



Pacific Northwest Economic Development Council: 2005

Fuel Cells in
Strathcona County

A scenic view of a park. In the foreground, a paved path with a yellow line on the right side curves to the left. To the right of the path is a grassy bank that slopes down to a calm pond. The pond reflects the sky and the surrounding greenery. In the background, there are several trees and a building with a brown roof. The sky is blue with scattered white clouds.

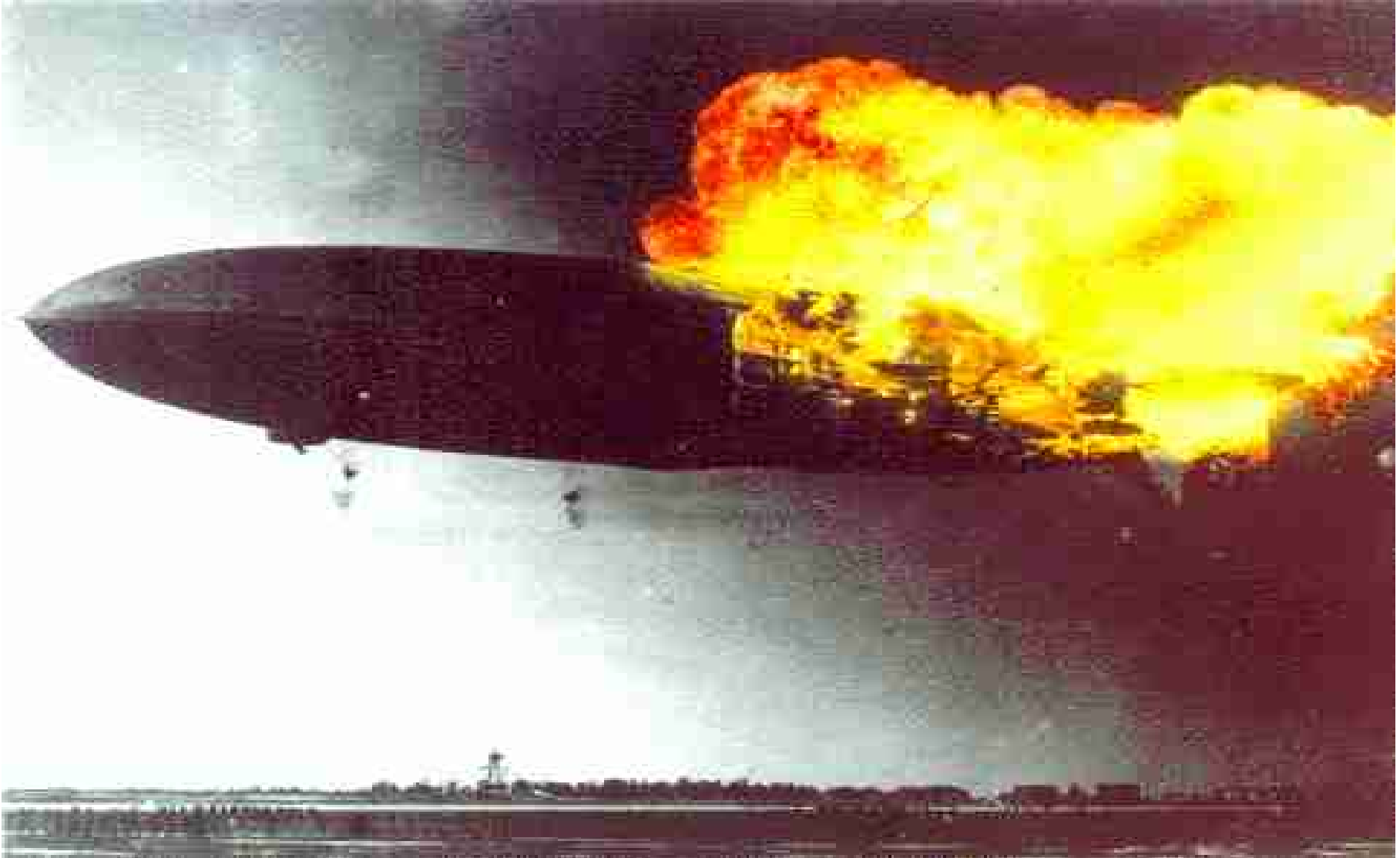
Central Energy System

Centre in the Park

What is hydrogen

- The simplest, lightest chemical element
- Colorless, odorless, highly flammable gas
- Burns with pale blue, almost invisible flame
- Combustion produces water vapor
- Most abundant element, 90% of universe by weight
- Broad range of combustibility by volume

Hydrogen myths:



Hydrogen myths:

- fire was caused by fabric doping (cellulose nitrate with aluminum powder, like a rocket fuel)
- “Hindenburg” did not explode
- stayed aloft & upright for several seconds
- falling fabric was aflame & not self-extinguishing
- bright flames not almost invisible H₂
- no garlic smell, odorizer to detect H₂ leaks
- NASA tests verify fabric volatility

Truth of hydrogen

- as safe as natural gas
- must consider unique characteristics in handling & use

NAIT Fuel-CELL



Target Industry Study

- There are several NAICS categories associated with this emerging industry

Fuel cells, solid-state, manufacturing

Fuel cells, electrochemical generators, manufacturing

Target Industry Study

- Current test systems sponsored by the Bonneville Power
- Several forces are driving the market for fuel cells.

Target Industry Study

- In the longer term, fuel cells may be used to power automobiles and other transportation systems. They are environmentally clean, producing only water as a byproduct.
- The rationale for developing the fuel cell industry in Strathcona County is that the sources of fuels are there and continuing testing and refinement can be done as the technologies evolve.

First steps:

- developed H2 inventory
- fuel cell self education
- fuel Cells 2000 website:
 - briefing book
 - technologies
 - state of the industry
 - list of companies
 - links (to government, research institutions, organizations, & associations)
 - other related sites (e.g. Fuel Cell Investor)

Fuel cell types by technology:

- phosphoric acid (PAFC)

- most mature technology
- 200 installed world-wide
- one at NAIT
- 40% electricity efficient
- 85% steam efficient (35% utility power)
- operate at 300 – 400 degrees F
- can use impure H₂
- large size & weight

Fuel Cell Types by Technology

- proton exchange membrane (PEM)
 - low temperature (175 degrees F, 80 C)
 - good electrical output
 - quick startup
 - good for vehicles
 - sensitive to impure fuel
 - relatively short life

Fuel Cell Types by Technology

- molten carbonate (MCFC)

- high fuel to electrical efficiency (60% normal, 85% with cogeneration)
- operate at 1,200 degrees F, 650 C
- high temperature causes corrosion & breakdown
- suitable for utilities, up to 2MW
- various fuels: H₂, landfill gas, propane, diesel fuel

Fuel Cell Types by Technology

- solid oxide (SOFC)

- operate at 1,800 degrees F, 1,000 C
- 60% electrically efficient, 85% with cogeneration
- large scale: up to 220 kw so far

Fuel Cell Types by Technology

- alkaline

- long used by NASA
- 70% electrically efficient
- operating temperature 300 – 400 degrees F, 150 – 200 degrees C
- high cost is primary limitation

Fuel Cell Types by Technology

- direct methanol fuel cell (DMFC)

- similar to PEMs but don't need fuel reformer
- 40% efficient
- operate at 120–190 degrees F, 50–100 degrees C
- low temperature makes it good for cell phones, laptops, etc.
- higher temperatures yield higher efficiencies but fuel will cross from anode to cathode without producing electricity

Fuel Cell Types by Technology

- regenerative fuel cell

- exhaust water is separated into H₂ and O₂ and returned to the cell for reuse

- zinc-air fuel cell (ZAFC)

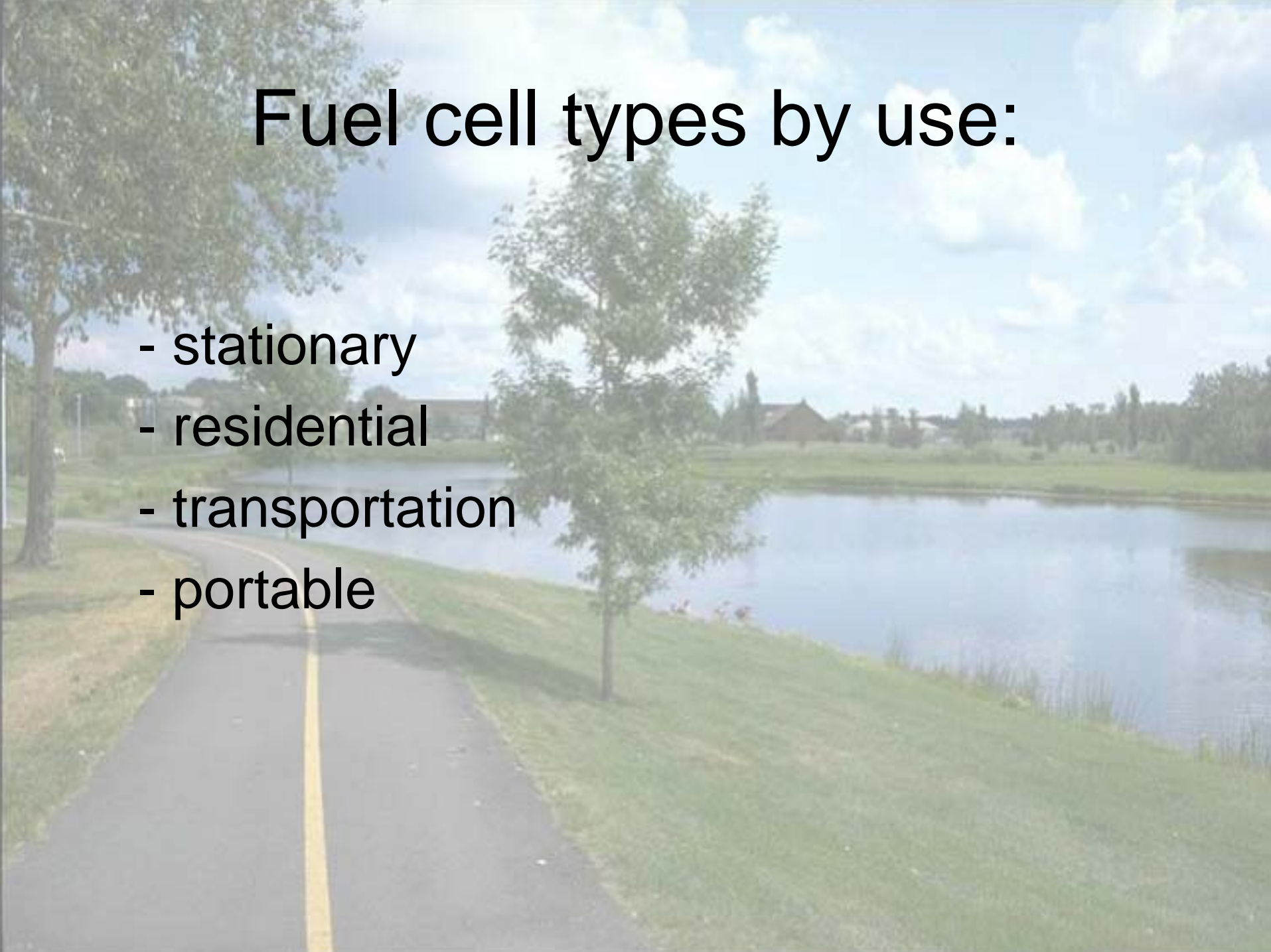
- like a combined fuel cell and battery in that it needs recharging
- low cost
- good for use in electric vehicles

Fuel Cell Types by Technology

- protonic ceramic fuel cell (PCFC)
 - operate at 700 degrees C
 - very high fuel efficiencies
 - uses hydrocarbon fuel, eliminates costly reforming process
 - primary exhaust product is CO₂
 - electrolyte cannot leak or dry out

Fuel cell types by use:

- stationary
- residential
- transportation
- portable



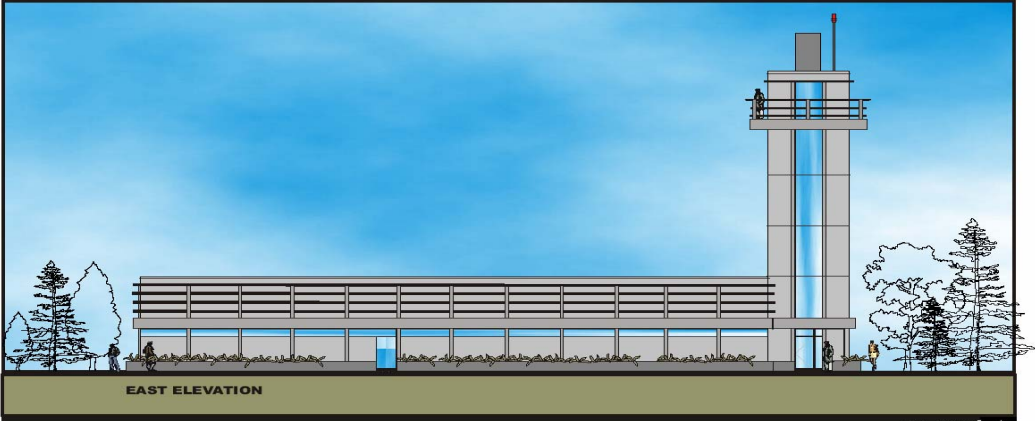
Fuel cell benefits:

- increases national energy security
- security of supply, can use various types of fuels
- physical security, distributed generation
- high quality power
- high efficiency, do not burn fuel
- environmental benefits
- least polluting vehicles
- battery replacement/alternative
- distributed generation

Centre in the Park Project



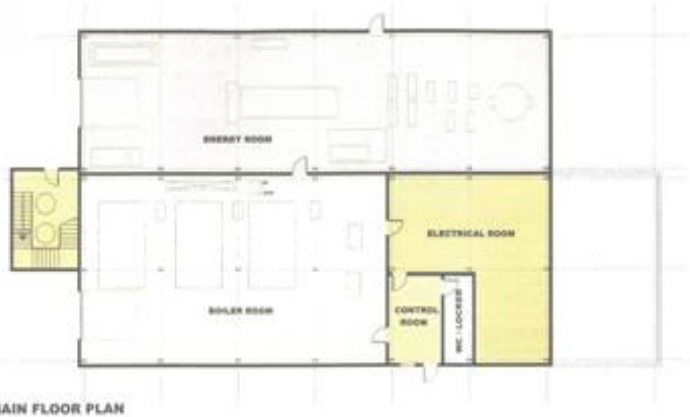
Central Energy System



Strathcona
County

PROPOSED DISTRICT ENERGY BUILDING

CADD-ABILITY
Design & Drafting Ltd.
1111 10th Street, Suite 100
Edmonton, Alberta T6E 6K1
403.462.1111



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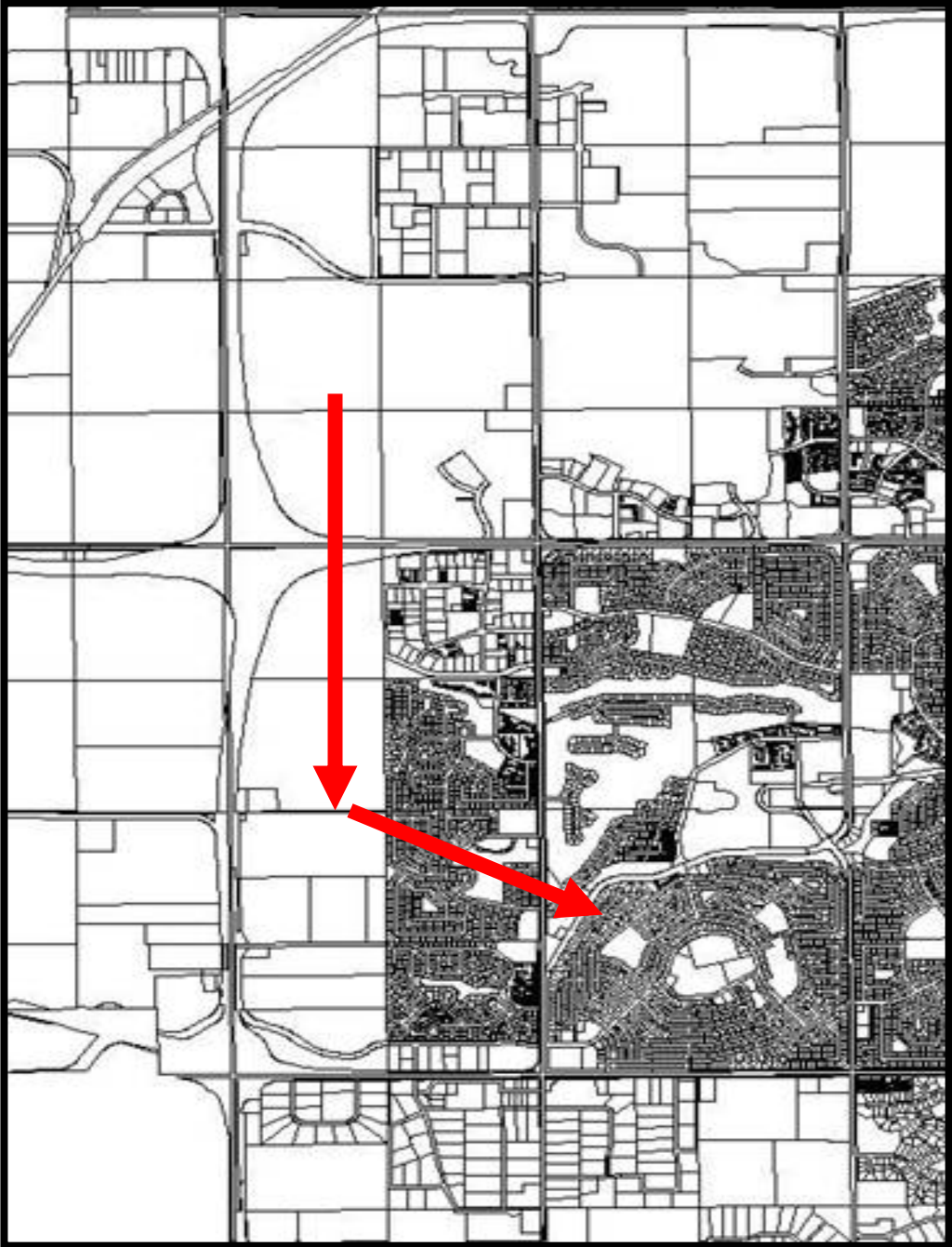
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ATCO Gas Role

- partner in CES
- own and operate pipeline
- own and operate fuel cells and other hydrogen technologies in CES
- sell heat to County utility and electricity to the grid
- . Praxair role – sell H₂ to ATCO at discount price

Hydrogen
Pipeline
Location



Community Energy System



Research required by ATCO

- distribution vs. transmission line
- odorants for use in H₂
- appropriate plastic pipe
- pressure monitoring

. Alternative H₂ sources

Benefits of Fuel Cells to CES

- multiple H₂ technologies in one room
- “plug & play” installation
- H₂ & conventional heat in one location
- positions County for future projects
- positions County as being innovative
- use of by-product H₂
- greenhouse gas reduction: 5,000 metric tonnes annually

Funding

- Strathcona County
- ATCO Gas
- Federation of Canadian Municipalities
- Alberta Innovation and Science
- Praxair

Future

- vehicle demonstration project
- H2 refueling station at Flying J

Conclusion

- how to take a target industry to company level
- creating awareness through innovation
- location of R & D activities
- education in sustainable technologies
- demonstrate new energy technologies