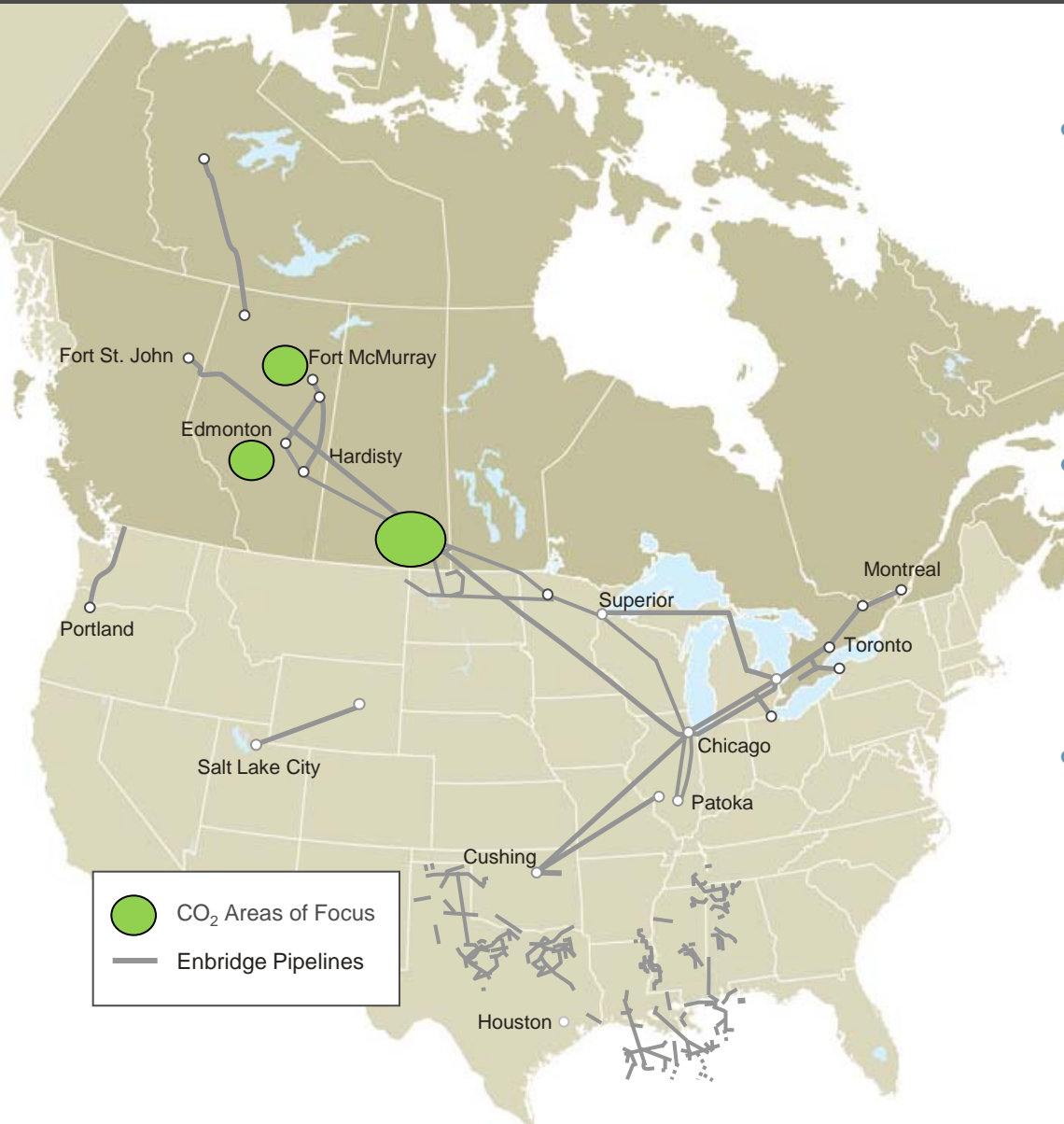
- **Neutral Footprint Goal**
  - A kilowatt of renewable energy for each kilowatt of power our operations consume
- **Wind: Entered 2011 with over 700 MW**
  - 397 Turbines
  - 11% of Canada's installed capacity
- **Solar: 80 MW operating & announced two additional Ontario acquisitions**
  - 5 MW Tilbury Solar
  - 20 MW Amherstburg II
- **22MW Geothermal**
  - Investment in US Geothermal's Neal Hot Springs Project

# Waste Heat to Power; Untapped Potential



**NRGreen Power Limited Partnership is an Alliance Pipeline affiliate established in 2006**  
**Pursue the commercial development of electrical generation opportunities**

# Enbridge Focus on Carbon Dioxide



- **CO<sub>2</sub> Components**

- Transportation
- Slurry transportation
- Sequestration

- **Geography**

- Alberta
- Saskatchewan

- **Economics**

- Tariffs similar to hydrocarbon transportation

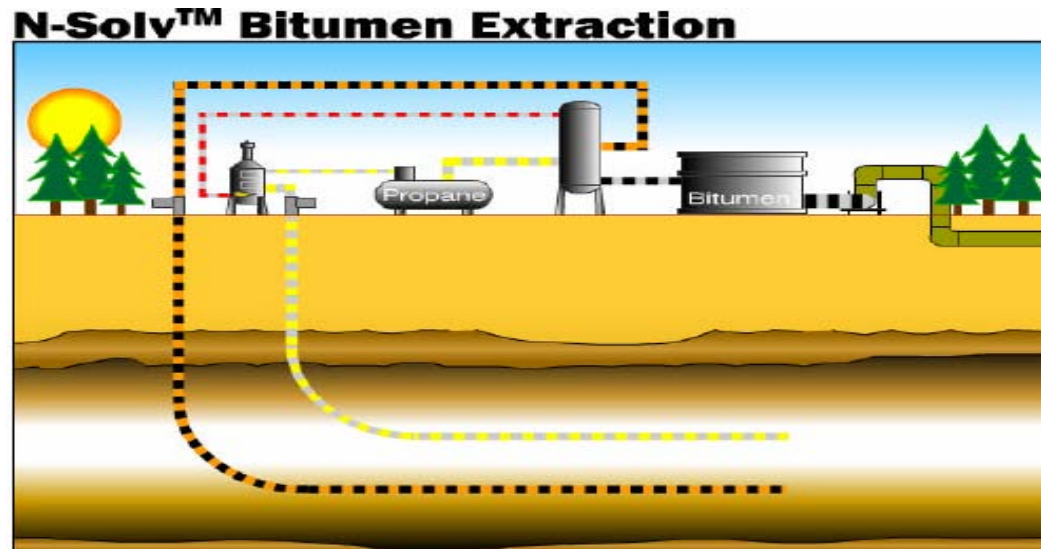
- **Compressed Natural Gas Marine Transportation**

- Sea NG



- **Bitumen Extraction & Upgrading**

- N-Solv
- Value Creation



- **Run of River Hydro**
  - Coastal

Wasdell Falls Hydroelectric Project



- **Waste Heat Recovery**
  - Genalta

Waste Heat Recovery station



# Multi-Megawatt Stationary Fuel Cells

- **High temperature fuel cells offer most efficient, and cleanest use of both fossil and renewable fuels**
  - Direct natural gas operation
  - Unmatched operation on renewable biogas
  - Suitable for syngas (wood waste gasification, etc.) and H2 blends
  
- **Efficient, predictable, high-capacity generation, has strong near & medium-term emission reductions**
  - Renewable energy without burning fuel
  - Up to 60% more low-carbon power from same input energy supply

Bloomfield, CT



Pohang, Korea



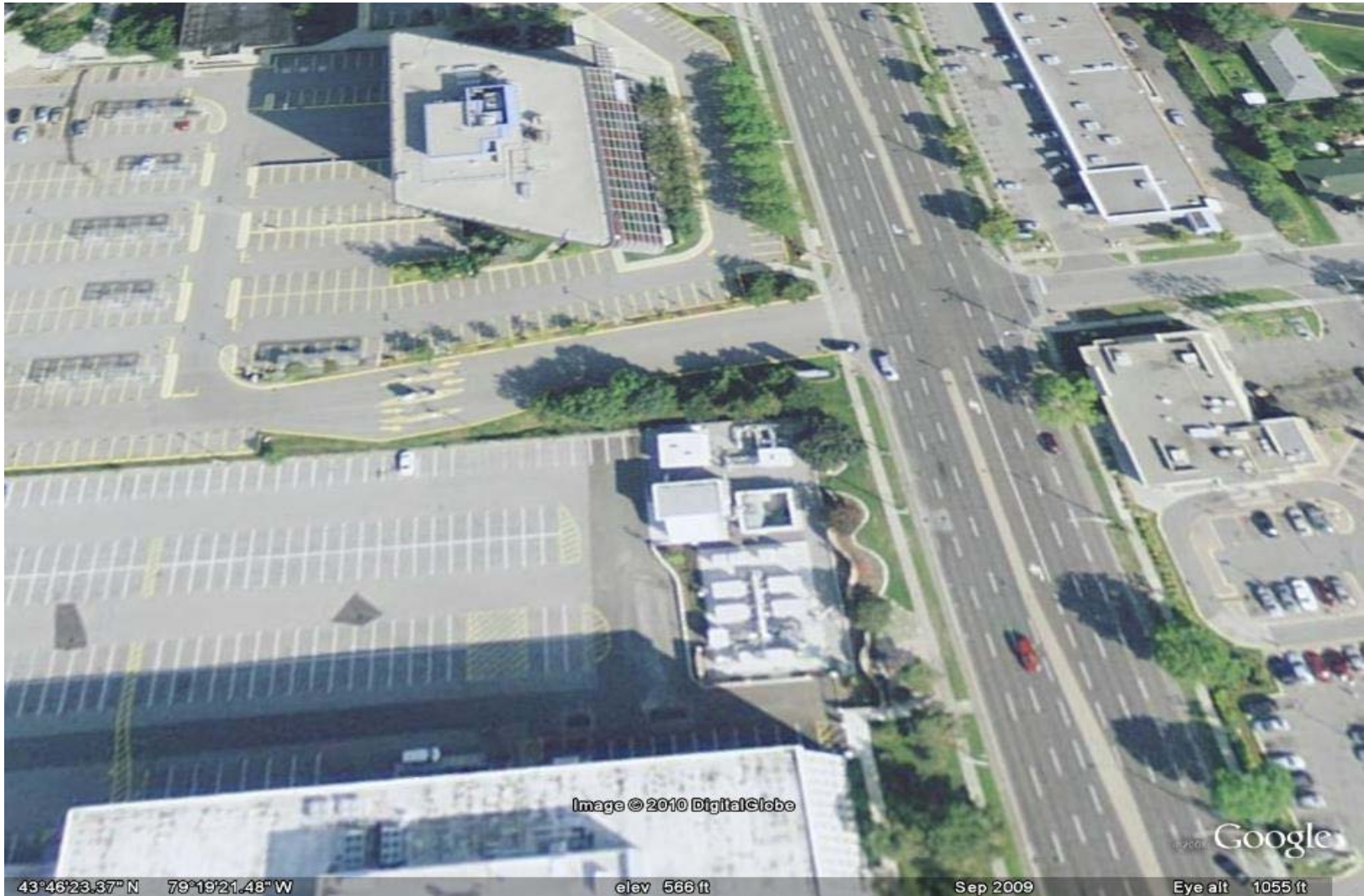
# Enbridge Innovation with Fuel Cells

- **Canada's largest Hybrid Fuel Cell; operational for over 2 years**
- **2.2 MW of clean electricity**
  - combining 1 MW of energy recovery with 1.2 MW of zero-combustion fuel cell power
- **Unmatched electrical efficiency range of 60-70%**
- **Scale up to 10 MW+ sites**
- **Project support through NRCan, Environment Canada, and Ontario Ministry of Research & Innovation**

Hybrid FuelCell @ Enbridge's Toronto Facilities

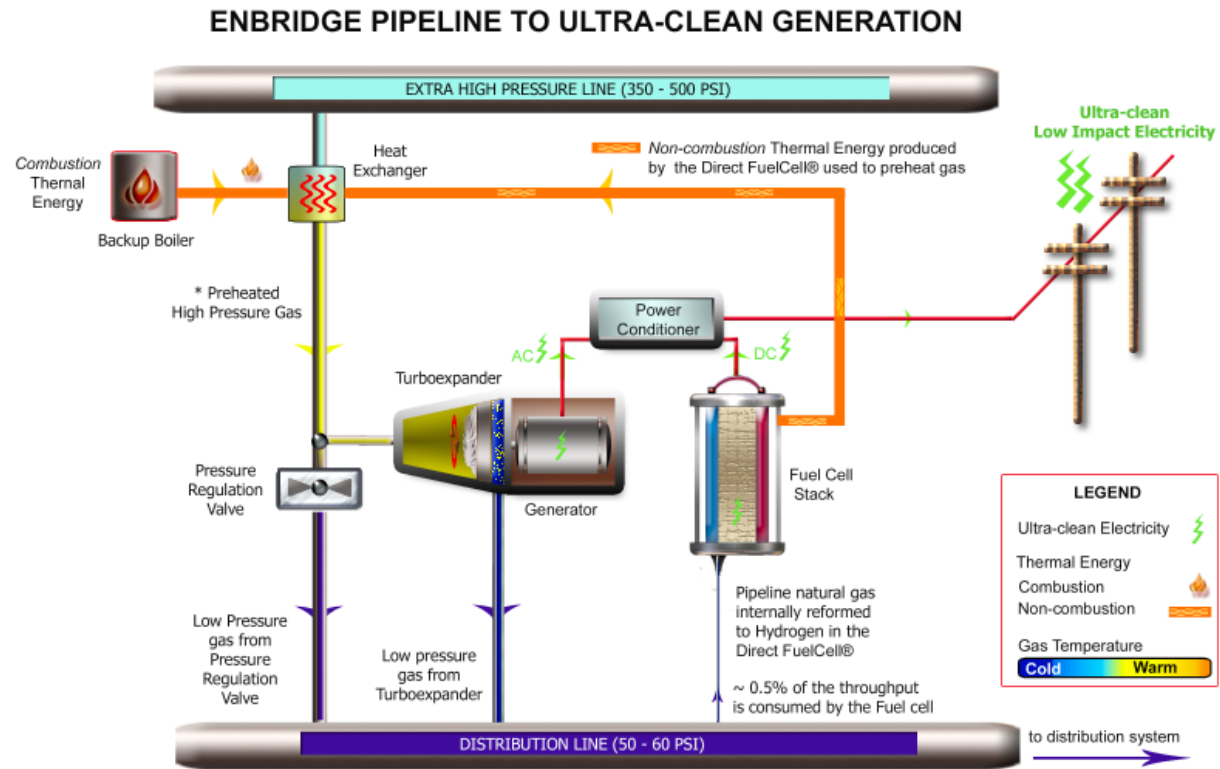


# Small Footprint: Two Tennis Courts



# Hybrid FuelCell Operating Schematic

- Integration of two low-carbon technologies
- Turboexpander recovers wasted energy for electricity
- Fuel cell doubles electricity generation
- Utility-scale investment potential



\* Pre-heating is required because gas cools as its pressure is reduced. The Direct FuelCell® provides thermal energy for pre-heating and therefore the boiler is only required for backup.

- **Toronto operational history**
  - 93 % unit availability (year 1)
  - 95.8% unit availability (year 2)
  - Manufacturer currently refurbishing stacks, and Enbridge working with Toronto Hydro to remove grid stability issues
- **30-45 MW of new Ontario projects identified in Enbridge pipeline**
- **Competitive with contract support at wind and biogas price levels**
  - Ontario's Feed-in-Tariff, and clean programs, do not recognize fuel cell environmental benefits
- **Enbridge investment focus shifting to markets like Connecticut**
  - Stationary fuel cells a tier one renewable regardless of input energy

Stationary fuel cells maturing as long-life, reliable assets

Competitive with renewables.

Cost reductions likely with fuel cell applications in fossil & renewable space

Policy should incent results.

Investment exists where level playing field exists with wind, solar, etc.

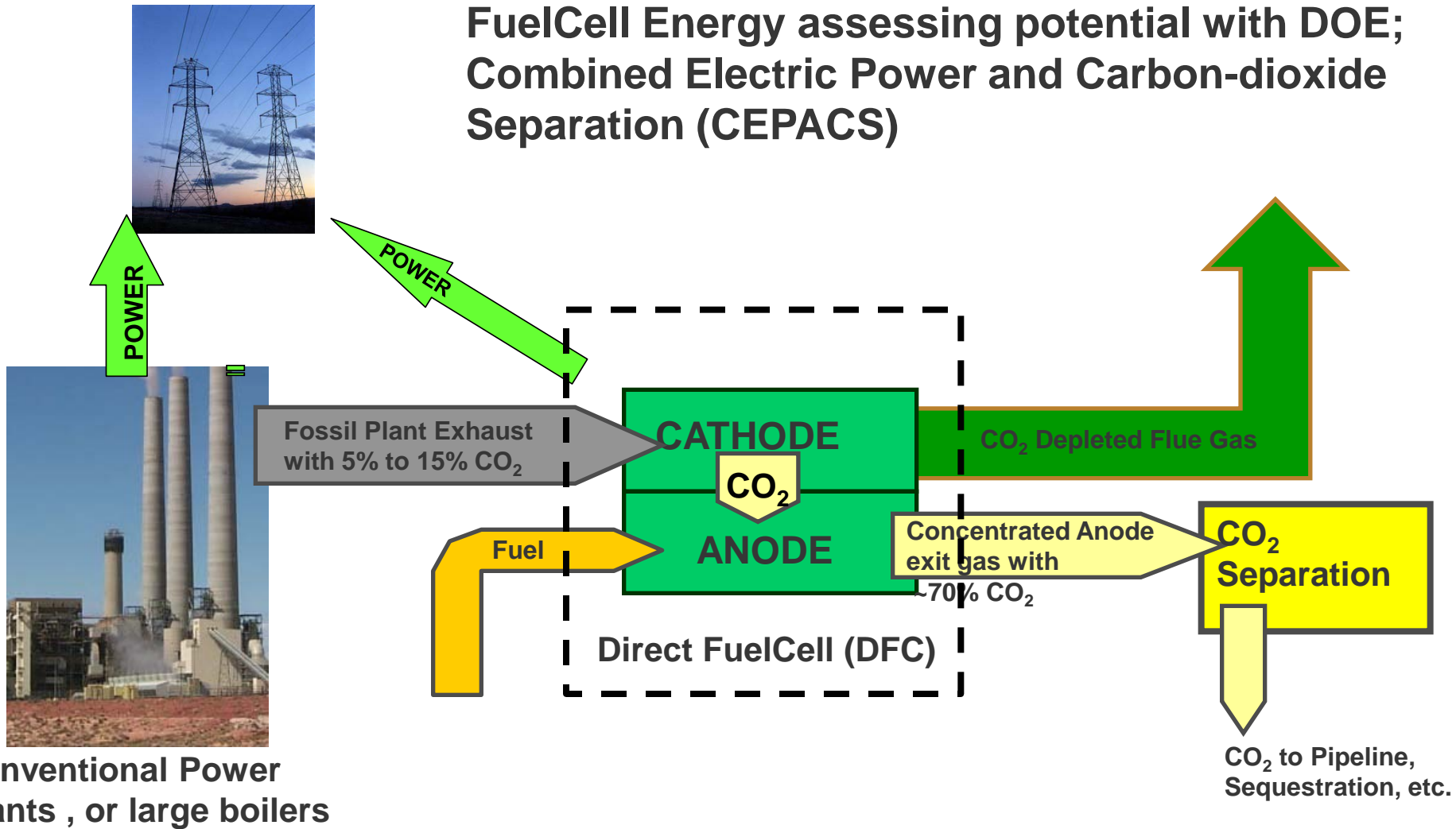
Fuel cells offer high-value to policy makers and ratepayers

Significant market penetration limited by policy

Mainstream investment will be slow until technology benefits recognized and monetized

# Carbon Separation from Fossil Plant Exhaust

## FuelCell Energy assessing potential with DOE; Combined Electric Power and Carbon-dioxide Separation (CEPACS)



- Carbonate electrochemical process transfers CO<sub>2</sub> from Air Electrode (Cathode) to Fuel Electrode (Anode)
- CO<sub>2</sub> is easily separated from Fuel Electrode exhaust gas because it is no longer diluted with air

- **DOE Goals for a Successful Carbon Capture Approach**
  - Retrofit Possibility – Solution for existing fleet of fossil plants
  - Capacity Loss – Avoid reduction in plant output
- **Cost – Have a path for low-carbon power, predictable supplies, and manageable economics**
  - <35% incremental cost-of-electricity
- **Direct FuelCell® a proven commercial power plant adapted as CO<sub>2</sub> separator.**
  - “Application“ is at a pre-pilot stage
  - Cost of pilot plant demonstration estimated at ~ \$16 million
- **Enbridge encouraging broad-based industry-government outreach**
  - Seeking industry-government interest in pilot-scale demonstration
  - Timeline to commercial-scale applications estimated at 5 years

- **Low-risk business model**
- **Attractive returns available**
- **Stationary fuel cells have a role in a diversified portfolio of green platforms**
- **Leadership position in CO<sub>2</sub> transportation and storage could open new opportunities for fuel cells**
- **Enbridge's green energy portfolio contributes to neutral environmental footprint objective and earnings growth**

Q&A